AMENDMENT 14

to

THE PACIFIC COAST SALMON PLAN (1997)

Incorporating the Regulatory Impact Review/Initial
Regulatory Flexibility Analysis and
Final Supplemental Environmental Impact Statement

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ACKNOWLEDGMENTS AND LIST OF PREPARERS

This document and its appendices constitute Amendment 14 to the *Pacific Coast Salmon Plan*. A complete list of all of the persons who participated in the preparation of the various parts of the amendment is contained in Chapter 7.

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COVER SHEET

[x] Final Supplemental Environmental Impact Statement

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PROPOSED ACTION:

Approval and implementation of Amendment 14 to the *Pacific Coast Salmon Plan* (1997).

Abstract:

The proposed action is to implement Amendment 14 to the salmon fishery management plan (FMP) under the provisions of the Magnuson Fishery Conservation and Management Act of 1976, as amended. Final Amendment 14 and its accompanying supplemental environmental impact statement provide a comprehensive updating of the salmon FMP, are responsive to the Sustainable Fisheries Act (SFA) of 1996 and increased listings of salmon stocks under the Endangered Species Act, and include other issues identified in amendment scoping sessions. The amendment updates the fishery description and clarifies what is covered by the salmon FMP. To be consistent with the SFA, Amendment 14 redefines optimum yield, provides new criteria to prevent or end overfishing, describes and defines essential fish habitat, and establishes salmon bycatch reporting specifications. In response to wild stock protection and harvest allocation issues, the proposed amendment modifies the FMP section on non-Indian harvest allocations north of Cape Falcon, Oregon to (1) clarify implementing selective fisheries that target on hatchery fish and (2) to formally recognize a recreational allocation for the La Push port area which has been essentially implemented for several years during the preseason management process. The proposed amendment also contains many other editorial changes to help clarify the FMP. The most significant editorial change is to provide a table listing all of the salmon stock complexes and indicator stocks which the Council manages, along with a summary of pertinent management information.

------- EXECUTIVE SUMMARY -------

AMENDMENT 14 AND FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

WHAT IS THE PACIFIC COAST SALMON PLAN?

Since 1977, salmon fisheries in the exclusive economic zone (EEZ) (3 to 200 miles offshore) off Washington, Oregon, and California have been managed under salmon fishery management plans (FMPs) of the Pacific Fishery Management Council (Council or PFMC). Creation of the Council and the subsequent development and implementation of these plans were initially authorized under the Magnuson Fishery Conservation and Management Act of 1976. This act, now known as the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), was most recently amended by the Sustainable Fisheries Act (SFA) in 1996.

In 1978, the Council developed a comprehensive salmon FMP and environmental impact statement (EIS) to initiate ocean fishery management. From 1979 through 1983 the Council amended the original salmon FMP each year and issued a new supplemental environmental impact statement (SEIS). In 1984, to replace this very cumbersome and untimely process, the Council adopted a comprehensive, multi-year, framework amendment which established a structure of fixed management objectives with flexible elements to allow annual management measures to be varied to reflect changes in stock abundance and other critical factors. Since completion of the framework amendment and its SEIS, only limited parts of the FMP have been amended, primarily in regard to harvest allocation and salmon stock conservation objectives. The current plan and the proposed amendment retain the framework structure.

WHY AMEND THE SALMON PLAN NOW?

Amendment 14 and its accompanying final SEIS cover a comprehensive updating of the salmon FMP and its environmental impacts. The changes are necessary to make the FMP responsive to the SFA, to reflect increased listings of salmon stocks under the Endangered Species Act (ESA), to include issues identified in amendment scoping sessions, and to generally update and clarify the plan.

Updating and Editorial Improvements

The amendment contains many editorial changes to help clarify the FMP, including a complete updating of the fishery description and identification of what the salmon FMP covers (Issues 1 and 2, respectively). The most significant editorial change is to provide a table listing all of the salmon stock complexes and indicator stocks which the Council manages, along with a summary of pertinent management information. A second table lists all the evolutionarily significant units (ESUs) defined by National Marine Fisheries Service (NMFS) in its review of stocks under the ESA. The table includes a list of the stocks included in each ESU and their current status with regard to ESA listing (part of Issue 4).

To Be Consistent With the Sustainable Fisheries Act

To be consistent with the SFA, Amendment 14 redefines optimum yield (Issue 3) , provides new criteria to prevent or end overfishing (Issue 4), sets salmon bycatch reporting specifications and priorities for avoiding or minimizing bycatch mortalities (Issue 5), and describes and defines essential fish habitat (EFH) (Issue 6).

Improving Fishing Opportunity North of Cape Falcon

In response to public, agency, and industry requests, the amendment considers modification of the FMP section on non-Indian harvest allocations north of Cape Falcon, Oregon. The proposed changes would (1) formally recognize a recreational allocation for the La Push, Washington port area which has been essentially implemented for several years during the preseason management process (Issue 7), and (2) allow more flexibility in implementing selective fisheries that target on hatchery fish while releasing wild fish (Issue 8).

PLAN AMENDMENT ISSUES, OPTIONS, AND IMPACTS

This section summarizes the options and impacts of the eight individual amendment issues. In comparing options, the specifications of the current FMP are designated as Option A and those of the proposed amendment as Option B. Some amendment issues contain suboptions within Option B. The complete text of the proposed changes, as it would appear in a new *Pacific Coast Salmon Plan*, is appended at the end of the main Amendment 14 document. The Council recommends implementation of Option B for each of the eight amendment issues.

Issue 1 - Fishery Description

OPTIONS

Under the current salmon FMP, the "Introduction" (Option A-1) references previously published documents which contain, in total, a description of the fishery as required prior to the SFA.

Option B-1 deletes the former fishery description references (which are somewhat dated) and references new Appendices to the FMP which contain an updated description consistent with the requirements of the SFA. Appendix B contains a complete fishery description and harvest trend as of the time of this amendment. Appendix C would always be the most current version of the Council's annual review of ocean salmon fisheries which serves as an annual update to the information in Appendix B.

IMPACTS

There are no regulatory impacts or direct management effects involved in this issue. The ecological, social, and economic impacts of adopting Option B-1 are expected to be insignificant when compared to the status quo. The proposed action clarifies Council management and ensures it is consistent with the Magnuson-Stevens Act, but does not materially change it.

COUNCIL RECOMMENDATION

The Council adopted Option B-1.

Issue 2 - What the Plan Covers

OPTIONS

Chapter 2 (Management Unit) of the current salmon FMP (Option A-2) identifies the salmon species and principal stocks under Council management by broad geographical areas and includes some fishery management objectives and descriptions by broad subarea. This description has not been amended since 1984.

Option B-2 proposes to update, simplify, and clarify Option A-2 to be consistent with the SFA. The basic information for "What the Plan Covers" is contained in Chapter 1 of the new FMP. Information in the previous Chapter 2 not pertaining to a general description of the affected species and geographical area have been deleted or moved to other chapters in the new plan. The information on stock management objectives within fisheries has been updated and moved to a new section (Section 5.2) within the chapter on harvest. Reference to the plan's coverage of EFH has also been added to Chapter 1.

IMPACTS

There are no regulatory impacts or direct management effects involved in this issue. The ecological, social, and economic impacts of adopting Option B-2 are expected to be insignificant when compared to the status quo. The proposed action clarifies Council management and ensures it is consistent with the Magnuson-Stevens Act, but does not materially change it.

COUNCIL RECOMMENDATION

The Council adopted Option B-2.

Issue 3 - Optimum Yield

OPTIONS

The SFA has redefined optimum yield (OY) by including a consideration for "the protection of marine ecosystems" and limiting OY to maximum sustainable yield (MSY) as "reduced", rather than "modified" by, relevant economic, social, or ecological factors. The Council's stock conservation objectives in Option A-4 (Chapter 6 of the current FMP) that guide the determination of OY are based on achieving MSY or returning to MSY levels. The Council is not aware of information to indicate these desired levels of stock abundance jeopardize any marine ecosystems. Therefore, the Council believes Section 4.1 of the current FMP (Option A-3) is consistent with the SFA. However, in the interest of specifically defining OY in the FMP to be consistent with the SFA and clarifying the Council's approach to achieving it, Alternative B-3 proposes a more thorough treatment of the issue in Chapter 2 of the proposed FMP.

IMPACTS

There are no regulatory impacts or direct management effects involved in this issue. The ecological, social, and economic impacts of adopting Option B-3 are expected to be insignificant when compared to the status quo. The proposed action clarifies Council management and ensures it is consistent with the Magnuson-Stevens Act, but does not materially change it.

COUNCIL RECOMMENDATION

The Council adopted Option B-3.

Issue 4 - Stock Conservation Objectives and Overfishing Criteria

OPTION A-4

The stock conservation objectives of the current FMP are contained in Chapter 6 and utilized in the criteria for overfishing in Section 4.2. Section 4.2.1 of Option A-4 states that "overfishing is an occurrence whereby all mortality, regardless of the source, results in a failure of a salmon stock to meet its annual spawning escapement goal or management objective (as specified in Chapter 6 of the salmon FMP) for three consecutive years, and for which changes in the fishery management regime offer the primary opportunity to improve stock status." When a stock meets the overfishing definition, the Council appoints a workgroup to investigate the causes and report its conclusions and recommendations to the Council. The Council then may implement actions within its authority to recover the stock or recommend actions to other entities for issues beyond Council authority, such as habitat destruction.

OPTION B-4

Option B-4 makes significant editorial changes to Chapters 4 and 6 of Option A-4 and places all of the stock and overfishing information in Chapter 3. In addition, Section 3.2 provides a new treatment of overfishing which meets the requirements of the SFA, and Section 3.3 includes a new, updated description of stocks listed under the ESA. Option B-4 does not change any of the present spawner escapement goals, but provides a single table (Table 3-1) with a detailed listing of the salmon stocks (arranged by major stock complex), stock conservation objectives (spawner escapement goals), pertinent management information, and the applicability of overfishing criteria to the stocks.

Overfishing Criteria

As required by the SFA, Section 3.2 of Option B-4 provides the Council's objective and measurable criteria for identifying when a fishery is overfished and the conservation and management measures necessary to prevent or end overfishing and rebuild the fishery. The Council criteria are based on meeting annual stock conservation objectives in Table 3-1 which are based on either MSY, an MSY proxy, maximum sustainable production (MSP), a rebuilding schedule designed to allow a stock to build to its MSY, or a jeopardy standard in the case of stocks listed under the ESA. By striving to meet these objectives annually, the Council protects stocks against overfishing, quickly rebuilds stocks which may experience episodic depressions in abundance, provides long-term rebuilding of stocks which have been consistently depressed, and allows for stabilization of stocks listed under the ESA.

Conservation Alert

To anticipate potential long-term problems in stock abundance, Option B-4 (Section 3.2.2.1) provides that a conservation alert is triggered when a stock is projected to fall short of its conservation objective. When this occurs, the Council notifies the pertinent fishery and habitat managers of the problem, and depending on other information known about the stock, may request a formal assessment of the situation by the pertinent managers (Section 3.2.2.2). Option B-4 then provides for consideration of three suboptions with regard to the action the Council may take in establishing fisheries for the coming season:

Suboption A: Close all fisheries within Council jurisdiction which impact the stock(s) in question, except for Washington coastal and Puget Sound stocks under U.S. District Court orders which may be impacted by Council fisheries as long as annual spawner targets agreed to by Washington Department of Fisheries and Wildlife (WDFW) and the treaty tribes are met. This is the status quo option (same as Option A-4).

Suboption B: Same as Suboption B-4A except that the targets agreed to by WDFW and the treaty tribes must be greater than 50% of the MSY conservation objective or greater than 50% of the lower end of the MSY range.

Suboption C: Allows the same deviation from the MSY objectives for all stocks that Suboption B-4B provides for the Washington coastal and Puget Sound stocks, unless the stock has not met it MSY conservation objective in each of the past three years.

Overfishing Concern

As in Option A-4, when a stock fails to meet its conservation objective in three consecutive years, the Council's overfishing concern is triggered and an assessment is begun. The action is different under Option B-4 in that the Council must recommend management measures or a plan amendment within one year to end the overfishing and rebuild the stock in as short a time as possible. To accomplish this, the Council assigns the Salmon Technical Team (STT), with assistance from pertinent managers, to assess the stock and provide recommendations to the Council by the March meeting of the following year. The Council also requests the Habitat Steering Group to assist state, federal, tribal, and local habitat experts and managers in identifying and resolving habitat problems.

Exceptions

Certain exceptions apply to the Council's implementation of its overfishing criteria (Section 3.2.4). The Council does not apply the criteria to hatchery stocks which generally do not represent unique gene pools and whose long-term production is rarely threatened by fishing impacts. Natural stocks which have negligible impacts in Council fisheries are also an exception as there is no value served by denying harvest of healthy stocks while providing no benefit to the stock(s) in question. The criteria used to designate these stocks is an adult equivalent exploitation rate of less than five percent in base period Council fisheries. The third exception is stocks listed under the ESA which are managed under a NMFS jeopardy standard or recovery plan to stabilize the stock until such time as restoration of their habitat makes it possible to develop new MSY objectives consistent with the recovered habitat.

IMPACTS

Under Option B-4, the Council meets the requirements of the SFA to respond to an overfishing concern within one year with actions, regulations, or a plan amendment to end the overfishing and begin rebuilding the stock. The workload is not significantly different than under the current plan. However, some additional administrative burden may be imposed by the shorter time frame for action.

Option B-4 also adds a "conservation alert" process and status as an early warning that a stock may be in a weakened condition. The conservation alert may (1) increase administrative burdens by requiring the generation of new reports (all suboptions); (2) prevent the Council from implementing agreements that revise escapement goals to less than 50% of the lower end of the MSY range for Washington coastal and Puget Sound stocks managed under U.S. District Court orders (Suboptions B-4B and B-4C); and/or (3) reduce administrative burdens by making some actions, routinely taken only under emergency procedures, a part of the regular procedures (Suboption B-4C).

Suboptions B-4B and B-4C may increase the likelihood of rebuilding Washington coastal and Puget Sound stocks managed under U.S. District Court orders. Under the current system, the Council may recommend seasons based on any escapement levels agreed to by the tribes and WDFW (even if the spawning escapement would fall more than 50% below the lower end of the MSY goal range).

Impacts under the overfishing criteria in Suboptions B-4B and B-4C would be negligible for all stocks south of Cape Falcon and for chinook stocks north of Cape Falcon. However, implementation of these suboptions could require additional reductions in fisheries north of Cape Falcon to meet conservation objectives for Washington coastal and Puget Sound coho stocks (see Table 2-3 in the main body of the Amendment 14 document). The potential fishery reductions that could occur under Suboptions B-4B and B-4C are within the range of reductions already experienced north of Cape Falcon over the past 10 years.

COUNCIL RECOMMENDATION

The Council adopted Option B-4 with editorial modifications of Suboption A to simplify it and better recognize the court ordered process for Washington coastal and Puget Sound salmon stocks.

Issue 5 - Bycatch

OPTIONS

Under the current FMP (Option A-5) there is no specific definition of bycatch, though Section 9.5.3 provides five basic guidelines for addressing bycatch in species specific fisheries. The STT compiles estimates of mortality as a result of nonretention of salmon species in salmon fisheries in its preseason reports and the annual review of ocean salmon fisheries.

Option B-5 (Section 3.4) responds to the requirements of the SFA to define bycatch, to provide guidance for minimizing the amount of bycatch and the mortality of such bycatch, and to establish a standardized reporting methodology to assess the type and amount of bycatch. Section 6.5.3 of Option B-5 retains the guidance of Option A-5 with respect to selective fisheries.

Within the salmon preseason planning process, management options will be assessed for the effects on the amount and type of salmon bycatch and bycatch mortality. Estimates of salmon bycatch and incidental mortalities associated with salmon fisheries will be included in the modeling assessment of total fishery impact and assigned to the stock or stock complex projected to be impacted by the proposed management measure.

IMPACTS

There are no regulatory impacts or direct management effects involved in this issue. The ecological, social, and economic impacts of adopting Option B-5 are expected to be insignificant when compared to the status quo. The proposed action clarifies Council management and ensures it is consistent with the Magnuson-Stevens Act, but does not materially change it.

COUNCIL RECOMMENDATION

The Council adopted Option B-5.

Issue 6 - Essential Fish Habitat

OPTIONS

Amendment 8 to the FMP (1988) provides a habitat appendix for Pacific Coast Salmon Stocks (Option A-6). The appendix contains or describes (1) pertinent salmon life history information, (2) physical characteristics of marine and freshwater habitat required for the production of a healthy salmon resource, (3) actions with significant adverse impacts on salmon habitat, and (4) recommendations for ways to maintain and restore the productive capacity of the salmon resource. The habitat appendix does not meet the requirements of the SFA and is not a viable option.

The Council provides Option B-6 to adequately incorporate the requirements of the SFA into the FMP with regard to EFH. Option B-6 is contained in Section 4.1 and Appendix A of the proposed new salmon FMP. It is based on the specific requirements of the SFA to define and describe EFH for each fishery and to minimize, to the extent practicable, adverse effects on such habitat caused by fishing, and identify other actions to encourage the conservation and enhancement of such habitat.

The SFA requires that EFH must include those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. In specifying its definition, the Council further clarified EFH to be those waters and substrate necessary for salmon production needed to support a long-term sustainable salmon fishery and salmon contributions to a healthy ecosystem rather than merely being habitat necessary to assure that salmon exist. To achieve that level of production, EFH must include most of the habitat historically available to salmon. The option of limiting EFH to only the most essential habitat to assure continued existence of salmon does not provide for a viable, economically valuable, renewable resource as envisioned in the SFA.

The complete EFH definition in Option B-6 is provided in Chapter 1 of Appendix A. It includes all currently viable waters and most of the habitat historically accessible to salmon within the USGS hydrologic units identified in Table A-1. Salmon EFH excludes areas upstream of longstanding naturally impassible barriers (i.e., natural waterfalls in existence for several hundred years). Salmon EFH includes aquatic areas above all artificial barriers except the impassible barriers (dams) listed in Table A-2. However, activities occurring above impassable barriers that are likely to adversely affect EFH below impassable barriers are subject to the consultation provisions of the Magnuson-Stevens Act. In the future, should subsequent analyses determine the habitat above any of the dams listed in Table A-2 is necessary for salmon conservation, the Council will modify the identification of EFH.

Initially, the Council considered only including marine areas out to 60 km as EFH, based on information available that indicates the importance of this area to juvenile and adult fish. However, given the occurrence of chinook and coho salmon in high seas fisheries and tagging programs, and other documentation in Appendix A, any offshore boundary would be arbitrary. Therefore, the Council chose to designate all marine waters within the EEZ off Washington, Oregon, and California north of Point Conception.

Foreign waters (i.e., off Canada) are not included in salmon EFH, because they are outside U.S. jurisdiction. However, the Pacific Coast salmon fishery EFH also includes the marine areas off Alaska designated as salmon EFH by the North Pacific Fishery Management Council. Appendix A also contains a detailed assessment of adverse impacts and actions to encourage conservation and enhancement of EFH from both fishing activities and nonfishing activities.

IMPACTS

There are no direct management effects or impacts due to new regulations involved in this issue. The ecological, social, and economic impacts of adopting Option B-6 are expected to be insignificant when compared to the status quo. The proposed action clarifies Council management and ensures it is consistent with the Magnuson-Stevens Act, but does not materially change it.

Implementation of Option B-6 does not have any direct biological or physical impacts on the human environment or on the physical habitat utilized by salmon or other fish or animal species. It provides a description of habitat required to maintain a healthy, harvestable salmon resource and provides recommendations to protect, maintain, and restore that habitat. These descriptions and recommendations will form the basis for consultations by NMFS on federal actions which may adversely impact EFH. In the long-term, such guidance should have a positive effect on the status of the Pacific Coast salmon resource and reduce the need to list stocks under the ESA.

The Council's definition and description of EFH will have no immediate direct effect on fishing or nonfishing activities. However, there will be indirect effects that include some additional workload for federal agencies to consult with the Secretary in any action that may adversely affect the defined EFH. Part of that workload may pass through to private entities and other nonfederal governments in the form of delays or the identification of issues and concerns that lead to requests for modification of the impact analysis or project design, and the associated costs of such modifications. However, the definition of EFH and the related consultation requirement do not create any new standards for analysis, project design, or mitigation.

COUNCIL RECOMMENDATION

The Council adopted Option B-6 modified to require consultation for activities above impassable barriers that may adversely affect EFH below the barriers.

Issue 7 - Recreational Harvest Allocations for Port Areas North of Cape Falcon

OPTION A-7

Amendment 10 to the salmon FMP (1990) formally established three recreational subareas with harvest allocations in the area north of Cape Falcon and specifically allowed the Council to establish additional subarea quotas within a major subarea during the preseason management process to meet recreational season objectives when agreed to by representatives of the affected ports. The subarea allocations work to stabilize the salmon fishing opportunity of each port by assuring that no one subarea will harvest more than its recent historical share of the total recreational coho allocation. Prior to and at the time of Amendment 10, the Port of La Push was in a period of greatly diminished sport fishing activity and a single allocation was established that covered both Neah Bay and La Push. In this situation, with the greatly reduced overall harvest levels of recent years, fishing effort from Neah Bay can quickly exhaust the available quotas, leaving no way for La Push to rebuild its former sport fishery. Therefore, beginning in 1990, the Council annually approved a separate subarea quota for La Push. The separate subquota allowed for a longer season from La Push that could not be precluded by the Neah Bay fishery.

OPTION B-7

Under Option B-7, the Council proposes to formalize the subarea allocation to La Push at a level that is approximately 20% of the former Neah Bay/La Push allocation. This is equal to the level provided to La Push on an annual basis during the preseason process beginning in 1995. In addition, during years in which there is an Area 4B add-on fishery inside Washington internal waters (which benefits only Neah Bay), La Push will be accorded a small percentage increase in its allocation in the same manner as has been established in the FMP for Westport. The specific FMP language establishing these allocations is contained in item six of Section 5.3.1 and in Section 5.3.1.1 of the proposed *Pacific Coast Salmon Plan*. Also, under item six of Section 5.3.1, the language has been modified to allow deviations from subarea quotas to meet recreational fishery objectives if agreed to by representatives of the affected ports.

IMPACTS

There are no significant impacts associated with the proposed amendment. The change in the FMP formalizes the action which the Council has taken during the preseason management process beginning in 1990 and adds some additional flexibility to be more responsive to meeting the recreational objectives of the FMP for fisheries north of Cape Falcon. This flexibility may allow the Council to more fully utilize available harvest opportunity and slightly increase the benefits to the local communities. Regulations under § 660.408(c)(1)(v) would have to be modified to reflect the increase in the number of subareas and to change the allocation percentages.

COUNCIL RECOMMENDATION

The Council adopted Option B-7.

Issue 8 - Selective Coho Fisheries North of Cape Falcon

Issue 8 considers allowing deviations in the non-Indian harvest allocations north of Cape Falcon to take advantage of selective fisheries to access more of the available harvest of hatchery produced coho salmon while not increasing impacts on pertinent natural stocks of management concern.

OPTION A-8

Under the current FMP (Option A-8), it is possible to establish fisheries that are selective for various species and sizes of salmon, as well as for fish which may be marked in some way to identify them to the fishers. However, the gear and subarea allocations for the fisheries north of Cape Falcon are based on landed catch quotas rather than impacts. Therefore, a selective fishery cannot be used to increase coho harvest over that occurring without the selection unless all gear groups and subareas are able to increase their harvest proportionally without increasing impacts on the critical natural stocks. Due to variations in the distribution of hatchery and natural stocks and timing of fisheries, the ability to achieve such a proportional increase may not always be possible.

OPTION B-8

Alternative B-8 allows deviations from the specified port area and gear allocations to increase harvest opportunity through fisheries that are selective for marked coho salmon as long as: additional harvestable fish are available; the selective fisheries are implemented primarily in August and/or September; the total impacts within each port area or gear group on critical natural stocks of management concern are not greater than those under the original allocation without selective fisheries; other allocation objectives of the plan are met; and the selective fishery is assessed against the guidelines of Section 6.5.3 of the proposed plan. The specific FMP language is found under "Selective Fisheries Which May Change Allocation Percentages" in Section 5.3.1.1 of the proposed plan.

IMPACTS

Increased Ocean Harvest and Fishing Opportunity

Using the 1996 fisheries as an example, a fully expanded, equivalent impact recreational selective coho fishery could have potentially increased harvest by up to 153,700 coho, about a 3.4 fold increase. In terms of angler opportunity, the equivalent impact fishery could have provided 174,100 more trips than a status quo selective fishery and 194,300 more trips than a nonselective fishery. Effort levels such as those potentially allowed under a selective fishery have not been observed for two month periods since the late 1970s. Experience in selective fisheries in 1999 indicated it is unlikely angler trips would expand to these potentials in the near future.

The 1996 example of a fully expanded selective recreational fishery would result in a removal of about six percent of the Puget Sound hatchery stocks, roughly ten percent to 15% of the Washington coastal hatchery stocks and roughly 50% of the Columbia River hatchery stocks.

Impacts on Other Fisheries and Natural Escapement

A fully expanded, equivalent impact, selective recreational ocean salmon fishery for coho would significantly decrease the proportion of hatchery stocks and increase impacts on natural stocks of subsequent fisheries north of Cape Falcon. In the presence of an equivalent impact selective recreational fishery, the projected effect of the 1996 troll fishery is a relatively small reduction in ocean escapement of natural stocks, although the change in ocean escapement is very likely under estimated by the model (see "Risk and Modeling Limits" below). Options for maintaining a neutral effect on critical natural stocks from all sources of fishing mortality include selective harvest in other fisheries that impact the critical natural coho stocks; reducing harvest in the other fisheries by reducing quotas (if used), seasons, or bag limits, etc.; or not taking full advantage of potential selective fishing opportunities in the ocean fishery.

The troll ocean fishery will not have its quotas directly reduced as a result of selective recreational fisheries for coho. However, if the troll fishery occurs subsequent to an expanded recreational fishery, reduced catch rates may increase the cost per unit catch. A selective ocean troll fishery would likely increase total gross fishing revenue for the participants. The effect of a selective troll fishery on net revenue would depend on the additional cost associated with catching and discarding unmarked fish, i.e., retained catch per unit of effort would decrease, increasing marginal costs.

The proposed selective fishery amendment would increase fishing activity in coastal ports at some possible expense to salmon fishing communities in other locations.

The opportunity to increase effort in the ocean recreational fishery through imposition of a selective coho fishery may be associated with an increase in chinook mortalities. A similar conclusion would be likely for a selective ocean troll fishery. The amount of chinook available for north of Cape Falcon fisheries is the subject of negotiations each year. An increase in the potential coho harvest as a result of selective coho fisheries may increase the pressure for providing chinook quota or hook-and-release mortality impacts for ocean fisheries.

Risk and Modeling Limits

The risk of underestimating hook-and-release mortality in the evaluation of selective fisheries was modeled by comparing the impacts under an estimated 8% mortality rate and a 16% rate. The additional impacts in the ocean recreational fishery at a 16% hook-and-release mortality rate were 30% above those that would have been expected using an 8% rate. However, the reduction in ocean escapement of natural stocks would be generally less than one percent, with the exception of the Hoh and Queets stocks for which ocean escapement would be two percent and three percent less than expected, respectively. To maintain a neutral effect on natural coho stocks under this assumed example, catches would have to be limited to about 75% of the level modeled under the 8% percent hook-and-release mortality rate.

The model for selective fisheries is limited because it does not account for substantial within month changes that may occur in the stock mix as a result of removal of the marked hatchery component and it does not account for changes in the mortality rate for natural fish that are encountered more than once in a selective fishery. For example, within the recreational fishery the stock mix encountered by fishers at the start of a month may be substantially different than that encountered toward the end of the month, with unmarked coho encounter rates increasing through time. However, the model is not set up to make any adjustments to the stock mix from that which is present at the start of the month.

COUNCIL RECOMMENDATION

The Council adopted Option B-8 with minor editorial changes.

OTHER APPLICABLE LAW

Executive Order 12866

The actions contemplated in this amendment do not create serious inconsistencies or interfere with actions of other agencies, do not alter entitlements, grants, etc., and do not raise novel legal or policy issues. The action is unlikely to be found significant under Executive Order 12866.

Regulatory Flexibility Act

Only Issues 7 and 8 require a change in federal regulations. These issues deal with harvest allocation north of Cape Falcon. Issue 7 primarily formalizes a recreational allocation provided to the port area of La Push which has been made during the Council's preseason management process since 1990. Therefore, the action would not have a substantial impact on a significant number of small business entities.

Issue 8 allows flexibility for non-Indian harvest allocations north of Cape Falcon to increase harvest with selective coho fisheries (primarily marked hatchery fish). The actual change in harvest distribution among ocean and inside fisheries is the subject of annual negotiations by the involved parties. Therefore, it is not possible to determine the ultimate distribution of impacts for fisheries under the proposed amendment and not possible to certify that there would not be substantial and significant impacts on small entities resulting from the expansion of selective fisheries in ocean areas north of Cape Falcon. It is possible to say that it is unlikely that total harvest will be reduced as a result of the reallocation. In fact, aggregate recreational and commercial harvest may be increased if selective fisheries allow the harvest of hatchery fish that would have otherwise been excess hatchery spawning escapement. The Council solicited public comment on options that may have been overlooked in this amendment that would have a lesser impact on small businesses while achieving the objective of harvesting more hatchery fish without increasing impacts on natural stocks.

Endangered Species Act and Marine Mammal Protection Act

The proposed actions are not anticipated to jeopardize survival of endangered or threatened species or have any change in effects on marine mammal populations.

Coastal Zone Consistency

The Council believes the proposed action is consistent to the maximum extent practicable with the applicable state coastal zone management programs of Washington, Oregon, and California. The National Marine Fisheries Service corresponds with the responsible state agencies under Section 307 of the Coastal Zone Management Act to obtain their concurrence in this finding.

National Environmental Policy Act

In accordance with the National Environmental Policy Act (NEPA) and the Council on Environmental Quality regulations that implement NEPA, the Council and NMFS prepared a draft SEIS for Amendment 14 that was distributed to the public in January 1999. After public hearings in February, the Council adopted its preferred options for the amendment issues on March 11, 1999. The final SEIS contained in this document supplements the original EIS of 1978, the annual SEISs from 1979 through 1983, and the SEIS for the Framework Amendment in 1984. Copies of the draft and final amendment and SEIS are available from the Council office (phone 503/326-6352).

CONCLUSION

The issues in Amendment 14 respond to various identified management requirements of the SFA; to management recommendations of the fishery agencies, industry, and public; and to the need for maintaining an updated, understandable and accurate salmon FMP. In the face of declines in many natural salmon stocks, the proposed changes primarily reflect a move toward somewhat more conservative management, increased emphasis on the restoration and protection of fish habitat and the production of natural stocks, and innovative methods of maintaining fisheries without increasing impacts on naturally produced salmon. The impacts from the range of options considered in this amendment fall generally within the range of impacts considered possible under the framework amendment and its supplemental SEIS completed in 1984.

TABLE OF CONTENTS
(Amendment 14)

TABLE OF CONTENTS
(Amendment 14)

Page

TABLE OF CONTENTS
(Amendment 14)

TABLE OF CONTENTS
(Amendment 14)

Page

LIST OF FIGURES

LIST OF TABLES

LIST OF TABLES
(Continued)

LIST OF ACRONYMS AND ABBREVIATIONS

Council	Pacific Fishery Management Council
CCC	Central California Coast
CDFG	California Department of Fish and Game
CPUE	catch per unit of effort
CWT	coded wire tag
DEIS	Draft environmental impact statement
EEZ	exclusive economic zone
EIS	Environmental impact statement
EO	Executive Order
ESA	Endangered Species Act
ESU	evolutionarily significant unit
FMP	fishery management plan
FR	*Federal Register*
FRAM	Fishery Regulation Assessment Model
IRFA	Initial Regulatory Flexibility Analysis
KRSMG	Klamath River Salmon Management Plan
KRTT	Klamath River Technical Team
Magnuson-Stevens Act	Magnuson Fishery Conservation and Management Act
MMPA	Marine Mammal Protection Act
MSP	maximum sustainable production
MMS	Minerals Management Service
MSY	maximum sustainable yield
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPPA	Northwest Power Planning Act
NRC	National Research Council
OCN	Oregon coastal natural coho
ODFW	Oregon Department of Fish and Wildlife
OPI	Oregon Production Index
OY	optimum yield
PFMC	Pacific Fishery Management Council
PSC	Pacific Salmon Commission
PSTA	Pacific Salmon Treaty
RFA	Regulatory Flexibility Act
RIR	Regulatory Impact Review
SAS	Salmon Advisory Subpanel
Secretary	U.S. Secretary of Commerce
SEIS	Supplemental Environmental Impact Statement
SFA	Sustainable Fisheries Act
SONC	southern Oregon/northern California (coho ESU)
SSC	Scientific and Statistical Committee
STT	Salmon Technical Team
TAC	total allowable catch
TALFF	total allowable level of foreign fishing
USFWS	U.S. Fish and Wildlife Service
WDFW	Washington Department of Fisheries and Wildlife

INTRODUCTION

Since 1977, salmon fisheries in the Exclusive Economic Zone (EEZ) (3 to 200 miles offshore) off Washington, Oregon, and California have been managed under salmon fishery management plans (FMP) of the Pacific Fishery Management Council (Council or PFMC). Creation of the Council and the subsequent development and implementation of these plans were initially authorized under the Fishery Conservation and Management Act of 1976. This act, now known as the Magnuson-Stevens Fishery Conservation and Management Act, was most recently amended by the Sustainable Fisheries Act (SFA) in 1996.

This document presents and analyzes proposed changes to the Council's present salmon FMP, the *Pacific Coast Salmon Plan* (PFMC 1997a). It represents the 14th amendment to the Council's original salmon FMP.

Actions taken to amend FMPs or implement other regulations governing the fisheries must meet the requirements of federal laws and regulations. These include the Magnuson-Stevens Act, National Environmental Policy Act, Endangered Species Act, Marine Mammal Protection Act, Executive Order 12866, and the Regulatory Flexibility Act. This document contains the description and analyses of the proposed plan changes and the analyses required by the referenced federal laws and regulations as outlined below. The proposed new FMP is appended at the end of this document. The amendment appendices (A, B, C, and Public Comment) are in separate documents.

Chapters 1 through 9 describe and analyze the amendment issues. Chapter 1 describes the purpose and need for the proposed action while Chapter 2 describes the FMP amendment issues and options, and summarizes their expected impacts. These chapters contain key elements necessary for a Regulatory Impact Review/Initial Regulatory Flexibility Analysis (RIR/IRFA) as well as the final supplemental environmental impact statement (SEIS). Chapter 3 describes the relationship of other federal law to the amendment and contains or references the information required for a structurally complete RIR/IRFA. Chapters 4 and 5 contain or reference the primary information required for the final SEIS. Chapter 6 contains a list of the cited literature. Chapter 7 provides information on the preparation of the document. Chapter 8 summarizes public participation in the amendment process and Chapter 9 summarizes the substantive public comments and the Council response. Following Chapter 9 is the complete text of the amended portions of the salmon FMP as adopted by the Council. Appendix A contains the definition and description of essential fish habitat which is a new requirement in the SFA. Appendix B contains a detailed and updated description of the fishery and its social and economic characteristics. Appendix C references the Council's most current annual review of ocean salmon fishery management which will serve to update the fishery description each future year. The pubic comments received by the Council are contained in the Public Comment Appendix. The table below provides a quick reference to the parts of the amendment.

Statement, Description or Assessment	Reference
Purpose and Need for Action	Chapter 1
Description of Alternative Actions and Options	Chapter 2; *Draft Pacific Coast Salmon Plan; and Appendix A*
Option Impacts (ecological, administrative, social, and economic)	Chapter 2
RIR/RFA and Other Applicable Law	Chapter 3
Affected Environment	Chapter 4
Environmental Consequences	Chapters 2 and 5, and Appendix B
Literature Cited	Chapter 6
List of Preparers	Chapter 7
Public Participation and Review	Chapter 8
Response to Comments	Chapter 9

1 PURPOSE AND NEED FOR ACTION

The need for this action is to consider proposed changes to the Pacific Coast Salmon Plan (PFMC 1997a) which directs ocean salmon fishery management actions relative to the exclusive economic zone (EEZ) off the coasts of Washington, Oregon, and California. The no action alternative in this process would be to retain the current salmon fishery management plan (FMP) unchanged. This FMP amendment process began in October 1996 for the purpose of (1) updating the current Environmental Impact Statement (EIS) completed in 1984, (2) meeting new or modified FMP requirements as a result of the Sustainable Fisheries Act (SFA), (3) responding to amendment proposals offered by representatives of the fishing industry, fishery management agencies, tribes, and public, and (4) making editorial and organizational improvements in the format of the FMP. The subsections below provide a brief background of the development of the current salmon FMP and further details on the needs to which this action responds.

1.1 HISTORY OF THE SALMON FMP

The Council's first salmon FMP and its environmental impact statement (EIS) were issued to govern the 1977 salmon season. A new salmon management plan and EIS were issued in 1978 to replace the 1977 documents. To establish management measures from 1979 through 1983, the 1978 FMP was amended annually and published along with a supplemental EIS (SEIS) and Regulatory Impact Review/Regulatory Flexibility Analysis (RIR/RFA). This annual process was lengthy, complex and costly. It lacked a long-range perspective and was too cumbersome to allow for timely implementation of the annual regulations and efficient fishery management (PFMC 1984). Therefore, in 1984, the Council adopted a comprehensive framework amendment which was designed to end the need for annual plan amendments and SEISs.

The comprehensive framework plan amendment of 1984 (Amendment 6) replaced the 1978 plan as the base FMP document and established a framework of fixed management objectives with flexible elements to allow annual management measures to be varied to reflect changes in stock abundance and other critical factors. Subsequently, at irregular intervals, the Council has developed various amendments to portions of the framework plan to address specific management issues raised by participants in the salmon management process or as necessary to respond to reauthorization of the original Fishery Conservation and Management Act of 1976. Each of the seven amendments adopted since implementation of the framework FMP in 1984 has been accompanied by an environmental assessment.

The primary amendment issues since 1984 have included specific spawner escapement goals for Oregon coastal natural (OCN) coho and Klamath River fall chinook (Amendments 7, 9, 11, and 13), non-Indian harvest allocation (Amendments 7, 9, and 10), inseason management criteria (Amendment 7), habitat (Amendment 8), safety (Amendment 8), a definition of overfishing (Amendment 10), and management objectives for stocks listed under the Endangered Species Act (ESA) (Amendment 12).

In 1996, as part of Amendment 12, the Council made an editorial update to the framework FMP which included incorporating all of the amendments after 1984 into the *Pacific Coast Salmon Plan* (PFMC 1997a), the current salmon FMP. In 1997, the Council adopted Amendment 13 which modifies the Oregon coastal natural (OCN) coho management goals. This proposed amendment would be Amendment 14.

1.2 UPDATING THE ENVIRONMENTAL IMPACT STATEMENT

The present SEIS for the Pacific Coast salmon fishery was completed 14 years ago. Several aspects of the SEIS may benefit from an editorial updating to make it a more useful, accurate and timely document from which to assess current ocean salmon fishery management. However, the primary need in updating the 1984 SEIS is to assess changes in the potential range of environmental impacts from future ocean fisheries resulting from an overall general decline in the abundance of many Pacific Coast salmon stocks, and, in particular, from those species listed or considered for listing under the Endangered Species Act (ESA).

1.2.1 Overall Alternatives Considered in 1984

The 1984 EIS to the salmon FMP considered five alternatives with regard to managing the Pacific Coast salmon fishery. Besides the adopted alternative of a framework FMP with a mix of fixed goals and objectives and flexible management measures, the EIS considered (1) the status quo (a new plan amendment each year), (2) a plan with all fixed measures, (3) a plan with all flexible measures, and (4) no federal management (PFMC 1984).

Since adoption of the 1984 framework amendment, the Council has found the adopted framework approach meets the requirements of the Magnuson-Stevens Act and the fishery with considerably greater efficiency than the former method of establishing a new amendment each year. The efficiency has been gained while maintaining public opportunity for review and comment. The procedures since 1984 probably allow for a more focused review on the specific annual measures being proposed since the overall management objectives are fixed from year to year. The particular mix of fixed and flexible measures in the adopted plan has generally fulfilled the expectations stated in the 1984 EIS when compared to the "all fixed" or "all flexible" alternatives (flexibility to meet changing or unforseen situations while limiting uncertainty and the breadth of factors to be decided each year). Plan amendments since 1984 have dealt primarily with adjusting or refining specific fixed objectives in response to additional information or changing stock status and management needs.

The alternative of no federal ocean salmon fishery management is probably less viable now than in 1984. This conclusion is based on the present need for regionally coordinated management as a result of the overall declining status of several important Pacific Coast salmon stocks with inter-state harvest implications, listings under the federal ESA, the need for regional input in several harvest allocation decisions, and more stringent federal requirements of the SFA with regard to optimum yield, overfishing, and stock rebuilding. Support by the fishing industry and public for maintaining Council management, versus allowing each state to control the fisheries within its jurisdiction, appears stronger now than in 1984 when public comments challenging the need for the Council were not uncommon. Comments received in the scoping sessions were supportive of continued Council management of the EEZ.

1.2.2 Effect of Chronic Stock Depression and Listings Under the Endangered Species Act

Since the current supplemental EIS for the salmon FMP was completed in 1984, the most significant change affecting ocean salmon fishery management within Council jurisdiction has been in the chronically declining status of numerous Pacific Coast salmon stocks, several of which have direct impacts on Council management. Due to continued or frequent periods of stock depression, new conservation objectives were developed for Oregon coastal natural (OCN) coho (Amendments 7, 11 and 13) and Klamath River fall chinook (Amendment 9). Both of these stocks have been major contributors to Council-area ocean fisheries.

Prior to 1989, no Pacific Coast salmon species or stocks had been listed under the ESA. Since that time, several stocks of chinook and coho salmon that directly affect ocean salmon fishery seasons in some degree have been listed. With the exception of threatened OCN coho, the listed stocks do not have a history of being important contributors to Council-managed ocean salmon fisheries and generally are affected to a relatively low degree by salmon harvest activities in the Council-area. However, the major restrictions required to protect OCN coho and the potential for further restrictions to protect other stocks currently proposed for listing under the ESA raise significant concern for the future of the mixed-stock ocean salmon fishery.

Management changes due to critical stock declines have been assessed in the pertinent FMP amendments for OCN coho and Klamath River fall chinook and their accompanying environmental assessments. Amendment 12 specifically provided overall conservation objectives for any ESA listed species. In addition, the Council's annual preseason reports update the impacts and management decisions resulting from ESA requirements. However, given the breadth of change since 1984 with regard to present and future ESA listings and their potential impacts on Council-area fisheries, it is appropriate to use this opportunity to update the 1984 supplemental EIS to clarify the overall impact of these actions.

1.2.3 Approach for Updating the EIS

Because the need to update the EIS derives primarily from the general decline in the abundance of many Pacific Coast salmon stocks and the listing of some of those stocks under the ESA, the approach of this update will be to compare fisheries and impacts prior to the decline in fisheries with fisheries and impacts in more recent years. For purposes of this analysis, the first listing of a salmon stock under the ESA (1989) will generally be used to delineate a shift in regimes, though it was not until a few years after the first listing that the effects of declines in stock conditions were felt more broadly along the coast. Chapter 4 updates the EIS with a description of the affected environment and Chapter 5 compares fishery related impacts during the time the FMP was first adopted to impacts in more recent years.

1.3 RESPONSE TO REQUIREMENTS OF THE SUSTAINABLE FISHERIES ACT

The Sustainable Fisheries Act (SFA) amends the Magnuson-Stevens Act in several respects which require changes to the Council's current salmon FMP. The most significant changes include three new National Standards which all councils must meet, new requirements for the definition and description of essential fish habitat (EFH), a new definition of optimum yield, a definition and new requirements with respect to bycatch, and new requirements with regard to the prevention of overfishing and the rebuilding of stocks which are overfished. The Council's proposed options for meeting the requirements of the SFA are contained in Chapter 2.

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At its October 1996 meeting, the Council conducted an extensive scoping session to review all aspects of the salmon FMP. Besides those issues addressing requirements of the SFA, the session identified several additional issues for Council consideration (PFMC 1997b). The identified issues considered in this plan amendment include (1) updating and clarifying the species, stocks and area covered by the plan, (2) reviewing the plan objectives for clarity, consistency and adequacy, (3) linking conservation objectives with identified stock management units, (4) clarifying the procedures for determining allowable ocean harvest, and (5) revising the troll/sport allocations north of Cape Falcon to allow equitable sharing of weak stock mortality under selective fisheries (aimed at harvesting primarily hatchery fish) and to establish a fourth recreational port area allocation in the La Push subarea.

1.5 EDITORIAL AND ORGANIZATIONAL CHANGES

With the magnitude and scope of changes required by the SFA and in the interest of making a more readable plan, considerable editorial and organizational changes are proposed for the new salmon FMP. The specific changes are covered in more detail in Chapter 2 and displayed completely within the text of the new plan which follows Chapter 9.

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With the magnitude and scope of changes required by the SFA and in the interest of making a more readable plan, considerable editorial and organizational changes are proposed for the new salmon FMP. The specific changes are covered in more detail in Chapter 2 and displayed completely within the text of the new plan which follows Chapter 9.

2 PLAN AMENDMENT ISSUES, OPTIONS, AND IMPACTS

The no action alternative in this amendment process would be to retain the current salmon fishery management plan (FMP) unchanged. The action alternative involves consideration of several amendment issues which propose relatively small, but important changes to the current FMP. The proposed amendment issues may contain more than one option. This chapter describes the individual amendment issues, options and impacts considered by the Council and the Council's final recommendation. The complete text of the recommended changes as it would appear in a new *Pacific Coast Salmon Plan* (1999) is appended following Chapter 7. Table 2-1 matches the chapters and sections of the proposed amended FMP with those of the current salmon FMP (PFMC 1997a), lists the issues involved, and cryptically identifies the proposed changes. In comparing options, the specifications of the current FMP are designated as Option A and those of the proposed amendment as Option B. Some amendment issues contain suboptions within Option B.

2.1 ISSUE 1 - FISHERY DESCRIPTION

2.1.1 Options

Under the current salmon FMP, the "Introduction" (Option A-1) references previously published documents which contain, in total, a description of the fishery as required prior to the Sustainable Fisheries Act (SFA). Option B-1 deletes these references (which are somewhat dated) and references new Appendices to the FMP which contain an updated description consistent with the requirements of the SFA. Appendix B contains a complete fishery description as of the time of this amendment. Appendix C would always be the most current version of the Council's annual review of ocean salmon fisheries which serves as an annual update to the information in Appendix B. The Council provides Option B-1 to adequately update the FMP and make it clearly consistent with requirements of the SFA.

2.1.2 Impacts

There are no regulatory impacts or direct management effects involved in this issue. The ecological, social, and economic impacts of adopting Option B-1 are expected to be insignificant when compared to the status quo. The proposed action clarifies Council management and ensures it is consistent with the Magnuson-Stevens Act, but does not materially change it.

2.1.3 Council Recommendation

The Council adopted and recommends implementation of Option B-1 as presented in the draft amendment. Option B-1 uses Appendix B to the FMP and the most current edition of the annual review of ocean salmon fisheries to update and amplify the description of the fishery. Implementation of Option B-1 requires no change in current federal regulations.

2.2 ISSUE 2 - WHAT THE PLAN COVERS

2.2.1 Options

Chapter 2 (Management Unit) of the current salmon FMP (Option A-2) identifies the salmon species and principal stocks under Council management and refers to this as the "Management Unit". The management unit has not been amended since 1984. It lists the primary salmon stocks of concern to ocean fishery management by broad geographic areas or river basins and includes some fishery management objectives and descriptions by broad subarea.

TABLE 2-1. Summary of proposed amendments to the *Pacific Coast Salmon Plan* (1997). (Page 1 of 2)

Proposed, Amended FMP Chapter/Section	1997 FMP/Status Quo Chapter/Section	Amendment Issue and/or Proposed Change
Introduction	1 Introduction	Issue 1 - Fishery description. Update and modify Introduction; reference new fishery description in Appendices B & C.
1 What the Plan Covers	2 Management Unit (introductory section only)	Issue 2 - What the plan covers. Update and clarify consistent with SFA (including reference to EFH); simplify by moving description of stock concerns by area to new Chapter 5 (Harvest); clarify relationship to stocks other than chinook, coho, and pink.
2 Achieving Optimum Yield (OY) 2.1 Theory 2.2 Implementation	4 OY and Overfishing 4.1 Optimum Yield	Issue 3 - OY. Define OY consistent with SFA; clarify role of MSY and Council's determination of OY.
3 Conservation 3.1 Salmon Stock Objectives 3.2 Overfishing 3.3 Supplemental Conservation Info 3.3.1 ESA Listings 3.3.2 OCN Coho	6 Escapement Goals 6.1 Coho; 6.2 Chinook 4.2 Overfishing No section 6.1 Coho	Issue 4 - Stock conservation objectives and overfishing. Move conservation info to one chapter; clarify and expand description of stock conservation objectives and relate directly to overfishing criteria consistent with SFA and ESA.
3.4 Bycatch (new)	No section	Issue 5 - Bycatch. Add section on bycatch consistent with SFA.
4 Habitat and Production 4.1 Essential Fish Habitat (new) 4.2 Restoration of Natural Losses 4.3 Artificial Production	3.2 Habitat and Environment No section 3.2.1 Habitat Objectives 3.2.2 Production Objectives	Issue 6 - EFH. Add new section on EFH as required by SFA, refer to full EFH information in Appendix A.
5 Harvest 5.1 Overall Fishery Objectives 5.2 Mgmt by Species and Area (delete sockeye)	3 Fishery Mgmt. Objectives 3.1 Harvest Management 7 Procedures for . . . Ocean Harvests 2.1 Coho, 2.2 Chinook, 2.3 Pink	Editorial Issue–Organize all harvest and fishery objectives in one chapter; delete sockeye.
5.3 Allocation 5.3.1 Non-Indian N. of Cape Falcon	8 Allocation of Ocean Harvest 8.1 Non-Indian Fisheries 8.1.1 . . . N. of Cape Falcon	Issue 7 - Provide recreational port allocation for La Push and increased flexibility to modify subarea allocations. Issue 8 - Allow flexibility to increase subarea or gear group landings north of Cape Falcon when using selective coho fisheries which protect wild escapement.
5.3.2 . . . South of Cape Falcon	8.1.2 South of Cape Falcon	Clarifies allocation south of Cape Falcon with non-retention fisheries and ESA listings consistent with amendments 12 & 13.
5.3.3 . . . Tribal Indian Fisheries	8.2 Indian Fisheries	No change to tribal Indian allocation.
5.4 U.S. Harvest and Processing	5 U.S. Harvest and Processing Capacity . . .	Editorial changes.

TABLE 2-1. Summary of proposed amendments to the *Pacific Coast Salmon Plan* (1997). (Page 2 of 2)

Proposed, Amended FMP Chapter/Section	1997 FMP/Status Quo Chapter/Section	Amendment Issue and/or Proposed Change
6 Measures to Manage the Harvest	7 Procedures for . . . Ocean Harvests	Editorial issue: move explanatory information on quotas and seasons (from old Chapter 7) into 6.5
	9 Salmon Harvest Controls	
6.1 thru 6.4 (no change in text)	9.1 thru 9.4	Editorial move of material from Chapter 9 to Chapter 6.
6.5 Seasons and Quotas	9.5 Seasons and Quotas	Issue 8 - add (1) a sixth guideline to ensure "selective fisheries" meet applicable court orders and (2) a section for guidance on selective fisheries which deviate from allocation percentages north of Cape Falcon.
7 Data Needs, Data Collection Methods, and Report Requirements	10 Data Needs, . . . and Report Requirements	No change
8 Schedule and Procedures for Analyzing the Effectiveness of the Salmon FMP	11 Schedule . . . of the Salmon FMP	Editorial updates to make consistent with changes in earlier chapters.
9 Schedule and Procedures for Preseason Modification of Regulations	12 Schedule . . . Modification of Regulations	No change
10 Inseason Management Actions and Procedures	13 Inseason . . . Actions and Procedures	No change
11 Schedule and Procedures for FMP Amendment and Emergency Regulations	14 Schedule and Procedures for FMP Amendment	Update number of days emergency rules are effective and note emergency rule procedures
12 Literature Cited	15 Literature Cited	Updated
Appendix A	Habitat Appendix (1988)	New EFH description (SFA requirement)
Appendices B and C	References cited in Introduction	Consolidated and expanded fishery description

Option B-2 (Chapter 1) proposes to update, simplify and clarify Option A-2 (Chapter 2) to be consistent with the SFA. The basic information for "What the Plan Covers" is contained in Chapter 1 of the new FMP. Information in the previous Chapter 2 not pertaining to a general description of the affected species and geographical area have been deleted or moved to other chapters in the new plan. The information on stock management objectives within fisheries has been updated and moved to a new section (Section 5.2) within the chapter on harvest. Reference to the plan's coverage of essential fish habitat (EFH) has also been added to Chapter 1. The Council provides Option B-2 to adequately update the description of what the plan covers and make it clearly compatible with the SFA.

2.2.2 Impacts

There are no regulatory impacts or direct management effects involved in this issue. The ecological, social, and economic impacts of adopting Option B-2 are expected to be insignificant when compared to the status quo. The proposed action clarifies Council management and ensures it is consistent with the Magnuson-Stevens Act, but does not materially change it.

2.2.3 Council Recommendation

The Council adopted and recommends implementation of Option B-2 as provided in the draft amendment. Option B-2 provides a clear statement of what the FMP covers and places information on stock impacts by fishery in the chapter on harvest (see chapters 1 and 5 of the amended FMP). Implementation of Option B-2 requires no change in federal regulations.

2.3 ISSUE 3 - OPTIMUM YIELD

2.3.1 Options

The SFA has redefined optimum yield (OY) by including a consideration for "the protection of marine ecosystems" and limiting OY to maximum sustainable yield (MSY) as "reduced", rather than "modified" by, relevant economic, social, or ecological factors. The Council's stock conservation objectives in Option A-4 (Chapter 6 of the current FMP) that guide the determination of OY are based primarily on achieving MSY or returning to MSY levels. In some cases, maximum sustainable production (MSP) objectives are also used which reduce the risk of consistently exceeding the MSY harvest level due to management uncertainties. The Council is not aware of information to indicate that these desired levels of stock abundance jeopardize any marine ecosystems. Therefore, the Council believes Section 4.1 of the current FMP (Option A-3) is consistent with the SFA. However, in the interest of specifically defining OY in the FMP to be consistent with the SFA and clarifying the Council's approach to achieving it, Alternative B-3 proposes a more thorough treatment of the issue in Chapter 2 of the proposed FMP. The Council provides Option B-3 to adequately update the FMP and make it clearly compatible with the SFA.

2.3.2 Impacts

There are no regulatory impacts or direct management effects involved in this issue. The ecological, social, and economic impacts of adopting Option B-3 are expected to be insignificant when compared to the status quo. The proposed action clarifies Council management and ensures it is consistent with the Magnuson-Stevens Act, but does not materially change it.

2.3.3 Council Recommendation

The Council adopted and recommends implementation of Option B-3 as presented in the draft amendment to define and clarify the concept of optimum yield (see Chapter 2 of the amended FMP). Implementation of Option B-3 requires no change in federal regulations.

2.4 ISSUE 4 - STOCK CONSERVATION OBJECTIVES AND OVERFISHING CRITERIA

2.4.1 Option A-4 (Chapters 4 and 6)

The stock conservation objectives of the current FMP are contained in Chapter 6 and utilized in the criteria for overfishing in Section 4.2. Section 4.2.1 of Option A-4 states that "overfishing is an occurrence whereby all mortality, regardless of the source, results in a failure of a salmon stock to meet its annual spawning escapement goal or management objective (as specified in Chapter 6 of the salmon FMP) for three consecutive years, and for which changes in the fishery management regime offer the primary opportunity to improve stock status." When a stock meets the overfishing definition, the Council appoints a workgroup to investigate the causes and report its conclusions and recommendations to the Council. The Council then may implement actions within its authority to recover the stock or recommend actions to other entities for issues beyond Council authority, such as habitat destruction.

2.4.2 Option B-4 (Chapter 3)

Option B-4 makes significant editorial changes to Chapters 4 and 6 of Option A-4 and places all of the stock and overfishing information in Chapter 3. In addition, Section 3.2 provides a new treatment of overfishing which meets the requirements of the SFA and Section 3.3 includes a new, updated description of stocks listed under the ESA.

2.4.2.1 Stock Conservation Objectives

Option B-4 does not change any of the present spawner escapement goals, but provides a single table (Table 3-1) with a detailed listing of the salmon stocks (arranged by major stock complex) and their stock conservation objectives (spawner escapement goals), pertinent management information, and the applicability of overfishing criteria to the stocks. Table 3-1 includes the following stock conservation objectives that are new to the FMP but previously agreed to and managed for by the pertinent fishery management entities:

Chinook:		
North Lewis River fall	5,700	natural adults
Willapa Bay fall hatchery	8,200	hatchery adults
Nooksack spring	2,000	natural adults - interim goal
Cedar River summer/fall	1,200	natural adults
White River spring	1,000	natural adults - interim goal
Green River summer	5,750	natural adults
Nisqually River summer/fall	900	natural adults
Coho:		
Willapa Bay Hatchery	WDFW	objectives
South Puget Sound Hatchery	52,000	hatchery adults

2.4.2.2 Overfishing Criteria

As required by the SFA, Section 3.2 of Option B-4 provides the Council's objective and measurable criteria for identifying when a fishery is overfished and also the conservation and management measures necessary to prevent or end overfishing and rebuild the fishery. The Council criteria are based on meeting annual stock conservation objectives in Table 3-1 of Option B-4 which are based directly on MSY or a proxy thereof, MSP, a rebuilding schedule designed to allow a stock to build to its MSY, or a NMFS jeopardy standard in the case of stocks listed under the ESA. By striving to meet these objectives annually, the Council protects stocks against overfishing, quickly rebuilds stocks which may experience episodic depressions in abundance, provides long-term rebuilding of stocks which have been consistently depressed, and allows for stabilization and recovery of stocks listed under the ESA.

Table 3-1 in Option B-4 does not contain conservation objectives for all Pacific Coast salmon stocks. However, to the extent practicable, each major stock complex is represented by one or more indicator stocks. Additional or revised conservation objectives are under development for several stocks and will be incorporated in the table in the future as may be appropriate to reflect the best scientific information available.

Certain exceptions apply to the Council's implementation of its overfishing criteria (Section 3.2.4). The Council does not apply the criteria to hatchery stocks which generally do not represent unique gene pools and whose long-term production is rarely threatened by fishing impacts. Natural stocks which have negligible impacts in Council fisheries are also an exception as there is no value served by denying harvest of healthy stocks while providing no benefit to the stock(s) in question. The criteria used to designate these stocks is an adult equivalent exploitation rate of less than 5% in base period Council fisheries (the period 1979-1982 for chinook and 1979-1981 for coho). This was a period when the ocean seasons were relatively unrestricted. The third exception is stocks listed under the ESA which are managed under a NMFS jeopardy standard or recovery plan to stabilize the stock until such time as restoration of their habitat makes it possible to develop new MSY objectives consistent with the recovered habitat.

Table 2-2 summarizes and compares Options A-4 and B-4 in regard to the Council's overfishing criteria and terms of the National Standard Guidelines (NSG). Further details of the proposed overfishing criteria are provided in the text which follows.

Conservation Alert

To anticipate potential long-term problems in stock abundance, Option B-4 (Section 3.2.2.1) provides that a conservation alert is triggered when a stock is projected to fall short of its conservation objective. When this occurs, the Council notifies the pertinent fishery and habitat managers of the problem and, depending on other information known about the stock, may request a formal assessment of the situation by the pertinent managers (Section 3.2.2.2). Option B-4 then provides for consideration of three suboptions with regard to the action the Council may take in establishing fisheries for the coming season.

Suboption A: Close all fisheries within Council jurisdiction which impact the stock(s) in question, except for Washington coastal and Puget Sound stocks under U.S. District Court orders which may be impacted by Council fisheries as long as annual spawner targets agreed to by Washington Department of Fisheries and Wildlife (WDFW) and the treaty tribes are met. Suboption A represents the status quo.

Suboption B: Same as Suboption B-4A except that the targets agreed to by WDFW and the treaty tribes must provide a minimum spawner threshold that is greater than 50% of the MSY/MSP conservation objective or greater than 50% of the lower end of the MSY range.

Suboption C: Allows the same deviation from the MSY objectives for all stocks that Suboption B-4B provides for the Washington coastal and Puget Sound stocks, unless the stock has not met it MSY/MSP conservation objective in each of the past three years. This option is most conservative for Washington coastal and Puget Sound stocks and least conservative for the remaining stocks.

The suboptions allow consideration of a range of flexibility in annual stock management decisions by the Council that meet or exceed the requirements of the SFA to prevent overfishing and recover overfished stocks. Suboption B reflects perceptions that Washington coast and Puget Sound stocks which are primarily managed under U.S. District Court orders should be held to the same standard in the Council's FMP as the other stocks. Suboption C reflects a perception that flexibility within the limits of the SFA should be standardized for all stocks.

TABLE 2-2. Council management objectives and criteria to achieve OY, prevent overfishing and rebuild stocks that are overfished. (page 1 of 2)

CURRENT SALMON FMP (OPTION A-4)	PROPOSED FMP (OPTION B-4)	COMMENTS ON CHANGE
Council recommends only fisheries that meet spawner escapement objectives of indicator stocks in Table 6-1 which lists only those stocks with objectives (MSY, MSP, rebuilding objectives to discover or approximate MSY, or jeopardy standard).	Council recommends only fisheries that meet conservation objectives of indicator stocks in Table 3-1 which lists all stock complexes, indicator stocks with objectives (MSY, MSP, or rebuilding objectives to discover or approximate MSY), other stocks without objectives, ESA listed stocks, management information, relation to overfishing criteria, and clarifies conservation objectives for Washington coastal (WC) and Puget Sound (PS) stocks.	Aids understanding of Council's use of indicator stocks to guide management, achieve OY, and protect stocks without specific objectives; clarifies actions to prevent overfishing.
Preseason Overfishing Criteria (Section 4.2)	**Preseason Overfishing Criteria** (Section 3.2.2)	To comply with SFA.
--	**Conservation Alert** - issued to managers if preseason projection predicts a natural stock will fail to meet its MSY, MSP, or floor conservation objective (in Table 3-1). Alert requests identification of probable causes; if stock failed to meet objective in previous two years, a request is issued for formal assessment prior to next season.	Uses projected spawner escapement numbers to flag and prevent potential overfishing as defined by National Standard Guidelines (NSG) (i.e., [1] to exceed a maximum fishing mortality threshold [MFMT], or proxy thereof, that meets the MSY control rule, or [2] a minimum stock size threshold [MSST] less than 50% of MSY).
Fisheries must close to meet spawner goal for stocks in Table 6-1, except fisheries may be implemented which impact WC and PS stocks if annual spawner targets are agreed to by WDFW and the treaty tribes consistent with U.S. District Court orders.	*Suboption A*: All fisheries impacting the stock are closed except (as in Option A-4) fisheries may be implemented which impact WC and PS stocks if annual spawner targets are agreed to by WDFW and the treaty tribes consistent with U.S. District Court orders.	The spawner escapement objectives are set at or above MSY with no MSST proxy below the MSY level. This is more precautionary than the NSG which allow a MFMT at MSY and a MSST down to as low as 50% of MSY. WC and PS stocks may experience higher harvest rates if agreed to under the terms of U.S. District Court orders.
--	*Suboption B*: Same as Sub-option A except the targets agreed to by WDFW and the treaty tribes must be greater than 50% of the MSY or MSP conservation objective.	Same as Suboption A, except requires WC and PS stocks to meet MSST proxy >50% of MSY/MSP which makes it more conservative than Suboption A.
--	*Suboption C:* Allows fisheries as long as stocks are projected to achieve a conservation objective >50% of MSY or MSP and have met the objective in each of the past three years.	Most liberal option for harvest of stocks other than WC and PS. Slightly more conservative than Suboption B for WC and PS stocks. Meets MSST requirements of NSG for all stocks.
	Council Recommendation: Option B-4, Suboption A, with editorial changes.	Precautionary approach that exceeds the protection specified under the NSG while allowing limited flexibility for weak stock management of WC and PS stocks (see comments for Suboption A).

TABLE 2-2. Council management objectives and criteria to achieve OY, prevent overfishing and rebuild stocks that are overfished. (page 2 of 2)

CURRENT SALMON FMP (OPTION A-4)	PROPOSED FMP (OPTION B-4)	COMMENTS ON CHANGE
Exceptions:	**Exceptions:**	
1) Hatchery stocks.	1) Hatchery stocks.	More options to maintain hatchery production. No threat of listing.
2) Upper Columbia River spring and summer chinook.	2) Stocks which have negligible impacts from Council-managed fisheries (e.g., WC and PS chinook and other individual stocks noted in Table 3-1 based on base period, adult equivalent fishery exploitation rate of less than 5%.	Council fisheries have virtually no impact and do not retard potential recovery.
3) Listed stocks.	3) Listed stocks.	Council must meet jeopardy standard.
Postseason Overfishing Criteria (Section 4.2)	**Postseason Overfishing Criteria** (Section 3.2.3)	Compliance with SFA.
Natural, unlisted stock in Table 6-1 fails to meet its MSY/MSP or floor spawner goal–	Natural, unlisted stock in Table 3-1 fails to meet its MSY/MSP or floor conservation objective--	No change except in terminology.
One year–manage to achieve MSY or MSP objective the following season (except as exempted for WC and PS stocks.	**One year**--manage to achieve MSY/MSP objective the following season, with exceptions as provided above for Sub-Options a, b and c.	No change. Immediate rebuilding program.
Two consecutive years–same as above.	**Two consecutive years**–same as above.	No change. Immediate rebuilding program.
Three consecutive years--overfishing review is initiated to assess problem and provide Council with recommendations for recovery.	**Three consecutive years**–meets criteria for **overfishing concern** which initiates assessment of the problem by the STT and development of rebuilding program within one year, except as noted for exceptions under §3.2.4.	More rigorous action to address potential problem that requires assessment and possible change in management practices.
Exceptions: Same as for preseason exceptions.	**Exceptions:** Same as for preseason exceptions under conservation alert.	Same as for preseason exceptions.
Rebuilding Program (Section 4.2)	**Rebuilding Program** (Section 3.2.3)	Compliance with SFA.
Work group assesses stock and makes recommendations to Council for future management actions.	STT and HSG, with help from pertinent entities, assess stock. Within one year, STT recommends management measures and Council implements recovery action to end overfishing.	Requires Council to take specific action prior to the next season to assure end of overfishing.
Exceptions: Same as for preseason exceptions.	**Exceptions:** Same as for preseason exceptions.	Same as preseason exceptions.

Overfishing Concern

As in Option A-4, when a stock fails to meet its conservation objective in three consecutive years, the Council's overfishing concern is triggered and an assessment is begun. The action is different under Option B-4 in that the Council must recommend management measures or a plan amendment within one year to end the overfishing and rebuild the stock in as short a time as possible. To accomplish this, the Council assigns the STT, with assistance from pertinent managers, to assesses the stock and provide recommendations to the Council by the March meeting of the following year. The Council also requests the Habitat Steering Group to assist state, federal, tribal and local habitat experts and managers in identifying and resolving habitat problems.

2.4.3 Impacts

2.4.3.1 Stock Conservation Objectives

The section on stock specific escapement goals has been reorganized in Option B-4 to clearly relate these goals (conservation objectives) to the major stock complexes occurring on the Pacific Coast and to consolidate other pertinent management information in one table. However, there are no changes to the conservation objectives contained in the current FMP, except to include the objectives listed in section 2.4.2.1 (above) which have been previously agreed to and managed for by the pertinent fishery management entities. Therefore, no regulatory, biological, administrative, economic, or social impacts are expected to result from this action.

2.4.3.2 Overfishing Criteria

One effect of Option B-4 is to clarify how the Council's current policies and practices meet or exceed the standards established by the Magnuson-Stevens Act for identifying overfishing situations and developing rebuilding programs. Congress requires a one year time limit for responding to overfishing situations. Option B-4, the alternative to the Council's current overfishing provisions (Option A-4), imposes that time limit and the requirement that action be taken to end overfishing and rebuild stocks. This time limit will increase the priority for assessment of overfishing situations and may change the scope of management options considered in response to overfishing, but will not directly change fishery regulations or the associated workload. Impacts of required changes in management measures or plan amendments to end overfishing and rebuild stocks will be analyzed when they are proposed. Table 2-3 provides some sense of the frequency of meeting overfishing criteria if this option had been in effect since 1984. However, changes in objectives over the time period reviewed make exact comparisons difficult for some stocks.

Option B-4 also would add a "conservation alert" status and process as an early warning that a stock may be in a weakened condition. The conservation alert would be triggered when a stock is projected to fall short of its annual conservation objective. There are three suboptions for the conservation alert with varying impacts. The conservation alert may (1) increase administrative burdens by requiring the generation of new reports (all suboptions); (2) prevent the Council from implementing WDFW-tribal agreements that revise escapement goals to less than 50% of the conservation objective for Washington coastal and Puget Sound stocks managed under U.S. District Court orders (Suboptions B-4B and B-4C)--currently the Council can implement any escapement goal reductions agreed to by WDFW and the tribes; and/or (3) make some actions, taken only under emergency procedures, a part of the routine procedures (Suboption B-4C).

Administrative burdens may be minimally increased under all options by the requirement that a conservation alert be issued when a stock is projected to fall short of its annual conservation objective in the absence of Council-area fishery impacts. If the stock has not met its conservation objectives in the previous two years, an assessment of causes would also be required.

TABLE 2-3. Frequency of conservation alerts and overfishing concerns triggered by natural stocks with Council conservation objectives under Option B-4 (exclusive of ESA listed stocks). Data is for 1984 through 1998 (1999 preseason estimates) unless indicated otherwise by dates in parentheses. (Page 1 of 4)

Stock Complex and Indicator Stock	**Conservation Objective** (to be met annually)	**Pre/Post-season Spawner Estimates**	**Conservation Alerts and Years of Occurrence** ("*" denotes ≤50% of objective)	**Overfishing Concerns and Years in which the Conservation Objective was not Achieved** ("*" denotes ≤50% of objective)	**Most Recent Year Conservation Objective Achieved**	**Subject to Council Actions to Prevent Overfishing**
		- - - CHINOOK - - -				
CALIFORNIA CENTRAL VALLEY:						
Sacramento River Fall	122,000-180,000 natural and hatchery adult spawners.	Yes/Yes	0	1 1990-1992	1998	Yes
NORTHERN CALIFORNIA COAST:						
Klamath River Fall (Klamath & Trinity Rivers)	35,000 natural adult spawners (floor).	Yes/Yes (1989/1984)	1 1992	1 1984*, 1985, 1990*, 1991*, 1992*, 1993, 1994	1998	Yes
OREGON COAST (fall and spring stocks):						
Southern, Central, and Northern Oregon	150,000 to 200,000 natural adult spawners.	No/Yes	-	0	1998	Yes
COLUMBIA RIVER BASIN:						
Upper River Bright (Fall)	40,000-45,000 natural adults above McNary Dam.	Yes/Yes	0	0	1998	Limited (exploitation rate exception)
WASHINGTON COAST:						
Grays Harbor Fall	14,600 natural adults spawners.	No/Yes	-	1 1985, 1986, 1991, 1993, 1994, 1995, 1998	1997	Limited (exploitation rate exception)
Grays Harbor Spring	1,400 natural adult spawners.	"	-	0 1984, 1985, 1987, 1991, 1993	1998	"
Queets Fall	2,500 natural adult spawners.	"	-	0	1998	"
Queets Spring/Summer	700 natural adult spawners.	"	-	0 1985, 1987, 1991, 1992, 1995, 1997, 1998	1996	"

TABLE 2-3. Frequency of conservation alerts and overfishing concerns triggered by natural stocks with Council conservation objectives under Option B-4 (exclusive of ESA listed stocks). Data is for 1984 through 1998 (1999 preseason estimates) unless indicated otherwise by dates in parentheses. (Page 2 of 4)

Stock Complex and Indicator Stock	**Conservation Objective** (to be met annually)	**Pre/Post-season Spawner Estimates**	**Conservation Alerts and Years of Occurrence** ("*" denotes ≤50% of objective)	**Overfishing Concerns and Years in which the Conservation Objective was not Achieved** ("*" denotes ≤50% of objective)	**Most Recent Year Conservation Objective Achieved**	**Subject to Council Actions to Prevent Overfishing**
			--- CHINOOK ---			
WASHINGTON COAST (continued)						
Hoh Fall	Manage terminal fisheries for 40% harvest rate, but no less than 1,200 natural adult spawners.	"	-	0	1998	"
Hoh Spring/Summer	Manage terminal fisheries for 31% harvest rate, but no less than 900 natural adult spawners.	"	-	0	1998	"
Quillayute Fall	Manage terminal fisheries for 40% harvest rate, but no less than 3,000 natural adult spawners.	"	-	0	1998	"
Quillayute Spring/Summer	1,200 natural adult spawners for summer component.	"	-	1 1984*, 1985*, 1986*, 1987*, 1991, 1992, 1994, 1996, 1997	1998	"
Hoko Summer/Fall (Western Strait of Juan de Fuca)	850 natural adult spawners.	"	-	0 Data limited to 1995-1997	1997 (1998 NA)	"

PUGET SOUND:

All natural stocks within Puget Sound listed as threatened under the ESA, Mar. 1999.

--- COHO ---

OREGON PRODUCTION INDEX AREA:

Oregon production index area stocks listed as threatened under the ESA.

TABLE 2-3. Frequency of conservation alerts and overfishing concerns triggered by natural stocks with Council conservation objectives under Option B-4 (exclusive of ESA listed stocks). Data is for 1984 through 1998 (1999 preseason estimates) unless indicated otherwise by dates in parentheses. (Page 3 of 4)

Stock Complex and Indicator Stock	**Conservation Objective** (to be met annually)	**Pre/Post-season Spawner Estimates**	**Conservation Alerts and Years of Occurrence** ("*" denotes ≤50% of objective)	**Overfishing Concerns and Years in which the Conservation Objective was not Achieved** ("*" denotes ≤50% of objective)	**Most Recent Year Conservation Objective Achieved**	**Subject to Council Actions to Prevent Overfishing**
			--- COHO ---			
WASHINGTON COAST:						
Grays Harbor	35,400 natural adult spawners.	Yes/Yes	4 1984, 1988, 1994, 1997*, 1998	0 1985, 1987, 1992, 1994*, 1997	1996 (1998 NA)	Yes
Queets	5,800 to 14,500 natural adult spawners.	Yes/Yes	7 1984, 1986, 1988, 1994, 1996, 1997*, 1998	1 1985-1990, 1993, 1994*, 1997*	1998	Yes
Hoh	2,000 to 5,000 natural adult spawners.	"	1 1997	0 1993, 1994, 1997	1998	Yes
Quillayute Fall	6,300 to 15,800 natural adult spawners .	"	1 1997	0 1990, 1993, 1994, 1997	1998	Yes
Western Strait of Juan de Fuca	9,720 natural adult spawners. (formerly 12,850 managed together with eastern strait)	Yes/Yes (1995/1984)	3 1995*, 1996*, 1997*	Constantly since 1984 (less than 50% except in 1986, 1989, 1992)	None (1998 NA)	Yes
PUGET SOUND:						
Eastern Strait of Juan de Fuca	3,130 natural adult spawners. (formerly 12,850 managed together with western strait).	Yes/Yes 1995/1984	3 1995, 1996, 1997	Constantly since 1984	None (1998 NA)	Yes
Hood Canal	21,500 natural adult spawners.	Yes/Yes (1988/1984)	6 1988, 1991, 1992*, 1994, 1995, 1996	1 1985, 1987, 1988, 1989, 1990*, 1991, 1992, 1993	1998	Yes
Snohomish	70,000 natural adult spawners.	Yes/Yes (1986/1984)	0	0 1996, 1997	1998	Yes
Stillaguamish	17,000 natural adult spawners.	Yes/Yes 1986/1984	2 1994, 1997	1 1989*, 1990, 1991*, 1992, 1993, 1996, 1997	1998	Yes

TABLE 2-3. Frequency of conservation alerts and overfishing concerns triggered by natural stocks with Council conservation objectives under Option B-4 (exclusive of ESA listed stocks). Data is for 1984 through 1998 (1999 preseason estimates) unless indicated otherwise by dates in parentheses. (Page 4 of 4)

Stock Complex and Indicator Stock	**Conservation Objective** (to be met annually)	**Pre/Post-season Spawner Estimates**	**Conservation Alerts and Years of Occurrence** ("*" denotes ≤50% of objective)	**Overfishing Concerns and Years in which the Conservation Objective was not Achieved** ("*" denotes ≤50% of objective)	**Most Recent Year Conservation Objective Achieved**	**Subject to Council Actions to Prevent Overfishing**
			- - - COHO - - -			
PUGET SOUND (continued)						
Skagit	30,000 natural adult spawners. (Recent evaluation indicates method of counting has significantly underestimated spawners)	Yes/Yes	6 1984, 1985, 1993, 1994, 1995,1996	**Pending re-evaluation:** 1 1986, 1988, 1989, 1990*, 1991*, 1992*, 1993*, 1994, 1995*	1998	Yes
			- - - PINK (odd-numbered years) - - -			
The Fraser River Panel of the Pacific Salmon Commission (PSC) manages fisheries for pink salmon in the Fraser River Panel Area (U.S.) north of 48° N latitude to meet Fraser River natural spawning escapement and U.S./Canada allocation requirements.						
Puget Sound	900,000 natural spawners or consistent with provisions of the Pacific Salmon Treaty (Fraser River Panel)	NA	NA	NA	NA	No (exploitation rate exception)

Some administrative burden may be reduced by making some actions taken only under emergency procedures a part of the regular procedures (Suboption B-4C). Under current Council procedures, if a stock will not make its conservation objective even in the absence of Council fisheries, an emergency action may be requested to allow fisheries to proceed that have incidental impacts on the stock of concern. Such actions are taken only when it is clear that the ability of the stock to recover will not be jeopardized. Under Suboption B-4C, such action could be part of the normal season recommendations so long as escapement would not be more than 50% below the lower end of the MSY/MSP escapement goal and the stock had met its conservation objective in each of the three previous years. Whether as part of an emergency action or through the routine process, NMFS would still make the final determination as to whether or not to approve the Council's action. Thus, administrative burdens would be reduced while still applying the standard that the long-term ability of the stock to produce MSY not be threatened.

Suboptions B-4B and B-4C may be more risk adverse with regard to potential overfishing of Washington coastal and Puget Sound coho stocks managed under U.S. District Court orders. Under the current system, the Council may recommend seasons based on any escapement levels agreed to by the tribes and WDFW (even if the spawner escapement would fall 50% or more below the lower end of the MSY goal range). Under the conservation alert of Suboptions B-4B and B-4C, the Council could not recommend a spawner escapement that would fall 50% or more below the lower end of the MSY goal range, except through an emergency request. The frequency of projected spawner escapements 50% or more below the lower end of the MSY goal range for Washington coho stocks is provided on the third and fourth pages of Table 2-3.

Based on the data in Table 2-3, impacts under the overfishing criteria in Suboptions B-4B and B-4C would be negligible for all stocks south of Cape Falcon and for chinook stocks north of Cape Falcon. However, implementation of these suboptions could require additional reductions in fisheries north of Cape Falcon to meet conservation objectives for Washington coastal and Puget Sound coho stocks. In particular, Strait of Juan de Fuca coho have been projected to be below 50% of the MSY spawner objective in several years . Skagit River coho also appear to be of concern. However, recent evaluation indicates spawner escapements have been underestimated and the objectives are being re-evaluated under new accounting methods. Both the Grays Harbor and Queets coho stocks were projected to achieve less than 50% of their MSY objectives in 1997 which would have required additional fishery closures or an emergency rule.

The potential fishery reductions that could occur under Suboptions B-4B and B-4C are within the range of reductions already experienced north of Cape Falcon over the past 10 years. If the short-term reductions were successful at rebuilding the stocks, future reductions may be decreased in the long-term. However, rebuilding of the stocks is dependent on many variables other than fishery impacts from Council-managed fisheries. Any modeling of stock rebuilding would be extremely speculative. Section 5.3, in particular part 5.3.4, contains a discussion of the socio-economic impacts from reduced ocean fisheries.

The following table summarizes the impacts of the B-4 suboptions:

Impact	Suboption B-4A	Suboption B-4B	Suboption B-4C
Increased administrative burdens related to new reports	X	X	X
Reduced administrative burdens related to elimination of the need to take emergency actions in some situations			X
Potential for more timely conservation responses to indications of depressed stock status as a result of conservation alert and accompanying reports	X	X	X
Increased conservation protection in FMP related to limit on the deviation from MSY goals for Washington coastal and Puget Sound stocks subject to U.S. District Court orders		X	X
Increased likelihood of short-term fishery closures north of Cape Falcon		X	X

2.4.4 Council Recommendation

The Council adopted and recommends implementation of Option B-4 with Suboption A as editorially modified to eliminate an unneeded characterization of Type I and Type II conservation alerts (see Section 3.2 in the amended FMP). Additional corrections and edits have been made in the final version of the amended plan to clarify and update some conservation objectives (e.g., listing of Puget Sound chinook). The choice of Suboption B-4A reflects the Council's recognition of the special management requirements for Washington coastal and Puget Sound salmon stocks for sharing of tribal and non-Indian harvest as developed in U.S. District Court proceedings. The court established conservation objectives include a majority of the identified natural stocks and reflect MSY or more risk averse MSP management goals which meet optimum yield as characterized under the Magnuson-Stevens Act. Additional flexibility to set annual spawner targets below MSY is granted under the court orders, but does not negate the long-term goal of meeting MSY spawner escapements. Table 2-3 indicates that only the Strait of Juan de Fuca coho stocks have been incapable of achieving their objective MSY/MSP escapement levels within the past three years. WDFW and the tribes are currently reviewing the conservation objectives for these stocks as well as implementing other recommendations for stock recovery developed during a previously completed overfishing review (PSSSRG 1997).

The Council believes Option B-4 with Suboption A meets the requirements of the Magnuson-Stevens Act and the NSG with regard to preventing overfishing and recovering overfished stocks (National Standard 1). The adopted option provides a control rule with conservation objectives that require the Council to annually manage each stock so as to achieve MSY/MSP, an MSY proxy, or, in some cases, a stock rebuilding objective (e.g., the Council's goal for Klamath River fall chinook is to rebuild the stock and determine MSY by using a fixed harvest rate along with a very conservative minimum spawner escapement level). The stock conservation objectives set an annual maximum fishing mortality threshold (MFMT) as well as a minimum spawning stock threshold (MSST). In preliminary drafts, the Council considered, but was unwilling to propose, a control rule which set the MSST below MSY or a proxy thereof, except in the case of rebuilding objectives. The precision of determining MSY objectives is limited and often controversial. The Council was unwilling to identify a lower management target given the risk of potential overfishing. However, because of the numerous factors which result in large natural variations in annual salmon abundance (including their short life span, high reproductive potential, and dependence on both marine and freshwater environments), the Council did not define overfishing as a failure to meet the conservation objective in one year. Such management would be more responsive to noise in the system than a true loss of capacity to produce MSY over the long-term. Table 2-3 displays the considerable variation in spawner escapements which do not necessarily result in a long-term loss of capacity to meet MSY spawner escapement levels. Instead, the Council's control rule provides that a stock triggers an overfishing concern if the conservation objective is not met in three consecutive years. Such cases may still be simply natural variation which have no impact on long-term production. However, they may also indicate the beginning of a trend. Therefore, they trigger an overfishing review and consideration of management measures to assure the trend does not continue.

Option B-4A requires regulatory changes as follows:

§ 660.410 ~~Escapement and management goals~~ Conservation objectives

(a) The ~~escapement and management goals~~ conservation objectives are summarized in Table ~~6-1~~ 3-1 of the ~~Fishery Management Plan for Commercial and Recreational Salmon Fisheries off the Coasts of Washington, Oregon, and California~~ *Pacific Coast Salmon Plan*.

(b) * * *

(1) A comprehensive technical review of the best scientific information available provides conclusive evidence that, in the view of the Council, Salmon Technical Team, and the Scientific and Statistical Committee, justifies modification of a~~n escapement goal~~ conservation objective; except that the 35,000 natural spawner floor for Klamath River fall chinook may only be changed by FMP amendment;

* * * * *

2.5 ISSUE 5 - BYCATCH

2.5.1 Option A-5 (Section 9.5.3)

Under the current FMP (Option A-5) there is no specific definition of bycatch and the only guidelines for addressing bycatch are found in Section 9.5.3 (Species Specific Fisheries) which reads as follows:

> In addition to the all-species seasons and the all-species-except-coho seasons established for the commercial and recreational fisheries, other species limited fisheries, such as "ratio" fisheries, may be considered by the Council during the preseason regulatory process based on the following guidelines:
>
> 1. harvestable fish of the target species are available;
> 2. harvest of incidental species will not exceed allowable levels determined in the management plan;
> 3. proven, documented selective gear exists (if not, only an experimental fishery should be considered);
> 4. significant wastage of incidental species will not occur or a written economic analysis demonstrates the landed value of the target species exceeds the potential landed value of the wasted species; and
> 5. the species specific or ratio fishery will occur in an acceptable time and area where wastage can be minimized and target stocks are maximally available.

In addition to the guidance in the salmon FMP, the STT preseason reports and annual review of ocean salmon fisheries provide estimates of mortality as a result of nonretention of salmon species in salmon fisheries.

2.5.2 Option B-5 (Sections 3.4 and 6.5.3)

Option B-5 (Section 3.4) responds to the requirements of the SFA to define bycatch, provide guidance for minimizing the amount of bycatch and the mortality of such bycatch, and establish a standardized reporting methodology to assess the type and amount of bycatch. Section 6.5.3 of Option B-5 retains the guidance of Option A-5 with respect to selective fisheries.

The key points of Option B-5 are that bycatch is defined as salmon that are caught in an ocean salmon fishery, but not sold or kept for personal use; Council conservation and management measures shall seek to minimize salmon bycatch and bycatch mortality (drop off and hooking mortality) to the greatest extent practical in all ocean fisheries; and, when bycatch cannot be avoided, priority will be given to conservation and management measures that seek to minimize bycatch mortality and ensure the extended survival of such fish.

The present bycatch and bycatch mortality estimation methodologies and procedures for salmon in salmon fisheries are documented in STT (1999) and a compilation of Scientific and Statistical (SSC) reviews of salmon estimation methodologies (PFMC 1997c). Within the salmon preseason planning process, management options will be assessed for the effects on the amount and type of salmon bycatch and bycatch mortality. Estimates of salmon bycatch and incidental mortalities associated with salmon fisheries will be included in the modeling assessment of total fishery impact and assigned to the stock or stock complex projected to be impacted by the proposed management measure.

2.5.3 Impacts

There are no regulatory impacts or direct management effects involved in this issue. The ecological, social, and economic impacts of adopting Option B-5 are expected to be insignificant when compared to the status quo. The proposed action clarifies Council management and ensures it is consistent with the Magnuson-Stevens Act, but does not materially change it.

Alternative B-5 would ensure that sources and amounts of bycatch are identified as part of the annual preseason process for developing salmon management regulations. There will be some personnel time and administrative costs associated with the additional reporting requirements for the STT. While relatively minor, the additional burden will occur during a period where the team's resources are already utilized to near their maximum.

The primary bycatch that occurs in Council management of the salmon fishery is bycatch of one salmon species during fisheries targeted on another species (e.g., bycatch of coho in chinook-only fisheries), bycatch of natural salmon stocks of one species in fisheries targeted on hatchery stocks of the same species, bycatch of one stock of a species in fisheries targeted primarily on another stock of the same species (e.g., bycatch of Klamath River or Snake River fall chinook in fisheries targeted on Sacramento River fall chinook), and bycatch of halibut, primarily in commercial fisheries from central Oregon northward. Bycatch of fish other than salmon in salmon fisheries is generally very limited. Only hook-and-line gear is allowed in ocean salmon fisheries and regulations allow for retention of most groundfish species and limited numbers of Pacific halibut that are caught incidentally while salmon fishing.

Specific measures addressing bycatch reduction will be developed as part of the annual preseason process. Economic analysis of such proposals will be provided as part of the normal preseason analysis of options.

2.5.4 Council Recommendation

The Council adopted and recommends implementation of Alternative B-5 with editorial changes as provided in the amended FMP (Section 3.4). The edits more clearly summarize the general bycatch and mortality estimation procedures under a heading of "standard reporting methodology".

Implementation of Option B-5 requires no regulatory changes.

2.6 ISSUE 6 - DEFINITION AND DESCRIPTION OF ESSENTIAL FISH HABITAT

2.6.1 Option A-6 (Section 3.2 and Habitat Appendix to the FMP [1988])

Amendment 8 to the FMP (PFMC 1988) provides a Habitat Appendix for Pacific Coast salmon stocks (Option A-6). The appendix contains or describes (1) pertinent salmon life history information, (2) physical characteristics of marine and freshwater habitat required for the production of a healthy salmon resource, (3) actions with significant adverse impacts on salmon habitat, and (4) recommendations for ways to maintain and restore the productive capacity of the salmon resource. The Habitat Appendix does not meet the requirements of the SFA and is not a viable option.

2.6.2 Option B-6 (Section 4.1 and Appendix A [1999])

The Council provides Option B-6 to adequately incorporate the requirements of the SFA into the FMP with regard to essential fish habitat (EFH). Option B-6 is contained in Section 4.1 and Appendix A of the proposed new salmon FMP. It is based on the specific requirements of the SFA to define and describe EFH for each fishery and to minimize, to the extent practicable, adverse effects on such habitat caused by fishing, and identify other actions to encourage the conservation and enhancement of such habitat.

The SFA requires that EFH must include those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. In specifying its definition, the Council further clarified EFH to be those waters and substrate necessary for salmon production needed to support a long-term sustainable salmon fishery and salmon contributions to a healthy ecosystem rather than merely being that habitat necessary to assure that salmon exist. To achieve that level of production, EFH must include most of the habitat historically available to salmon. The option of limiting EFH to only the most essential habitat to assure continued existence of salmon does not provide for a viable, economically valuable, renewable resource as envisioned in the SFA.

The complete EFH definition in Option B-6 is provided in Chapter 1 of Appendix A. It includes all the currently viable streams, lakes, ponds, wetlands, and other water bodies, and most of the habitat historically accessible to salmon in Washington, Oregon, Idaho, and California as identified in Table 1-1 of Appendix A). Salmon EFH has been defined to include aquatic areas above all artificial barriers except the impassible barriers (dams) listed in Table 1-2 of Appendix A. These exclusions could be re-examined in the future. Initially, the Council considered only including marine areas out to 60 km as EFH, based on information available that indicates the importance of this area to juvenile and adult fish. However, given the occurrence of chinook and coho salmon in high seas fisheries and tagging programs, and other documentation provided in Chapter 2 of Appendix A, any offshore boundary would be arbitrary. Therefore, the Council chose to designate all marine waters within the EEZ off Washington, Oregon, and California north of Point Conception. Foreign waters (i.e., off Canada) are not included in salmon EFH because they are outside U.S. jurisdiction. The Pacific coast salmon fishery EFH also includes the marine areas off Alaska designated as salmon EFH by the North Pacific Fishery Management Council. Appendix A also contains a detailed assessment of adverse impacts and actions to encourage conservation and enhancement of EFH from both fishing activities and nonfishing activities.

2.6.3 Impacts

There are no regulatory impacts or direct management effects involved in this issue. The ecological, social, and economic impacts of adopting Option B-6 are expected to be insignificant when compared to the status quo. The proposed action clarifies Council management and ensures it is consistent with the Magnuson-Stevens Act, but does not materially change it.

2.6.3.1 Biological and Physical Impacts

Implementation of Option B-6 does not have any direct biological or physical impacts on the human environment or on the physical habitat utilized by salmon or other fish or animal species. It provides for a description of habitat of importance to maintaining a healthy, harvestable salmon resource and provides recommendations to protect, maintain, and restore that habitat. These descriptions and recommendations will form the basis for consultations by NMFS on federal actions which may adversely impact EFH. In the long-term, such guidance should have a positive effect on the status of the Pacific Coast salmon resource and reduce the need to list stocks under the ESA.

2.6.3.2 Economic and Social Impacts

The Council's definition and description of EFH will have no immediate direct effect on fishing or nonfishing activities. However, there will be indirect effects which will depend on the scope of the EFH recommended by the Council and adopted by the Secretary of Commerce. These indirect effects will include the degree of obligation placed on federal agencies to consult with the Secretary of Commerce in any action that may adversely affect the defined EFH (the more extensive the EFH the more actions that may come under the consultation requirement). Part of that obligation may pass through to private entities and other nonfederal governments. The burden pass-through may occur to the degree that the extra consultation requirement results in delay on an action or the identification of issues and concerns that lead to requests for modification of the impact analysis[1/] or project design, and the associated costs of such modifications. However, the definition of EFH and the related consultation requirement do not create any new standards for analysis, project design, or mitigation. The EFH and consultation requirement increase the probability that standards related to impacts on fish will receive the consideration and emphasis specified under existing laws and regulations that guide each agency's actions, as well as under laws and regulations that may be developed in the future. Thus while there are no direct effects, the probability is increased that actions of other agencies will fully consider fish related impacts, and so, be based on a more complete and appropriate assessment of environmental, economic, and social costs and benefits.

1/ There are many situations in which the applicant requesting a governmental action prepares the impact analysis. Therefore, identified shortcomings in the analysis may lead to costs for the private entity related to needed improvement of the impact analysis.

The obligation on the Council may also be affected to some degree by the definition of EFH. The Council is required to comment on all actions that substantially affect the habitat of anadromous resources under its authority, not just those affecting EFH. However, there is no formal mechanism by which the Council is notified of actions affecting anadromous fish habitat beyond that specified for federal agencies with respect to actions affecting the EFH portion of the habitat. Therefore, a broadly scoped EFH definition is likely to bring more issues to the Council's attention than might otherwise occur.

2.6.4 Council Recommendation

The Council adopted and recommends implementation of Option B-6 as presented in the draft amendment with minor edits and corrections and the following primary changes:

1. Within the delineation of freshwater EFH in Chapter 1 of Appendix A, indicate that activities occurring above impassable barriers that are likely to adversely affect EFH below impassable barriers are subject to the consultation provisions of the Magnuson-Stevens Fishery Act.

2. In Section 4.2 of the amended FMP, modify the first guideline to indicate that replacement of fish losses will be by an "equivalent number" of the appropriate stock or by habitat capable of producing the "equivalent number" of fish of the same species lost.

Implementation of Option B-6 requires no regulatory changes.

2.7 ISSUE 7 - RECREATIONAL HARVEST ALLOCATIONS FOR PORT AREAS NORTH OF CAPE FALCON

Issue 7 resulted from recommendations submitted by WDFW, Salmon Advisory Subpanel (SAS) representatives, and the public at the Council's October 1996 amendment scoping session and is not related to management requirements resulting from passage of the SFA. This issue considers establishing a recreational allocation in the FMP for the port area of La Push that is separate from the Neah Bay port area and nearly identical to the allocation which has been provided to La Push on an annual basis during the preseason management process beginning in 1990. In addition, Issue 7 considers adding flexibility to deviate from subarea allocations to meet recreational fishery objectives if agreed to by representatives of the affected ports.

2.7.1 Option A-7 (Chapter 8)

Amendment 10 to the salmon FMP (1990) formally established three recreational subareas with harvest allocations in the area north of Cape Falcon and specifically allowed the Council to "establish additional subarea quotas within a major subarea to meet recreational season objectives when agreed to by representatives of the affected ports". The subarea allocations work to stabilize the salmon fishing opportunity of each port by assuring that no one subarea will harvest more than its recent historical share of the total recreational coho allocation. This type of control is especially important when harvests are very limited (as they have been in recent years) as the timing of fisheries vary by port. Without subarea allocations, those ports with early fisheries could preclude some or almost all harvest opportunity for those with later fisheries.

Under Amendment 10, the northern most subarea combined the ports of La Push and Neah Bay. At the time of the amendment, La Push, which is remotely located, had little angler effort and had gone through a recent period in which angler access had been somewhat discouraged while tribal fishing rights were being determined by the courts. Following that period, however, representatives of the port of La Push expressed a desire to rebuild the recreational salmon fishery to historic levels. Since the more developed facilities at Neah Bay and its proximity to large population centers attracted large numbers of anglers, under a single subquota, nearly all of the allocation would be taken in a very short time by anglers from Neah Bay. This left little opportunity for La Push to rebuild its fishery. Therefore, beginning in 1990, the Council annually approved a separate subarea quota for La Push. The separate subquota allowed for a longer season from La Push that could not be precluded by the Neah Bay fishery.

2.7.2 Option B-7 (Chapter 5)

Under Option B-7, the Council proposes to formalize the subarea allocation to La Push at a level that is approximately 20% of the former Neah Bay/La Push allocation. This is equal to the level provided to La Push on an annual basis during the preseason process beginning in 1995. In addition, during years in which there is an Area 4B add-on fishery inside Washington internal waters (which benefits only Neah Bay), La Push will be accorded a small percentage increase in its allocation in the same manner as has been established in the FMP for Westport. The specific FMP language establishing these allocations is contained in item six of Section 5.3.1.2 and in Section 5.3.1.3 of the proposed *Pacific Coast Salmon Plan.* Also, under item six of Section 5.3.1.2, the language has been modified to allow deviations from subarea quotas to meet recreational fishery objectives if agreed to by representatives of the affected ports.

2.7.3 Impacts for Issue 7

There are no significant impacts associated with the proposed amendment. The change in the FMP formalizes action which the Council has taken in the preseason management process beginning in 1990 and adds additional flexibility to be more responsive to meeting the recreational objectives of the FMP for fisheries north of Cape Falcon. This flexibility may allow the Council to more fully utilize available harvest opportunity and slightly increase benefits to local communities. Regulations under § 660.408(c)(v) would have to be modified to reflect the increase in the number of subareas, change the allocation percentages, and provide for modifying the allocations based on agreement by representatives of the affected ports.

2.7.4 Council Recommendation

The Council adopted and recommends implementation of Option B-7 as presented in the draft amendment (see Sections 5.3.1.2 and 5.3.1.3 of the amended FMP).

Implementation of Option B-7 requires the following regulatory changes:

§ 660.408 Annual actions

* * * * *

(c) * * *

(1) * * *

(v) *Recreational allocation.* The recreational allowable ocean harvest of chinook and coho derived during the preseason allocation process will be distributed among the ~~three~~ <u>four</u> major recreational subareas as described in the coho and chinook distribution sections below . . . The Council may ~~also establish additional~~ <u>deviate from</u> subarea quotas ~~within a major subarea~~ to <u>(1)</u> meet recreational season objectives based on agreement of representatives of the affected ports <u>and/or (2) in accordance with Section 6.5.3.2 of the *Pacific Coast Salmon Plan* with regard to certain selective fisheries</u>. [this last new phrase also implements Option B-8] Additionally, based upon the recommendation of the recreational Salmon Advisory Subpanel representatives for the area north of Cape Falcon, the Council will include criteria in its preseason salmon management recommendations to guide any inseason transfer of coho among the recreational subareas to meet recreational season duration objectives.

(A) *Coho distribution.* The preseason recreational allowable ocean harvest of coho north of Cape Falcon will be distributed to provide 50 percent to the area north of Leadbetter Point and 50 percent to the area south of Leadbetter Point. In years with no fishery in Washington State management area 4B, the distribution of coho north of Leadbetter Point will be divided to provide 74 percent to the subarea between Leadbetter Point and the Queets River (Westport), ~~and 26~~ <u>5.2</u> percent to the subarea ~~north of the~~ between Queets River <u>and Cape Flattery (La Push), and 20.8 percent to the area north of the Queets River (Neah Bay)</u>. In years when there is an Area 4B (Neah Bay) fishery under state management, 25 percent of the numerical value of that fishery shall be added to the recreational allowable ocean harvest north of Leadbetter Point prior to applying the sharing percentages for Westport and La Push. ~~That same value would then be subtracted from the Neah Bay/La Push share in order to maintain the same total distribution north of Leadbetter Point.~~ The increase to Westport and La Push will be subtracted from the Neah Bay ocean share to maintain the same total harvest allocation north of Leadbetter Point.

* * * * *

2.8 ISSUE 8 - SELECTIVE COHO FISHERIES NORTH OF CAPE FALCON

Issue 8 considers allowing deviations in the non-Indian harvest allocations north of Cape Falcon to take advantage of selective fisheries to access more of the available harvest of hatchery produced coho salmon while not increasing impacts on pertinent natural stocks of management concern.

2.8.1 Option A-8 (Chapter 8 of current FMP)

In a mixed-stock fishery, the ability to identify specific stocks through the use of a visible external mark provides a way to increase harvest of hatchery surplus without sustaining similar increases in harvest impacts[2/] on natural stocks of concern and those listed under the ESA. Under the current FMP (Option A-8), it is possible to establish fisheries that are selective for various species and sizes of salmon, as well as for fish which may be marked in some way to identify them to the fishers. However, the gear and subarea allocations for the fisheries north of Cape Falcon are based on landed catch quotas rather than impacts. Therefore, a selective fishery[3/] cannot be used to increase harvest over that occurring without selection unless all gear groups and subareas are able to increase their harvest proportionally while impacts on critical natural stocks are reduced or held neutral .

The first such selective fishery was conducted for coho salmon in the Columbia River area ocean sport fishery in 1998. The Columbia River area selective fishery reduced retained coho catch per angler, slowing the rate at which the coho quota was attained, and thereby, provided a longer season and opportunity for more individuals to participate for a similar amount of coho harvest. At the same time, the fishing mortality for natural stocks was reduced and ocean escapements increased. Implementation of selective fishery regulations was limited by requirements that allocation schedules fixed in the FMP not be violated. For 1999, selective coho fisheries were implemented for all recreational fisheries north of Cape Falcon and for a period in July for the recreational fishery between Cape Falcon and Humbug Mountain off Oregon.

2.8.2 Option B-8 (Chapter 6 of amended FMP)

Alternative B-8 allows deviations from the specified port area and gear allocations to increase coho harvest opportunity through fisheries that are selective for marked coho salmon as long as: additional harvestable fish are available; the selective fisheries are implemented primarily in August and/or September; the total impacts within each port area or gear group on critical natural stocks of management concern are not greater than those under the original allocation without selective fisheries; other allocation objectives of the plan are met; and the selective fishery is assessed against the guidelines and management constraints of Section 6.5.3 of the proposed FMP. The specific FMP language is found under "Selective Fisheries Which May Change Allocation Percentages" in Section 6.5.3.2. of the proposed plan.

2/ In this document the term "impact" in the context of impacts on a stock or species is a reference to the mortalities expected for that stock or species, not the number of fish handled or in some other way affected.

3/ For purposes of this discussion, except where noted, fisheries which allow fishers to retain only fin-clipped stocks will be called "selective fisheries" and it will be assumed that the fin-clipped fish are of hatchery origin. While this shorthand terminology will be used, there are other kinds of selective fishery regulations (see Section 5.1) and some natural stocks carry fin clips.

2.8.3 Impacts

All numbered tables in this impact section have been grouped together at the end of the section.

2.8.3.1 Definitions and Procedures

In the discussion of impacts, "*Status quo selective fisheries*" is the term that will be used for selective fisheries that can be implemented under the current plan. "*Equivalent impact selective fisheries*" is the term that will be used for selective fisheries that are permissible only under the proposed amendment (i.e., selective fisheries with quotas greater than would be allowed for a selective fishery under the current plan, but with critical coho stock impacts less than or equivalent to the nonselective base fishery).

Fisheries selective for marked stocks will redistribute hatchery and natural fish harvest among different fisheries and escapement, and affect the quality of salmon fisheries by changing catch per unit of effort and/or the total amounts of allowable catch. The following is primarily a qualitative discussion of the impacts of selective fisheries, with quantitative information and indicators provided where possible and appropriate.

For purposes of illustrating the nature of the possible impacts of selective coho fishing, the STT has run the coho FRAM selective fishery model using stock abundances and base allocations similar to those present in 1996, and applying the assumption that all hatchery fish are marked and natural fish are not. A July-August selective fishery was modeled based on the timing of the base season for the 1996 fishery. At its November 1998 meeting, the Council decided to restrict the implementation of the "equivalent impact selective fishery" to the August-September time period for the options sent out for public review. The models were not rerun subsequent to the meeting. In its final action the Council specified the "August-September period as the period for which selective fisheries will first be considered (6.5.3.2). The July-August models should adequately demonstrate the type of effects the Council will have to consider each year as it determines the degree to which selective fisheries will be implemented and timing for such fisheries.

Results are provided for three ocean recreational fisheries: (1) a base 1996 nonselective fishery, (2) a selective fishery that could be run under the current plan ("status quo selective fishery"), and (3) a selective fishery fully implemented under the proposed amendment ("equivalent impact selective fishery"). In the runs provided, it was assumed that equivalent impact selective fisheries would be implemented for the recreational fishery to the maximum extent allowed under the amendment. These maximum fisheries would not be expected in the near future for the following reasons: (1) all hatchery fish are not currently marked, (2) historically, there has not been enough recreational effort in the August-September time period to utilize all the fish that might be provided, (3) changes in stock impacts that would affect other fisheries would have to be negotiated within and outside the Council process and the results of those negotiations would be unlikely to immediately allow full expansion of the ocean fisheries, and (4) the amendment language and Council technical advisory bodies have emphasized the need for careful and judicious implementation of selective fisheries with full evaluation of stock impacts. The motivation for selective fisheries has been to allow some reasonable ocean fishing opportunities where, in the face of weak natural stocks, it might otherwise not be allowed, or be allowed only at very low levels. The full implementation scenario for ocean recreational fisheries has been modeled because it represents the upper bounds of the selective fisheries that may be implemented under the amendment and because it is unclear how much selective fisheries may expand over time as the Council, industry, and public develop greater familiarity and understanding of the use of the selective fishery tool.

The impact analysis was developed when the focus of Council attention was use of selective fisheries for the ocean recreational fishery north of Cape Falcon. At the November meeting, an intent to consider the selective ocean troll fisheries was articulated. While some of the following analysis has been adjusted to anticipate a potential selective ocean troll fishery, much of it remains oriented toward the recreational fishery.

2.8.3.2 Historic Harvest Redistribution

Harvest distribution among areas and groups varies annually based on the fishery management constraints dictated by the conditions of the stocks in a particular year (Table 2-4). Table 2-5 shows how fisheries in different regions have faired over time on the socio-economic basis of total recreational trips taken and commercial fishery exvessel salmon revenue. Implementation of selective fisheries in the ocean will have redistribution effects that will depend on whether or not selective fisheries are implemented in other areas.

2.8.3.3 Redistributions Caused by Selective Fisheries

Coho

Selective fisheries, as specified here, would harvest more hatchery coho without increasing impacts on critical natural coho stocks. For the equivalent impact selective fishery, the degree to which harvest of hatchery stocks could be expanded would depend heavily on assumed hook-and-release mortality rates. If harvest of hatchery stocks is not expanded to the maximum level allowable under the equivalent impact selective fishery option, ocean area impacts on critical natural coho stocks could be reduced by an amount equal to the difference between the hook-and-release mortality on natural stocks and the mortality under a nonselective fishery. However, as a result of the selective fishery (status quo or equivalent impact), subsequent fisheries may have increased contact rates with natural stocks.

Using the 1996 fisheries example, a fully expanded, equivalent impact recreational selective fishery (Table 2-6) could potentially increase harvest by up to 153,700 coho to a total harvest of up to 218,700 coho, about a 3.4 fold increase (Table 2-7 and 2-8). Subsequent fisheries would have greater contact rates with natural stocks because of the increased concentration of natural stocks after the removal of hatchery fish. A fully expanded selective recreational fishery would remove about 6% of the Puget Sound hatchery stocks, roughly 10%-15% of the Washington coastal hatchery stocks and roughly 50% of the Columbia River hatchery stocks (Table 2-9). These percent changes provide a rough sense for the degree of change to inside harvest that might be required to achieve a neutral effect on natural stocks.

The decrease in the proportion of hatchery stocks caused by the selective recreational fishery would increase impacts on natural stocks in subsequent ocean fisheries north of Cape Falcon. In the presence of a fully expanded equivalent impact selective recreational fishery, the projected effect of the 1996 troll fishery is a relatively small reduction in ocean escapement of natural stocks. The change in ocean escapement (Table 2-9) is very likely under estimated by the model (see "Risk and Modeling Limits" below). Natural stock impacts by subsequent fisheries could be reduced, if the subsequent fisheries are managed as selective fisheries. The feasibility of managing the subsequent fisheries as selective will depend on the encounter rate of marked fish and the nonretention mortality rates of gears used in those fisheries.

The model runs provided here are based on a fishery which begins in late July, with the majority of the fishery occurring in August. Fishery/stock interactions are modeled in monthly increments so the effects on stock composition of a July selective fishery do not show up in the model until August. Thus, there is an interaction between July and August recreational and troll fisheries. The table below shows retained coho salmon catch modeled for the base and selective fishing scenarios in the north of Cape Falcon ocean recreational fisheries, assuming 1996 stock conditions, 100% fin clips for hatchery fish, and an 8% hook-and-release mortality.

	1996 Base (Nonselective)	Status Quo Selective	Equivalent Impact Selective
July [a/]	14,300	14,300	49,283
August	50,643	50,643	169,380
Total	64,943	64,943	218,663

a/ July fishing would have occurred only in the Westport and Columbia River port areas.

In November, the Council proposed limiting the equivalent selective fishery option to the August/September time frame. In its final action, the Council placed a priority on August-September selective fisheries but did not limit the fishery to the August-September time period. To the degree selective fisheries are held to the August-September time period , the complexities of the fishery modeling problems may be limited. Harvest of coho in the nontreaty all-salmon troll fishery has extended into September in only five of the last 12 years. Therefore, if selective recreational fisheries are limited to August/September, it is likely that there would be fewer interactions in the model among the troll and recreational fisheries. For the treaty troll fishery, significant coho fisheries have occurred after August in six of the last 12 years.

Number of coho caught in the troll fisheries before September and after August (thousands).

		1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Nontreaty	Jan-Aug	121	62	2	53	79	62	19	10	0	18	18	0
	Sept-Dec	0	0	0	25	23	20	0	6	0	7	0	0
Treaty	Jan-Aug	85	90	58	49	78	79	74	32	0	31	5	11
	Sept-Dec	0	0	10	35	16	1	1	31	0	0	14	4

The scenarios modeled here provide for a July/August recreational fishery. Adjusting the modeled scenario by holding the start of the recreational fishery off until August would eliminate modeled interactions between the 1996 ocean recreational and nontreaty troll fisheries, reducing the modeled effects on ocean escapement. However, if selective ocean troll fisheries are implemented, extending the season into September, greater interactions would be modeled and the complexity of the modeling task could increase.

While the ocean recreational fishery may maintain a neutral impact on critical natural coho stocks, the effect from all fisheries taken together may increase impacts on natural stocks unless further adjustments are made. Options for maintaining a neutral effect on critical natural stocks from all sources of fishing mortality include selective harvest in other fisheries that impact the critical natural coho stocks; reducing harvest in the other fisheries by reducing quotas (if used), seasons, or bag limits, etc.; or not taking full advantage of potential selective fishing opportunities in the ocean fishery. By not expanding the ocean recreational harvest to the maximum extent permissible under the amendment, impacts on critical natural stocks in the ocean selective fishery could be reduced relative to a nonselective ocean fishery, so that the combined overall impact of the ocean and inside fisheries could be neutral, assuming adequate modeling. A complete modeling of all fisheries, ocean and inside, would be required to determine whether the more limited expansion of the ocean selective fisheries currently contemplated by the Council would entirely counteract potential increased natural coho impact rates in subsequent fisheries.

Chinook

The opportunity to increase effort in the ocean recreational fishery through imposition of a selective coho fishery may be associated with an increase in chinook mortalities associated with the fishery. A similar conclusion would be likely for a selective ocean troll fishery. The amount of chinook available for north of Cape Falcon fisheries is the subject of negotiations each year. An increase in the potential coho harvest as a result of selective coho fisheries may increase the pressure for providing chinook quota or hook-and-release mortality impacts for ocean fisheries. The pressure for additional chinook harvest/impact opportunity north of Cape Falcon will depend on the options available for reducing chinook impact rates. For example, the pressure for increased chinook quota may be moderated by the option of prohibiting chinook retention for all or a part of the selective fishery. However, in 1995 and 1996 there were recreational coho harvests north of Cape Falcon but no chinook harvest for either the troll or recreational fisheries. In such a situation, the opportunity to reduce chinook mortalities related to the selective fisheries would be more limited. In 1996, a coho quota of 56,200 fish was modeled preseason. Associated with this coho harvest, the STT estimated a 700 chinook hook-and-release mortality, for a chinook mortality rate of 0.0125 chinook per coho caught. If the mortality of critical chinook stocks in the ocean sport fishery north of Cape Falcon is greater than it would have been in the absence of a selective fishery, adjustments may be required in other fisheries.

2.8.3.4 Sport-Troll Preseason Quota Trades and Interaction of Selective Fisheries

The selective fishery option will likely alter the dynamics of the preseason chinook-coho quota trades between sport and troll fishers. The effect on the trading dynamics will depend on how the "base fishery" is defined. If the base fishery used to determine the critical coho stock impacts is the season and troll-sport allocation before any trade between the two groups, then there would be no incentive for the sport fishers to trade for more coho. Such a trade would provide them with no additional impacts on critical stocks and hence no additional fishing opportunity. If the base season is the season after such a trade occurs, then it is likely that the interest of recreational fishers in trading sport chinook quota for troll coho quota will be greater than under a nonselective fishery regime. Interest would increase because each coho the sport sector receives in the trade will give them access to even more coho in the selective fishery. While the incentive to trade may increase, the total amount of chinook they are willing to trade may decrease, as more chinook may be needed to access the increased coho harvest. The opportunity for a selective troll fishery would likely decrease the incentive for trollers to trade coho quota for chinook quota.

If selective fisheries are implemented for both the troll and sport fisheries, the order of occurrence of the selective fisheries will be important. For example, if the troll fishery occurs in August and the sport fishery in August and September, the impact rate of the September sport fishery will be greater than it would have been in the absence of the troll selective fishery. To implement selective fishing under the proposed rules for allowing deviations in the allocation, impacts of the fishery undertaking selective harvest must be held neutral from what they would have been under the base season in which no fisheries were selective. Therefore, a portion of the savings in critical coho impacts resulting from the selective sport fishery would have to be held back to make up for the increased natural stock impact rate caused by the selective troll fishery, rather than being used to access additional hatchery coho.

2.8.3.5 Risk and Modeling Limits

Hook-and-Release Mortality

Substantial concern has been expressed about the key role of the hook-and-release mortality assumption in development of selective fisheries and the potential effects of incorrect estimation of hook-and-release mortality. The Council and its advisory entities periodically review hook-and-release mortality estimates and revised them as appropriate.

For the north of Cape Falcon recreational fishery, the current estimate of hook-and-release mortality for handled fish is 8%. An additional mortality rate of 5% is applied to the total number of fish handled to account for fish that drop off the hook before being brought to the boat. In a fishery in which all unmarked fish are correctly identified and discarded, the fishing mortality applied to unmarked fish contacted is 13% of the unmarked fish handled.

To evaluate the sensitivity of the estimates of total mortality to the hook-and-release mortality rate, the coho FRAM selective fishery model was rerun assuming that the equivalent impact selective fishery is developed and fully expanded on the basis of the 8% hook-and-release mortality, but that the actual hook-and-release mortality is 16% (Table 2-10). The additional impacts resulting from this hypothetical mis-specification of hook-and-release mortality rate are mortalities in the north of Cape Falcon ocean recreational fishery 30% greater than would have been expected. However, reduction in ocean escapement of natural stocks would be generally less than 1%, with the exception of the Hoh and Queets stocks for which ocean escapement would be 2% and 3% less than expected, respectively (Table 2-11). To maintain a neutral effect on natural coho stocks under this assumed example (a 16% hook-and-release mortality rate), catches would have to be limited to about 75% of the level modeled under the 8% hook-and-release mortality rate.

Misidentification

Another concern about selective fisheries is angler ability to properly identify coho with an adipose fin clip. To account for this misidentification potential, current modeling (1998) assumes that 10% of all coho are misidentified. This means that 10% of unmarked coho will be incorrectly kept, increasing the mortality rate on natural coho, and 10% of the marked coho will be incorrectly discarded, decreasing the mortality on hatchery coho. The effect of this modeling assumption is a smaller expansion in the fishery and smaller retained coho quota than would otherwise be allowed because 10% of the unmarked coho handled are experiencing 100% mortality instead of the 13% mortality rate that is applied for properly identified coho.

Modeling Limits

The model for selective fisheries is limited because it does not account for substantial within month changes that may occur in the stock mix as a result of removal of the marked hatchery component and it does not account for changes in the mortality rate for natural fish that are encountered more than once in a selective fishery. For example, within the recreational fishery the stock mix encountered by fishers at the start of a month may be substantially different than that encountered toward the end of the month, with unmarked coho encounter rates increasing through time. However, the model is not set up to make any adjustments to the stock mix from that which is present at the start of the month.

2.8.3.6 Effects on Economic Value

Increased harvest in selective ocean recreational fisheries may cause adjustments to regulations for other fisheries which precede or follow the selective sport fishery. The need for and nature of possible adjustments are discussed in the section above on distribution of catch and escapement. In this section, the primary focus is on (1) changes in total harvest and effort for the ocean recreational fishery and the direct economic impacts of those changes on the north of Cape Falcon recreational industry, fishers and communities, (2) some of the implications of selective fishing in an ocean troll fishery, and (3) changes in the value per unit of harvest for all fisheries that may be affected by the selective fisheries allowed under the proposed amendment.

Recreational Fishers North of Cape Falcon

Selective fisheries in the ocean will provide ocean anglers with more fishing days and alter the quality of the angling experience. Ocean recreational fisheries have declined substantially in recent years (Table 2-5 and as follows).

Thousands of angler trips in the ocean fishery north of Cape Falcon.

	Averages															
	'76-80	'81-85	'86-90	'91-95	'86	'87	'88	'89	'90	'91	'92	'93	'94	'95	'96	'97
Total Trips	491	190	132	91	130	119	75	150	188	140	114	139	0	62	47	31

Using the 1996 season scenario, a fully implemented equivalent impact selective fishery in July and August could have provided an estimated 249,200 trips, 174,100 more trips than a status quo selective fishery and 194,300 more trips than the 54,900 trips projected for a nonselective fishery[4/] (Tables 2-7 and 2-8). These estimates assume average 1996 angler success rates. During a longer season, the average success rates may vary and increased harvest earlier in the season would likely reduce the success rates later in the season, reducing the season average angler success rates and increasing the total number of trips supported by the quota. Effort levels such as those potentially allowed under a selective fishery have not been observed for two month periods since the late 1970s.

Thousands of angler trips in the ocean fishery north of Cape Falcon (July-September).

	Averages															
	'76-80	'81-85	'86-90	'91-95	'86	'87	'88	'89	'90	'91	'92	'93	'94	'95	'96	'97
July-Aug	330	149	121	74	125	114	74	139	156	119	98	104	0	48	41	30
Aug-Sept	244	80	52	44	52	45	5	64	91	40	41	89	0	51	39	12
July-Sept	391	159	126	88	125	114	75	141	175	130	112	138	0	62	47	31

Salmon trips are taken on private and charter vessels, and both sectors would likely see increased effort under selective fisheries. In recent years, roughly 60% of all recreational salmon trips north of Cape Falcon have been taken on private vessels. The proportion of trips taken on private vessels has increased as seasons have become more restrictive. A proportion of private trips comparable to recent years was observed in 1984, another year of restricted fishing opportunity. This pattern indicates the possibility that the expanded seasons allowed under selective fisheries may result in a greater expansion of effort by those taking charter trips than those going out on private vessels.

Percent of trips taken on charter and private vessels north of Cape Falcon.

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Private	61%	46%	49%	48%	54%	53%	60%	62%	60%	64%	-	64%	61%	56%
Charter	39%	54%	51%	52%	46%	47%	40%	38%	40%	36%	-	36%	39%	44%

4/ Trips projected for the status quo nonselective fishery vary from that observed in 1996, in part, because the 1996 quota was under harvested.

The angler experience would change relative to the nonselective fishery. Catch rates would be similar or somewhat lower, but retained catch rates would decline significantly. Average retained fish per trip would be projected to decline from 1.18 to 0.88 fish per trip and the average coho mortality needed to support a single trip would decline from 1.24 to 0.94 fish per trip (Table 2-7). The per-angler-trip mortality for natural fish would decline from about 0.28 natural fish per trip to 0.06 natural fish per trip. Lower catch rates will tend to reduce the value of the trip to the angler, reducing effort and making it more unlikely that the recreational quota in a fully expanded selective fishery could be fully harvested in the August-September time frame to which it has been proposed the selective fishery be limited. While not likely to be as significant as the reduced value related to reduced retention, it should be noted that the reduced probability of killing a fish from a critical natural coho stock may increase the value of the trip to some anglers who are particularly conservation minded.

Other Recreational Fisheries

Seasons for other recreational fisheries (ocean fisheries south of Cape Falcon and inside fisheries) may be altered, depending on the degree to which selective fisheries are implemented and the opportunity for implementing the selective fisheries without increasing impacts on chinook. The changes in other recreational fishing seasons might be needed to take into account the effects of the expanded ocean recreational fishery on critical chinook stocks and/or increased natural stock impact rates in subsequent fisheries. As discussed above, these altered seasons could include selective fisheries for hatchery stocks so that total recreational fishing opportunity may not be decreased.

Recreational fishers in inside fisheries are likely to experience reduced angler success rates as a result of preceding selective fisheries.[5/] Thus, the value of these trips for the angler is likely to decline. Imposition of selective fishing regulations on inside fisheries would further reduce retained fish per angler trip, while expanding total fishing opportunity.

Recreational Charter Vessels

North of Cape Falcon, ocean charter vessels operators will likely benefit from the opportunity to make more trips during the longer season. Historic data indicates the possibility that effort in the charter mode may expand more than effort in the private boat mode (see Effects on North of Cape Falcon Recreational Fishers). However, if reduced quality of the experience (discussed above) caused demand for charter trips to decline substantially, gross daily revenue and daily profits could decline: charter vessels might either operate with lower daily revenues due to lower passenger loads or attempt to maintain passenger loads by reducing fees. Operators in other fisheries (e.g. Puget Sound) will be impacted depending on how angler success rates change and how seasons are adjusted (as discussed in previous sections).

North of Cape Falcon, ocean fishery charter vessels operate primarily out of Astoria, Ilwaco, Westport and Neah Bay. In 1998, there were 13 charter vessels reported operating out of Astoria, of which all 13 fished for salmon (Table 2-12). In the 1995-1996 period, 20 of 20 charter vessels out of Ilwaco fished for salmon, 31 of 33 charter vessels out of Westport fished for salmon, and 6 of 16 charter vessels out of Neah Bay fished for salmon (see Appendix B of the FMP for additional information on the activity of north of Cape Falcon charter vessels).

North of Cape Falcon Commercial Ocean Fisheries

The troll ocean fishery will not have its quotas directly reduced as a result of selective recreational fisheries. However, if the troll fishery occurs subsequent to an expanded recreational fishery, reduced catch rates may increase the cost per unit catch. A selective ocean troll fishery would likely increase total gross fishing revenue for the participants. The effect of a selective troll fishery on net revenue would depend on the

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5/ Impacts will not likely be evenly distributed among different natural stocks. For some local in-river/terminal area fisheries, escapement of natural stocks may increase, increasing angler success rates and, if the increased return is anticipated in management models, increasing fishing opportunity.

additional cost associated with catching and discarding unmarked fish, i.e., retained catch per unit of effort would decrease, increasing marginal costs per fish caught as compared to a nonselective fishery.

In 1997, there were 57 vessels that operated in the north of Cape Falcon troll fishery. Due to decreased fishing opportunities the number of troll vessels operating in the north of Cape Falcon area has declined substantially in recent years so that the participants in the north of Cape Falcon troll fishery comprise a small percentage of the total ocean troll fleet (Table 2-13).

Other Commercial Fisheries

Seasons for other commercial fisheries (ocean and inside, except north of Cape Falcon ocean troll fisheries) may be altered, depending on the degree to which selective fisheries are implemented in the north of Cape Falcon ocean fisheries and the opportunity for implementing the north of Falcon selective fisheries without increasing impacts on critical chinook stocks. The changes in seasons might be needed to take into account the effects of the expanded ocean selective fishery on critical chinook stocks and/or increased natural coho stock impact rates in subsequent fisheries.

Fisheries occurring subsequent to an expanded ocean recreational fishery would experience reduced catch rates, increasing cost per unit catch. Total commercial harvest could increase if selective fisheries are implemented in subsequent inside commercial fisheries. Inside fisheries are not under Council authority, and so, outside the scope of this plan amendment. The potential for implementing selective regulations for inside commercial fisheries will depend on discard mortality rates for inside commercial gears. For example, because of assumed relatively high discard mortality rates, selective fisheries have thus far not been contemplated for gillnet gear. Selective fishing regulations in the commercial fishery increase the cost per unit of catch. Fishers will have to sort through more fish to achieve the same catch level. Thus, if selective commercial fisheries follow other selective fisheries there will be two sources of increased cost for commercial fishers: (1) decreased catch rates as a result of reduced abundance of incoming fish, and (2) decreased catch retention rates due to the need to discard unmarked fish. In 1997 there were 719 non-Indian vessels that participated in commercial salmon fisheries inside Puget Sound, 164 vessels that participated inside the Washington coast, and 196 vessels that participated inside the Columbia River (Table 2-13).

2.8.3.7 Effects on Processors and Wholesalers

Processors and wholesalers will be affected by an expanded ocean recreational fishery only if,and to the degree, the commercial harvest is reduced. Reductions in the north of Cape Falcon ocean fisheries would not be allowed. Possible reasons for reductions in other commercial fisheries are discussed above. If selective fisheries are implemented for commercial fisheries there could be some redistribution of harvest between plants and buying stations serving inside harvesters and those serving ocean harvesters. In some cases, the plants serving the ocean and inside fisheries may be the same, in some other cases, the plants serving the fisheries may be different but the buying company the same and in still other cases the shift in geographic locations may result in a shift of some buying and processing activities to completely different firms. Shifts of product between firms may or may not imply shifts of product between communities.

2.8.3.8 Effects on Communities

Communities experience the impacts of changes in fisheries primarily as changes in employment cycles and income flows, along with associated social effects. The proposed selective fishery amendment would increase fishing activity in coastal ports at some possible expense to salmon fishing communities in other locations. Over the last few decades, unemployment rates in the coastal counties north of Cape Falcon have generally exceeded those of metropolitan areas and state wide averages (Table 2-14). Growth in per capita income has also not kept pace with either state average or metropolitan area increases. Estimates of personal income associated with recreational effort and commercial salmon landed in coastal communities have declined substantially in recent years (Table 2-15), as has the size and landings of the commercial fleet (Table 2-16). Personal income is modeled at the county level rather than for smaller geographic communities because (1) it is the level of geographic aggregation at which other demographic data is available, and (2) assumptions regarding the locations of expenditures flowing from the revenue generated by these fisheries begin to break down as smaller geographic areas are considered. To provide a sense of the distribution of fishing impacts for geographic communities on a scale smaller than the county, the primary ports in which the commercial troll vessels are located are shown in Table 2-17 and, where the information is considered nonconfidential, the value of salmon and other species landings by port is shown in Table 2-18. Time series information is not available for the Oregon or Washington charter fleets on a port-by-port basis. As a whole the Washington charter vessel fleet has declined in size substantially since the early 1980s.

Washington charter vessel fleet (number of vessels).

Year	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97
	510	478	415	375	334	288	308	280	281	276	273	267	269	265	260	231	210	209

Almost all charter operations in Westport, Ilwaco, and Astoria participate in the recreational salmon fishery while less than half of those out of Neah Bay participate in this fishery (Table 2-12). In the last three years, roughly one-third of the salmon angler trips out of Ilwaco and Astoria have been on charter vessels, three-fifths of those out of Westport, and less than one-twentieth of those out of La Push and Neah Bay.

As with a selective recreational fishery, a selective ocean troll fishery could increase total harvest revenue and coastal community benefits associated with that revenue. Such coastal community benefits could be at the expense of communities located elsewhere which also have some dependence on salmon fisheries, depending on the effects on inside total commercial harvest, commercial harvest costs and recreational effort.

2.8.3.9 Effects on Future Production

The cost of each additional hatchery fish taken in the ocean would be the value of that fish in its best use, other than the ocean selective fishery in which it is taken (also referred to as "next best use"). The other use would be either harvest in another fishery or as a return to the hatchery. If the fish comes out of hatchery returns and hatchery egg needs are met, the value of the fish to the hatchery and future production, may be very low depending on the market value of the carcasses and surplus eggs.

The cost of each natural fish taken would also be the net benefit of that fish in its next best use. Relative to hatchery fish, which are more often present in excess abundance, there is greater probability that additional spawning escapement of natural fish will contribute to future production.

Effect on natural spawners depends on (1) the degree to which selective ocean fisheries north of Cape Falcon are implemented, (2) adjustments made in fisheries occurring subsequent to the selective ocean fisheries, and (3) opportunities for decreasing impact rate on chinook in the ocean selective fishery and, if needed, management adjustments in other fisheries made in response to increased chinook impacts in the ocean fisheries.

2.8.3.10 Cost-Benefit Summary

The following table summarizes the impacts of selective recreational fishing for hatchery stocks using a qualitative cost-benefit approach. *Italicized text is used to track the flow of effects. Italicized text does not indicate a cost or benefit but indicates an interaction that will have a positive or negative impact in another section of the table.* For the north of Cape Falcon ocean troll fishery and the inside fisheries two summary sections are provided for each (one summary section assuming the respective fishery is implemented as nonselective fishery and one assuming the respective fishery is implemented as selective).

Effects of an expanded north of Cape Falcon recreational fishery selective for marked stocks. (Page 1 of 2)

Parameter	Positive	Negative
	North of Cape Falcon Ocean Recreational Fishery	
Recreational Trips	Increased number of angler trips	-
Experience Value	Some particularly conservation minded anglers may value reduced likelihood of killing critical stocks of natural fish	Decreased retained fish per trip (Table 2-7)
Charter Revenue	More charter vessel trips and likely increase in gross revenue for season	Potential decrease in charter vessel per trip revenue if net change in experience value is negative and substantially affects demand
Resources Used (cost or benefit associated with "resource use" is measured as the effect on other fisheries or spawning escapement): *Decreased per trip impact on natural coho in the recreational fishery (Table 2-7)* *Increased per trip and total consumption of hatchery fish.* *Potential increase in total chinook impacts, if ways cannot be found to reduce impact rates.*		
	North of Cape Falcon Ocean Troll Fishery (assuming nonselective)	
Commercial Value	No direct effect on total allowable catch and hence gross revenue, assuming that the base season is not affected by the anticipation of a selective recreational fishery.	For fisheries subsequent to the selective fishery, decreased catch rate resulting in increased cost per unit of catch
Resources Used (cost or benefit associated with "resource use" is measured as the effect on other fisheries or spawning escapement): *If the troll fishery occurs subsequent to the selective recreational fishery, increased impacts on natural coho per fish caught.*		
	North of Cape Falcon Ocean Troll Fishery (assuming selective)	
Same as for nonselective troll except as follows:		
Commercial Value	Potential increase in total revenues with greater total harvest	Decreased retention rates resulting in increased cost per unit of retained catch.
Resources Used (cost or benefit associated with "resource use" is measured as the effect on other fisheries or spawning escapement): *Decreased impact rate on natural coho per retained fish* *Increased total consumption of hatchery fish.* *Increased total chinook impacts, if ways cannot be found to reduce impact rates.*		
	Inside Fisheries (assuming selective fisheries **are not** implemented for inside fisheries)	
Commercial Value	--	Decreased per fish net profit due to lower catch rates. Possible lower total catch.
Angler Experience Value	--	Lower per trip value due to decreased angler catch rates
Recreational Trips	--	Potential decreased effort due to decreased angler catch rates. Possible decreased fishing opportunity.
Charter Revenue (Primarily Puget Sound and Straits)	--	Potential decreased net revenue due to potential decreased season and potential for decreased daily participation or decreased charter prices due to decreased angler success rates
Resources Used (cost or benefit associated with "resource use" is measured as the effect on other fisheries or spawning escapement): *Increased contact rates with natural stocks*		

Effects of an expanded north of Cape Falcon <u>recreational fishery</u> selective for marked stocks. (Page 2 of 2)

Parameter	Positive	Negative
	Inside Fisheries (assuming selective fisheries **are** implemented for inside fisheries)	
Same as for nonselective inside fisheries except as follows:		
Commercial Value	Potential increase in total harvest and revenues	Decreased retention rates resulting in increased cost per unit of retained catch.
Angler Experience Value	Some particularly conservation minded anglers may value reduced likelihood of killing critical stocks of natural fish. There may be local terminal/in-river fisheries in which natural fish return in greater numbers resulting in increased angler success rates.	Decrease in per trip value due to decreased retained fish per trip
Recreational Trips	Potential increase in total number of angler trips	--
Charter Revenue (Primarily Puget Sound and Straits)	More charter vessel trips and greater gross revenue for season	Potential decrease in charter vessel per vessel trip revenue if net change in experience value is negative and substantially affects demand

Resources Used (cost or benefit associated with "resource use" is measured as the effect on other fisheries or spawning escapement):

Decreased per trip impact on natural coho (i.e. decreased resource cost)–net effect of ocean selective and inside selective is uncertain.

Increased total chinook impacts and impacts on other species, if ways are not found to reduce impact rates.

Other Ocean Fisheries

Note: Potential decreases in seasons and/or catch if:

(a) net effect of selective ocean fisheries and subsequent inside fisheries is to increase impacts on natural coho, or

(b) the expanded selective ocean sport fishery and subsequent fisheries cannot be managed in a way that does not increase impacts on critical chinook stocks.

Effects would depend on how adjustments are made. For example, if impact reductions were necessary, ways might be found to maintain recreational fishing season length with more restrictive limits on what can be retained. The value anglers place on such trips would likely decline with some effect on total effort.

Hatchery Spawners

Returns to hatcheries would most likely be decreased. Lost value from decreased returns depend, in part, on whether egg take goals are met. If goals are met, costs of decreased returns may be minimal, depending on the value of carcasses and surplus eggs.

Natural Spawners

The effect on natural spawners is uncertain and depends on management adjustments made throughout the entire harvest system. Relative to hatchery fish, which are more often present in excess abundance, there is greater probability that additional spawning escapement of natural fish will contribute to future production. Thus, it is more likely that an increase in escapement would be a benefit and any decrease a cost to be included in an assessment of net benefits.

2.8.4 Council Recommendation

The Council adopted and recommends implementation of Option B-8 to allow flexibility in its management options which protect natural and listed salmon stocks while utilizing available harvest of hatchery produced salmon and providing benefits to ocean fishing communities as required by National Standard 8.

The following regulatory changes are necessary to implement Option B-8:

§ 660.408 Annual actions

* * * * *

(c) * * *

(1) * * *

(ii) *Deviations from allocation schedule.* The initial allocation may be modified annually in accordance with paragraphs (c)(1)(iii) through (viii) of this section. . . .

* * *

(v) *Recreational allocation.* The recreational allowable ocean harvest of chinook and coho derived during the preseason allocation process will be distributed among the ~~three~~ four major recreational subareas as described in the coho and chinook distribution sections below. The Council may ~~also establish additional~~ deviate from subarea quotas ~~within a major subarea~~ to (1) meet recreational season objectives based on agreement of representatives of the affected ports and/or (2) in accordance with Section 6.5.3.2 of the *Pacific Coast Salmon Plan* with regard to certain selective fisheries. Additionally, based upon the recommendation of the recreational Salmon Advisory Subpanel representatives for the area north of Cape Falcon, the Council will include criteria in its preseason salmon management recommendations to guide any inseason transfer of coho among the recreational subareas to meet recreational season duration objectives.

* * *

(viii) *Selective Fisheries.* Deviations from the initial gear and port area allocations may be allowed to implement selective fisheries for marked salmon stocks as long as the deviations are within the constraints and process specified in Section 6.5.3.2 of the *Pacific Coast Salmon Plan.*

[Change former viii and ix to ix and x]

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TABLE 2-4. Historic coho catch by area and fishery.

	North of Cape Falcon Recreational Catch					North of Cape Falcon Commercial Coho Catch					
						Ocean		Puget Sound		Columbia River	
	Ocean	Puget Sound	Buoy-10	Columbia Mainstem	Freshwater Washington	NonTreaty	Treaty	NonTreaty	Treaty	NonTreaty	Treaty
1985	198,900	180,300	25,400	10,500	45,800	147,100	88,500	422,000	730,400	190,000	5,200
1986	211,700	253,500	120,400	24,900	41,600	121,100	84,500	493,500	863,600	981,000	16,800
1987	149,200	260,100	47,200	6,900	20,200	62,200	89,600	664,000	1,118,200	165,200	2,300
1988	98,800	204,000	143,400	12,300	22,400	2,200	68,300	459,800	777,700	361,400	5,100
1989	227,300	220,600	78,700	18,500	27,400	78,300	83,900	344,400	621,100	387,300	2,500
1990	240,700	317,200	18,400	10,100	19,100	101,900	94,100	390,900	676,900	66,200	1,000
1991	232,000	252,400	207,100	31,600	62,800	81,200	78,900	196,400	401,800	407,500	6,700
1992	134,100	189,400	43,100	9,000	22,400	19,200	74,300	98,900	300,000	54,100	1,000
1993	139,000	137,000	20,900	6,900	24,800	15,600	61,300	27,700	162,000	35,600	900
1994	0	31,800	1,700	5,700	15,800	0	0	20,000	427,800	60,700	1,000
1995	75,400	74,300	5,100	2,900	25,500	25,400	31,300	24,500	278,300	21,400	300
1996	56,100	85,900	4,500	4,100	n/a	17,500	18,300	20,000	145,300	26,000	100
1997	31,200	130,200	20,400	3,800	n/a	0	14,400	9,600	142,400	20,900	600
Average	138,021	179,672	56,641	11,323	25,224	51,669	60,569	243,977	511,192	213,638	3,346
1985-1991 Base	194,066	241,162	91,517	16,400	34,188	84,857	83,971	424,429	741,386	365,514	5,657
1992-1997	72,636	107,935	15,952	5,400	n/a	12,950	33,267	33,450	242,633	36,450	650
Change	-121,430	-133,228	-75,565	-11,000	n/a	-71,907	-50,705	-390,979	-498,752	-329,064	-5,007
Percent Change	-63%	-55%	-83%	-67%	n/a	-85%	-60%	-92%	-67%	-90%	-89%
1985-1991 Base	--- Same as Above ---										
1994-1997	40,672	80,565	7,925	4,125	n/a	10,725	16,000	18,525	248,450	32,250	500
Change	-153,394	-160,597	-83,593	-12,275	n/a	-74,132	-67,971	-405,904	-492,936	-333,264	-5,157
Percent Change	-79%	-67%	-91%	-75%	n/a	-87%	-81%	-96%	-66%	-91%	-91%
1985-1993 Base	181,288	223,720	78,293	14,522	n/a	69,867	80,378	344,178	627,967	294,256	4,611
1994-1997	40,672	80,565	7,925	4,125	n/a	10,725	16,000	18,525	248,450	32,250	500
Change	-140,616	-143,155	-70,368	-10,397	n/a	-59,142	-64,378	-325,653	-379,517	-262,006	-4,111
Percent Change	-78%	-64%	-90%	-72%	n/a	-85%	-80%	-95%	-60%	-89%	-89%

TABLE 2-5. Measures of economic and social activity in ocean and inside salmon fisheries north of Cape Falcon.

	Recreational Trips (thousands)			Commercial Exvessel Revenue (thousands of dollars[a/])			
	Ocean[b/]	Puget Sound	Buoy-10	Ocean Troll[c/]	Columbia River Gillnet	Washington Inside	Puget Sound
1985	135	882	n/a	2,549	3,188	540	20,552
1986	130	972	102	1,470	9,267	1,523	21,299
1987	119	1,180	125	2,211	11,515	2,907	29,213
1988	75	927	183	2,361	20,019	4,258	21,078
1989	150	1,027	148	1,559	5,307	1,381	21,462
1990	188	1,016	76	1,837	2,873	1,414	19,199
1991	140	924	169	1,334	3,740	2,022	11,700
1992	114	726	115	1,371	911	1,435	7,195
1993	139	809	76	821	581	891	10,664
1994	0	353	9	0	559	753	10,416
1995	62	514	25	119	140	810	3,316
1996	47	n/a	18	61	266	909	1,604
1997	31	n/a	56	110	271	302	5,612
Average	102	848	92	1,216	4,510	1,473	14,101
1985-1991 Base	134	990	134	1,903	7,987	2,006	20,643
1992-1997	66	n/a	50	414	455	850	6,468
Change	-68	n/a	-84	-1,489	-7,532	-1,156	-14,175
Percent Change	-51%	n/a	-63%	-78%	-94%	-58%	-69%
1985-1991 Base			— Same as Above ---				
1994-1997	35	n/a	27	72	309	694	5,237
Change	-99	n/a	-107	-1,831	-7,678	-1,313	-15,406
Percent Change	-74%	n/a	-80%	-96%	-96%	-65%	-75%
1985-1993 Base	132	n/a	124	1,724	6,378	1,819	18,040
1994-1997	35	n/a	27	72	309	694	5,237
Change	-97	n/a	-97	-1,651	-6,069	-1,125	-12,803
Percent Change	-73%	n/a	-78%	-96%	-95%	-62%	-71%

a/ adjusted for inflation.
b/ Excludes 4B add-on fishery.
c/ Includes all 4B fishing.

TABLE 2-6. Spawner escapement goals, 1996 post season escapement estimates, and natural coho stock mortalities for a 1996 base fishery, status quo selective fishery, and equivalent impact selective fishery, assuming 100% marking of all hatchery coho and an 8% hook-and-release mortality rate.

Stock	Number of Mortalities			Spawner Escapement Goal	Postseason Escapement Estimate
	1996 PFMC Nonselective	Status Quo Selective[a/]	Equivalent Impact Selective Fishery[a/]		
Skagit	461	144	456	30,000	8,300
Stillaguamish	650	206	642	17,000	n/a
Hood Canal	337	104	333	21,500	37,100
Strait of Juan de Fuca	78	24	76	11,900	n/a
Quillayute Fall	437	122	440	6,300-15,800	11,009
Hoh	140	39	141	2,000-5,000	4,858
Queets	246	72	245	5,800-14,500	6,530
Grays Harbor	2,526	723	2,504	35,400	63,600
OCN	1,221	337	1,222	42 adults/mile	43 adults/mile
Total OCN HR	12.95%	11.07%	12.64%	(12.5%)[b/]	(8.0%)[c/]

a/ Buoy 10 modeled as selective also.

b/ Preseason target harvest rate (ocean and inside fisheries).

c/ Postseason estimated harvest rate.

TABLE 2-7. Estimates of trips, catch, and impacts for a 1996 base fishery, status quo selective fishery, and equivalent impact selective fishery, assuming 100% marking of all hatchery coho and an 8% hook-and-release mortality rate.

	Trips	Retained Catch	Total Discards	Total Mortality (Marked and Unmarked)	Total Mortality of Unmarked Fish[a/]	Catch Rate Per Trip	Retained Catch Rate Per Trip	Discard Rate Per Fish Handled	Discard Mortality Per Trip	Total Mortality Per Trip[b/]	Unmarked Fish Mortality Per Trip[a/]
Base Fishery											
Neah Bay	12,908	9,173	0	9,632	3,448	0.71	0.71	-	-	0.75	0.27
La Push	1,574	1,616	0	1,697	484	1.03	1.03	-	-	1.08	0.31
Westport	15,505	23,029	0	24,180	6,643	1.49	1.49	-	-	1.56	0.43
Columbia River	24,954	31,125	0	32,681	4,982	1.25	1.25	-	-	1.31	0.20
Total	54,940	64,943	0	68,190	15,557	1.18	1.18	-	-	1.24	0.28
Status Quo Selective Fishery											
Neah Bay	20,216	9,174	5,193	9,589	1,145	0.71	0.45	0.36	0.02	0.49	0.06
La Push	2,250	1,616	695	1,672	147	1.03	0.72	0.30	0.02	0.77	0.07
Westport	21,887	23,029	9,486	23,788	1,992	1.49	1.05	0.29	0.03	1.13	0.09
Columbia River	30,760	31,126	7,255	31,707	1,310	1.25	1.01	0.19	0.02	1.07	0.04
Total	75,115	64,945	22,629	66,756	4,594	1.17	0.86	0.26	0.02	0.92	0.06
Equivalent Impact Selective Fishery											
Neah Bay	58,518	26,393	15,192	27,608	3,356	0.71	0.45	0.37	0.02	0.49	0.06
La Push	7,139	5,090	2,241	5,269	475	1.03	0.71	0.31	0.03	0.76	0.07
Westport	70,391	73,475	31,109	75,964	6,564	1.49	1.04	0.30	0.04	1.12	0.09
Columbia River	113,174	113,705	27,419	115,898	5,008	1.25	1.00	0.19	0.02	1.07	0.04
Total	249,222	218,663	75,961	224,739	15,403	1.18	0.88	0.26	0.02	0.94	0.06

a/ Includes misidentified retained fish, mortality of discarded fish and dropoff mortality.
b/ Includes dropoff mortality, discard mortality and retained fish.

TABLE 2-8. Differences between base, status quo selective and equivalent impact selective fisheries using 1996 conditions, assuming 100% marking of hatchery fish and an 8% hook-and-release mortality.

Port Area	Trips	Retained Catch	Total Discards	Total Mortality (Marked and Unmarked)	Total Mortality (Unmarked)
Change from Status Quo Selective Fishery to Equivalent Impact Selective Fishery					
Neah Bay	38,301	17,219	9,999	18,019	2,211
LaPush	4,889	3,474	1,546	3,597	328
Westport	48,503	50,446	21,623	52,176	4,572
Columbia River	82,414	82,579	20,164	84,191	3,698
Total	174,107	153,718	53,332	157,983	10,809
Ratio of Equivalent Impact Selective to Status Quo Selective Fishery					
Neah Bay	2.89	2.88	2.93	2.88	2.93
LaPush	3.17	3.15	3.22	3.15	3.23
Westport	3.22	3.19	3.28	3.19	3.30
Columbia River	3.68	3.65	3.78	3.66	3.82
Total	3.32	3.37	3.36	3.37	3.35
Change from Status Quo Base (nonselective) to Equivalent Impact Selective Fishery					
Neah Bay	45,610	17,976	15,192	18,435	-92
LaPush	5,565	3,572	2,241	3,653	-9
Westport	54,886	51,784	31,109	52,935	-79
Columbia River	88,221	83,217	27,419	84,773	26
Total	194,282	156,549	75,961	159,796	-154
Ratio of Equivalent Impact Selective to Status Quo Base Fishery					
Neah Bay	4.53	2.87	-	3.01	0.97
LaPush	4.54	3.11	-	3.26	0.98
Westport	4.54	3.14	-	3.30	0.99
Columbia River	4.54	3.55	-	3.72	1.01
Total	4.54	3.30	-	3.46	0.99

TABLE 2-9. Ocean escapement of coho stocks for a 1996 base fishery, status quo selective fishery and equivalent impact selective fishery, assuming 100% marking of all hatchery stock and an 8% hook-and-release mortality.

	Ocean Escapement Estimates			Changes in Ocean Escapement			Changes in Ocean Escapement		
				Status Quo Selective Compared to	Equivalent Impact Selective Compared to		Status Quo Selective Compared to	Equivalent Impact Selective Compared to	
Stocks	Base Fishery (Nonselective)	Status Quo Selective Fishery	Equivalent Impacts Selective Fishery	Base Fishery	Base Fishery	Status Quo Selective	Base Fishery	Base Fishery	Status Quo Selective
Natural Coho Stocks (numbers of coho)							**(percent)**		
Skagit	27,500	27,800	27,300	300	-200	-500	1%	-1%	-2%
Stillaguamish	31,300	31,600	31,000	300	-300	-600	1%	-1%	-2%
Hood Canal	16,500	16,700	16,300	200	-200	-400	1%	-1%	-2%
Strait of Juan de Fuca	3,600	3,600	3,500	0	-100	-100	0%	-3%	-3%
Quillayute Fall	9,200	9,600	9,200	400	0	-400	4%	0%	-4%
Hoh	3,000	3,100	3,000	100	0	-100	3%	0%	-3%
Queets	5,400	5,600	5,400	200	0	-200	4%	0%	-4%
Grays Harbor	82,700	84,500	82,600	1,800	-100	-1,900	2%	-0%	-2%
OCN	53,200	54,200	53,300	1,000	100	-900	2%	0%	-2%
Hatchery Stocks (numbers of coho)							**(percent)**		
Puget Sound	824,500	818,800	772,400	-5,700	-52,100	-46,400	-1%	-6%	-6%
N. WA coast	40,800	40,200	34,700	-600	-6,100	-5,500	-1%	-15%	-14%
Grays Harbor	65,100	64,500	58,700	-600	-6,400	-5,800	-1%	-10%	-9%
Willapa	61,200	60,000	50,600	-1,200	-10,600	-9,400	-2%	-17%	-16%
Columbia Early	99,800	95,100	47,500	-4,700	-52,300	-47,600	-5%	-52%	-50%
Columbia Late	78,600	74,800	39,300	-3,800	-39,300	-35,500	-5%	-50%	-47%
Oregon Coast	35,700	35,400	32,800	-300	-2,900	-2,600	-1%	-8%	-7%
Rogue/Klamath	9,100	9,100	9,100	0	0	0	0%	0%	0%

TABLE 2-10. Natural stock mortalities in the north of Cape Falcon ocean sport fisheries if the fishery is managed for an 8% hook-and-release mortality but actual hook-and-release mortality is 16%.[a/]

Stock	Number of Mortalities			Difference compared to the projections for 8% hooking mortality		
	Base Fishery (Nonselective)	Status Quo Selective Fishery	Equivalent Impacts Selective Fishery	Base Fishery (nonselective)	Status Quo Selective Fishery	Equivalent Impacts Selective Fishery
Skagit	461	188	600	0	44	144
Stillaguamish	650	268	845	0	62	203
Hood Canal	337	135	439	0	31	106
Strait of Juan de Fuca	78	32	102	0	8	26
Quillayute Fall	437	161	581	0	39	141
Hoh	140	52	186	0	13	45
Queets	246	96	322	0	24	77
Grays Harbor	2,526	957	3312	0	234	808
OCN	1,221	446	1616	0	109	394
Total OCN HR	12.95%	11.29%	13.34%	0.00%	0.22%	0.70%

a/ Buoy 10 modeled as selective also. Hook-and-release mortality was set at 16% using the season structures developed assuming an 8% hook-and-release mortality. To maintain a neutral effect on natural stocks in the ocean sport fishery for a 16% hook-and-release mortality, catches should be about 75% lower than the level modeled using 8%.

TABLE 2-11. Ocean escapement if the north of Cape Falcon ocean sport selective fishery is managed for an 8% hooking mortality but actual hook-and-release mortality is 16%.[a/]

Stock	Ocean Escapement at 16% Hook-and-Release Mortality			Difference Compared to Projection (Number of Fish)			Difference Compared to Projection (Percent Difference)		
	Base Fishery (nonselective)	Status Quo Selective Fishery	Equivalent Impacts Selective Fishery	Base Fishery (nonselective)	Status Quo Selective Fishery	Equivalent Impacts Selective Fishery	Base Fishery (nonselective)	Status Quo Selective Fishery	Equivalent Impacts Selective Fishery
Natural Coho Stocks									
Skagit	27,500	27,700	27,200	0	-100	-100	0.0%	-0.4%	-0.4%
Stillaguamish	31,300	31,600	30,900	0	0	-100	0.0%	0.0%	-0.3%
Hood Canal	16,500	16,600	16,200	0	-100	-100	0.0%	-0.6%	-0.6%
Strait of Juan de Fuca	3,600	3,600	3,500	0	0	0	0.0%	0.0%	0.0%
Quillayute Fall	9,200	9,500	9,100	0	-100	-100	0.0%	-1.0%	-1.1%
Hoh	3,000	3,000	2,900	0	-100	-100	0.0%	-3.2%	-3.3%
Queets	5,400	5,600	5,300	0	0	-100	0.0%	0.0%	-1.9%
Grays Harbor	82,700	84,300	81,800	0	-200	-800	0.0%	-0.2%	-1.0%
OCN	53,200	54,100	52,900	0	-100	-400	0.0%	-0.2%	-0.8%
Hatchery Coho Stocks									
Puget Sound	824,500	818,700	772,200	0	-100	-200	0.0%	-0.0%	-0.0%
N. WA coast	40,800	40,200	34,600	0	0	-100	0.0%	0.0%	-0.3%
Grays Harbor	65,100	64,500	58,700	0	0	0	0.0%	0.0%	0.0%
Willapa	61,200	60,000	50,500	0	0	-100	0.0%	0.0%	-0.2%
Columbia Early	99,800	95,000	47,200	0	-100	-300	0.0%	-0.1%	-0.6%
Columbia Late	78,600	74,700	39,100	0	-100	-200	0.0%	-0.1%	-0.5%
Or Coast	35,700	35,400	32,800	0	0	0	0.0%	0.0%	0.0%
Rogue/Klamath	9,100	9,100	9,100	0	0	0	0.0%	0.0%	0.0%

a/ Buoy 10 modeled as selective also. Hooking mortality was set at 16% using the season structures developed assuming an 8% hooking mortality.

TABLE 2-12. Charter and private effort by port (thousands of trips) and number of charter vessels.

	Neah Bay			LaPush			Westport			Ilwaco			Astoria		
	Private	Charter	Total	Private	Charter	Total	Private	Charter	Total	Private	Charter	Total	Private	Charter	Total
1984	8.3	0.3	8.6	0.2	0.0	0.2	2.3	11.6	13.9	36.0	18.0	54.0	4.4	2.7	7.1
1985	15.2	2.0	17.2	1.5	0.0	1.5	13.7	42.2	55.9	19.4	20.7	40.1	11.7	8.3	20.0
1986	17.4	2.4	19.8	1.7	0.0	1.7	14.8	36.6	51.4	17.5	19.1	36.6	12.8	7.7	20.5
1987	17.9	1.9	19.8	2.0	0.0	2.0	9.8	34.1	43.9	18.6	17.7	36.3	9.1	8.0	17.1
1988	14.8	2.0	16.8	2.8	0.0	2.8	13.9	23.5	37.4	5.6	6.9	12.5	3.2	2.4	5.6
1989	15.0	1.5	16.5	1.6	0.0	1.6	18.7	40.8	59.5	30.6	16.2	46.8	10.7	9.1	19.8
1990	19.5	2.1	21.6	4.2	0.0	4.2	25.9	43.4	69.3	44.8	19.5	64.3	17.0	8.5	25.5
1991	14.8	1.4	16.2	3.3	0.2	3.5	24.2	28.6	52.8	27.3	13.5	40.8	13.6	8.1	21.7
1992	11.0	0.7	11.7	2.3	0.2	2.5	25.6	28.1	53.7	17.9	9.2	27.1	8.3	4.6	12.9
1993	18.4	1.0	19.4	2.8	0.1	2.9	23.5	27.4	50.9	24.2	11.7	35.9	12.7	5.8	18.5
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	5.3	0.2	5.5	1.4	0.1	1.5	9.0	12.7	21.7	14.2	5.0	19.2	7.2	2.5	9.7
1996	9.1	0.2	9.3	1.3	0.0	1.3	5.2	10.3	15.5	7.9	4.8	12.7	3.7	1.9	5.6
1997	2.8	0.1	2.9	0.9	0.1	0.9	7.3	10.0	17.3	4.1	2.4	6.5	2.3	1.3	3.6
# Salmon Charters a/	6			0			31			20			13		
All Charters	16			0			33			20			13		

a/ Number of charter vessels in 1995-1996 for Washington ports and in 1998 for Astoria.

TABLE 2-13. Number of commercial non-Indian salmon vessels by fishery area.[a/b/]

Year	Inside Fisheries			Ocean Fisheries[c/]	
	Puget Sound	Washington Coast	Columbia River	North of Cape Falcon	All Ocean Fisheries
1981	1,868	366	825	2,812	9,037
1982	1,812	370	806	2,464	8,539
1983	1,746	328	746	2,224	7,492
1984	1,532	289	750	572	3,447
1985	1,645	251	621	1,713	5,379
1986	1,519	234	669	1,618	5,665
1987	1,567	302	755	1,032	4,920
1988	1,619	315	856	684	4,710
1989	1,514	258	695	1,009	4,921
1990	1,482	266	640	1,024	4,216
1991	1,392	265	655	1,056	3,601
1992	1,241	273	519	678	2,261
1993	1,277	273	463	521	2,226
1994	1,024	218	390	-	1,346
1995	809	189	227	93	1,683
1996	518	196	230	86	1,477
1997	719	164	196	57	1,286

a/ Based on PacFIN annual vessel summary files.

b/ Counts for all species of salmon.

c/ Values differ from those in Table 2-16 due to differences between catch area and landing areas and the exclusion of unknown ocean catch areas from the "all ocean fisheries" total in this table.

TABLE 2-14. General economic and demographic data, by county of port.

	Port Areas/County				Areas for Comparison: Metropolitan Areas			Changes Compared to 1976						
	Neah Bay La Push	Westport	Ilwaco	Astoria	Seattle	Portland	State							
	Clallam	Grays Harbor	Pacific	Clatsop	King	Multnomah	Washington	Clallam	Grays Harbor	Pacific	Clatsop	King	Mult.	WA
							Population							
1976	43,100	60,200	16,100	29,814	1,155,900	547,381	3,634,900							
1986	52,800	62,700	17,700	32,900	1,376,100	566,200	4,462,200	22.5%	4.2%	9.9%	10.4%	19.1%	3.4%	22.8%
1995	63,600	67,700	20,800	34,300	1,613,600	626,500	5,429,900	47.6%	12.5%	29.2%	15.0%	39.6%	14.5%	49.4%
1996	65,000	68,200	21,100	34,600	1,628,801	636,000	5,516,800	50.8%	13.3%	31.1%	16.1%	40.9%	16.2%	51.8%
1997	66,400	68,300	21,300	34,500	1,646,201	639,000	5,606,800	54.1%	13.5%	32.3%	15.7%	42.4%	16.7%	54.2%
							Employment							
1976	15,980	24,120	5,950	12,190			1,621,000							
1986	20,160	22,810	6,090	15,550	715,800	308,390	2,198,000	26%	-5%	2%	28%	n/a	n/a	36%
1995	22,020	24,660	7,420	16,380	874,800	348,980	2,810,000	38%	2%	25%	34%	n/a	n/a	73%
1996	22,020	24,320	7,380	16,410	899,900	361,550	2,880,000	38%	1%	24%	35%	n/a	n/a	78%
1997	22,600	25,160	7,650	16,420	969,200	367,200	2,988,000	41%	4%	29%	35%	n/a	n/a	84%
							Unemployment Rate							
1976	9.1%	8.0%	9.7%	9.3%	n/a	n/a	8.6%							
1986	9.8%	12.6%	12.5%	8.5%	6.2%	8.5%	8.2%							
1995	8.6%	10.8%	9.7%	5.0%	5.2%	4.1%	6.4%							
1996	9.7%	11.8%	10.5%	6.3%	4.9%	5.2%	6.5%							
1997	7.9%	9.3%	9.0%	6.8%	3.3%	4.9%	4.8%							
							Personal Income ($ millions)							
1976	290	401	103	197	9,501	4,350	26,259							
1986	731	806	223	444	26,256	8,858	68,196	152%	101%	117%	125%	176%	104%	160%
1995	1,280	1,234	363	689	51,426	15,965	130,319	341%	208%	252%	250%	441%	267%	396%
1996	1,350	1,279	380	723	55,568	17,071	139,515	366%	219%	269%	267%	485%	292%	431%
							Per Capita Income ($)							
1976	6,606	6,480	6,312	6,622	8,136	7,947	7,115							
1986	13,871	12,929	12,555	13,762	19,062	15,638	15,316	110%	100%	99%	108%	134%	97%	115%
1995	20,520	18,335	17,458	19,472	32,205	25,955	23,974	211%	183%	177%	194%	296%	227%	237%
1996	21,315	18,884	18,116	20,476	34,440	27,481	25,277	223%	191%	187%	209%	323%	246%	255%

TABLE 2-15. Coastal county-level income impacts associated with ocean salmon fisheries ($ thousands).[a/]

	Neah Bay	La Push	Westport	Ilwaco	Astoria
		Commercial			
1976-1980	4,962	6,779	14,953	4,811	3,437
1980-1985	969	392	4,079	875	1,104
1986-1990	526	139	1,847	360	502
1990-1995	382	84	607	39	69
1991	645	201	1,234	46	91
1992	438	131	712	10	39
1993	0	0	0	0	1
1994	124	27	29	0	21
1996	63	2	64	2	55
1997	49	1	138	0	9
		Recreational			
1976-1980	2,134	1,128	12,251	4,842	2,918
1980-1985	1,946	229	8,476	3,936	1,660
1986-1990	830	95	3,969	2,140	1,136
1990-1995	441	86	2,450	1,242	758
1991	486	107	3,624	1,393	795
1992	798	117	3,476	1,823	1,095
1993	0	0	0	0	0
1994	222	63	1,536	916	544
1996	372	50	1,160	675	340
1997	117	40	1,218	343	223
		Total			
1976-1980	7,109	7,925	27,245	9,666	6,364
1980-1985	2,917	622	12,565	4,813	2,767
1986-1990	1,357	234	5,821	2,501	1,640
1990-1995	824	171	3,059	1,282	828
1991	1,134	308	4,861	1,439	886
1992	1,238	249	4,189	1,833	1,134
1993	0	0	0	0	1
1994	347	90	1,565	916	565
1996	435	52	1,224	677	395
1997	166	41	1,357	343	231

a/ Estimates from annual salmon review (STT 1998).

TABLE 2-16. Numbers of non-Indian vessels landing, total non-Indian revenue and nonIndian ocean salmon revenue by county, for vessels with valid identification numbers for the north of Cape Falcon area.[a/b/]

		Number of Vessels Landing[c/]						Vessel's Primary Port of Landing[d/]						Exvessel Revenue ($ thousands)					
		All Vessels			Ocean Salmon Vessels			All Species			Ocean Salmon			All Species			Salmon[e/]		
Region	County	1988	1989	1997	1988	1989	1997	1988	1989	1997	1988	1989	1997	1988	1989	1997	1988	1989	1997
St. of Geo.	Whatcom	1,496	1,436	806	1	25	0	804	762	563	0	19	0	23,513	24,256	18,178	conf	89	0
San Juan	San Juan	322	197	23	11	2	0	78	59	3	2	1	0	1,311	758	42	20	conf	0
	Skagit	1,078	856	276	38	3	0	350	312	136	17	2	0	5,887	5,718	2,799	364	conf	0
Metro Puget Sound	Snohomish	806	790	173	178	166	0	189	219	64	52	73	0	5,501	5,948	1,461	115	54	0
	King	1,516	1,186	318	180	50	2	558	493	127	48	22	2	11,015	9,822	8,103	416	73	conf
	Pierce	223	267	142	6	14	0	85	106	60	1	10	0	1,363	1,765	1,835	conf	3	0
South Puget Sound	Thurston	36	27	5	17	6	0	10	13	2	2	5	0	23	24	conf	8	conf	0
	Mason	44	75	7	0	1	0	20	12	4	0	1	0	62	75	38	0	conf	0
NE Olympic & Kitsap Peninsulas	Jefferson	308	307	90	19	14	0	92	74	40	12	6	0	1,328	1,416	1,779	141	61	0
NW Olympic Peninsula	Clallam	842	993	272	162	271	25	341	536	145	77	203	20	3,795	4,535	3,451	413	314	48
Cntrl WA Coast	Grays Harbor	776	803	369	351	457	26	371	521	258	175	334	23	20,943	16,780	20,456	662	651	70
S. WA Coast & Col R.	Pacific	1,000	887	342	224	194	0	604	622	253	81	125	0	25,366	18,704	9,863	200	156	0
OR Col. Upriver	Not Identified	700	536	192	0	0	0	483	395	158	0	0	0	13,560	3,300	558	0	0	0
Astoria	Clatsop	295	374	246	91	185	5	131	162	155	32	63	2	17,559	19,626	22,489	137	261	conf

a/ Based on PacFIN annual vessel summary files.
b/ Revenue is not reported where less than 10 vessels made landings in a county, indicated as "conf".
c/ Values differ from those in Table 2-12 due to differences between catch area and landing areas and the inclusion of unknown ocean catch areas from the "all ocean fisheries" total in this table.
d/ The primary port is the port where a majority of the value of all landings were made. Primary ports were assigned based on all species and on ocean caught salmon landings of chinook, pink and coho salmon.
e/ Ocean caught, chinook, coho and pink salmon only.

TABLE 2-17. Number of vessels by species group and primary port--1997 and 1998 (vessels are only counted under a species group if more than 1% of their deliveries were for a particular species, vessels may appear in more than one column for a particular year). Page 46 of 2a/

	California Halibut		Council Groundfish		Council Salmon		Cstl Pel Species-Finfish		Cstl Pel Species-Squid		Dungeness Crab		Groundfish		Lobster		Mollusks		Other Crab		Other Species		Pacific Halibut		Salmon		Sea Cucumbers		Sea Urchins		Shrimp and Prawns		Swdfsh & Hly Mig Shks		Tuna Albacore		Tuna Tropical	
	'97	'98	'97	'98	'97	'98	'97	'98	'97	'98	'97	'98	'97	'98	'97	'98	'97	'98	'97	'98	'97	'98	'97	'98	'97	'98	'97	'98	'97	'98	'97	'98	'97	'98	'97	'98	'97	'98
Washington																																						
Blaine				1							62	52	22	19							10	11		1	115	88	11	3								1		
Bellingham			15	15							46	54	63	57			1				15	10	36	52	279	190			3		1	3				1		
Point Roberts																																						
Friday Harbor											1	1													1	1		2	1	2		1						
Deer Harbor																									1	1												
Anacortes											53	53	8								3				49	6	9	8	9		6	5				2		
LaConner											3	4											2	2	21	19					2	3						
Coupeville													1	1											2	3		1										
Whidbey Island																									1	2												
Everett				3								1	1	4								1	5	5	57	27				2	2	1						
Seattle			14	3	2						33	19	23	9			1					1	31	20	48	50		2			5	4			4	5		
Tacoma											1						1	1			10	1			18	18	17	13	20	19								
Olympia			1										1												1	1		1										
Shelton																					3	3																
Centralia																																						
Port Townsend			1								8	7	1				1	1							12	7	9	5	1	4	4	4			1	1		
Poulsbo											1	1												1				1										
Bremmerton																															1	1						
Sequim											12	15																1			1							
Port Angeles			3	2	1	1					1	2	4	2							1				30	14	4	2	10	9		2			1			
Neah Bay			49	34	15	11						1	49	34							17	14	10	5	15	11	2	2										
La Push			17	16	1						7	7	17	16							1				1		1								4	1		
Taholah																					1				3													
Aberdeen			1					1			2	5	1									1			1						1	2						
Hoquiam																					4				4													
Westport (WA)			69	51	23	11	1				122	108	69	52							32	11	12	4	48	17					17	22			86	28		
Grayland																					4	7			7	16												
Tokeland											4	4									3	5			3	7									1			
Raymond																					8				15													
South Bend			1	1							4	3	1	1							6	9			11	28					3	3			1	2		
Bay Center											9	6									27	28			39	34					4	1						
Naselle																					1				4	1												
Nahcotta																					2	1			2	1												
Long Beach																					1	1			2	1						1						
Ilwaco			9	4			1				34	29	9	5							9	6	5	2	11	3					1	2			70	102		
Chinook			3	1							15	12	3	1							10	9		3	7	8					1					2		

TABLE 2-17. Number of vessels by species group and primary port--1997 and 1998 (vessels are only counted under a species group if more than 1% of their deliveries were for a particular species, vessels may appear in more than one column for a particular year). Page 47 of 2[a]

	California Halibut		Council Groundfish		Council Salmon		Cstl Pel Species-Finfish		Cstl Pel Species-Squid		Dungeness Crab		Groundfish		Lobster		Mollusks		Other Crab	
	'97	'98	'97	'98	'97	'98	'97	'98	'97	'98	'97	'98	'97	'98	'97	'98	'97	'98	'97	'98
Skamokawa																				
Kalama																				
Longview																				
Camas											4	3								
The Dalles																				
Washington Total			183	131	42	23	2	1			422	387	273	201			4	2		
Oregon																				
ColumbiaRiver																				
Astoria			72	64	3						68	58	73	65			1	2	1	
Cannon Beach																				
Nehalem Bay												1								
Garibaldi (Tillamook)			23	21	52	48					21	17	23	21			2	2		
Netarts																				
Pacific City			22	21	7	4					4	4	22	21						
Siletz Bay																				
Depoe Bay			2	3	7	4					6	6	2	3						
Newport			145	127	157	142		4			78	72	145	127			1		2	
Waldport												4								
Florence			16	17	22	21					5	7	16	17						
Winchester			6	6	22	16					16	15	6	6						
Charleston (Coos Bay)			94	82	60	53			4		44	44	94	82						
Bandon			2	1	2	5					1	3	2	1						
Port Orford			54	45	14	12					30	30	54	45						
Gold Beach			4	3									4	3						
Brookings	1	1	44	52	26	19					42	46	44	52						
Oregon Total	1	1	484	442	372	324		4	4		315	307	485	443			4	4	3	

	Other Species		Pacific Halibut		Salmon		Sea Cucumbers		Sea Urchins		Shrimp and Prawns		Swdfsh & Hly Mig Shks		Tuna Albacore		Tuna Tropical	
	'97	'98	'97	'98	'97	'98	'97	'98	'97	'98	'97	'98	'97	'98	'97	'98	'97	'98
Skamokawa																		
Kalama	5	11			5	5												
Longview		1																
Camas																		
The Dalles	2	1			2	1												
Washington Total	175	132	101	95	815	560	53	41	44	36	49	55			168	145		
Oregon																		
ColumbiaRiver	115	103			147	127												
Astoria	25	15	10	9	3						19	20	1	1	71	58	1	1
Cannon Beach																		
Nehalem Bay																		
Garibaldi (Tillamook)	1	1	13	16	52	48					4	3			20	15		
Netarts																		
Pacific City			1	1	7	4									3	2		
Siletz Bay																		
Depoe Bay			2		7	4			1	1					1	1		
Newport	10	4	76	63	157	142					18	26	1	2	131	81		1
Waldport																		
Florence	1		9	12	22	21								1	7	7		
Winchester		1	2	2	22	16									7	12		
Charleston (Coos Bay)	14	12	22	12	60	53				1	30	21			45	48		
Bandon			1	2	2	5									2	4		
Port Orford	11	24	11	1	14	12	1		11	7					10	6		
Gold Beach	1	1		1					3	2						1		
Brookings	8	11			26	19				3	16	13			32	14		
Oregon Total	186	172	147	119	519	451	1		15	14	87	83	2	4	329	249	1	2

a/ Ports with no vessels for 1997 or 1998 had vessels for which the port was a primary port in 1994, 1995, or 1996.

TABLE 2-18. Exvessel value (1997, 1998) and number of reported buyers (not adjusted for inflation). [a/] (Page 1 of 3)

Port	Number of Buyers	Grndfish (not Whtg)	Whiting	Salmon	Cstl Pel Spp--Finfish	Cstl Pel Spp--Squid	Pacific Halibut	California Halibut	Hly Mig Shks& Swdf	Albacore Tuna	Tropical Tuna	Herring	Shrimp & Prawns	Dungeness Crab	Other Crab	Lobster	Sea Cucumbers	Sea Urchins	Mollusks	Other Species	Tot ExVes Value	Percent Council Managed: Groundfish (w/wht)	Percent Council Managed: Salmon	% Native American
1997																								
Blaine	9	166	b/	1,595	-	-	-	-	-	-	-	b/	-	3,427	-	-	b/	b/	-	39	5,366	0.01	0.00	0.42
Bellingham	38	2,126	b/	5,417	-	-	62	-	b/	-	-	-	153	3,494	-	-	-	b/	396	61	11,744	0.97	0.00	0.46
Friday Harbor	7	-	-	3	-	-	-	-	-	-	-	-	13	22	-	-	-	20	b/	-	57 c/	-	0.00	b/
Anacortes	17	b/	-	336	-	b/	-	-	-	-	-	-	67	1,576	-	-	b/	83	b/	b/	2,462	b/	0.00	0.09
LaConner	11	-	-	361	-	-	-	-	-	-	-	-	81	760	-	-	-	-	b/	b/	1,202 c/	-	0.00	0.79
Everett	16	b/	-	1,670	-	-	-	-	-	-	-	-	54	68	-	-	-	b/	b/	-	1,877	b/	0.00	0.65
Seattle	44	1,103	-	1,136	-	-	-	-	-	48	-	15	337	2,476	-	-	b/	-	2,309	b/	7,442	1.00	0.01	0.55
Tacoma	28	-	-	210	-	-	-	-	-	-	-	216	-	b/	-	-	203	457	2,076	b/	3,297	-	0.00	0.29
Olympia	10	b/	-	26	-	-	-	-	-	-	-	-	-	b/	-	-	-	b/	531	b/	559	b/	0.00	0.99
Shelton	14	-	-	421	-	-	-	-	-	-	-	b/	b/	30	-	-	b/	-	3,484	b/	3,985	-	0.00	0.99
Port Townsend	16	b/	-	202	-	-	-	-	-	b/	-	b/	394	509	-	-	b/	99	3,580	b/	4,937	b/	0.00	0.55
Poulsbo	9	-	-	22	-	-	-	-	-	-	-	b/	b/	575	-	-	-	-	2,124	-	2,733	-	0.00	0.56
Bremmerton	10	b/	-	4	-	-	-	-	-	-	-	-	b/	b/	-	-	-	-	301	-	328	b/	0.00	0.63
Port Angeles	29	331	-	218	-	-	b/	-	-	b/	-	-	15	96	-	-	b/	396	506	2	1,641	1.00	0.12	0.64
Neah Bay	4	2,959	-	b/	-	-	b/	-	-	-	-	-	b/	b/	-	-	b/	b/	b/	362	4,252	1.00	b/	0.56
La Push	9	408	-	39	-	-	b/	-	-	b/	-	b/	-	b/	-	-	b/	-	b/	b/	2,001	1.00	0.01	0.67
Taholah	2	b/	-	b/	-	-	b/	-	-	b/	-	-	-	b/	-	-	-	-	-	b/	0 c/	b/	b/	b/
Aberdeen	6	b/	-	b/	-	-	-	-	-	b/	-	-	136	b/	-	-	-	-	-	b/	694	b/	b/	b/
Westport (WA)	21	3,676	b/	146	b/	b/	21	-	b/	2,474	-	b/	1,607	10,989	-	-	-	-	b/	104	19,686	1.00	0.58	0.00
Tokeland	4	-	-	14	-	-	-	-	-	b/	-	-	b/	309	-	-	-	-	b/	b/	355	-	0.00	-
South Bend	7	b/	-	26	-	-	-	-	-	b/	-	-	120	82	-	-	-	-	-	1	236	b/	0.00	-
Bay Center	5	-	-	b/	-	-	-	-	-	-	-	-	b/	b/	-	-	-	-	b/	b/	509	-	b/	-
Long Beach	4	b/	-	b/	-	-	-	-	-	b/	-	-	b/	-	-	-	-	-	b/	b/	92	b/	b/	b/
Ilwaco	8	b/	b/	33	b/	b/	b/	-	b/	3,732	-	-	b/	2,046	-	-	-	-	-	25	6,550	b/	0.00	-
Chinook	6	b/	-	20	-	-	b/	-	-	b/	-	b/	b/	1,306	-	-	-	-	-	19	1,792	b/	0.00	b/
Columbia River	22	b/	-	304	-	-	-	-	-	-	-	64	-	-	-	-	-	-	-	349	716 c/	b/	0.00	0.17
Astoria	17	8,683	3,426	b/	1	1	44	-	4	3,204	b/	0	1,475	5,130	b/	-	-	-	b/	189	22,172	1.00	b/	-
Gearhart-Seaside	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	-	7	-	-	-
Garibaldi (Tillamook)	24	119	b/	59	-	-	41	-	-	219	-	-	b/	580	b/	-	-	-	30	5	1,525	1.00	1.00	-
Pacific City	8	44	-	2	-	-	b/	-	-	4	-	-	b/	b/	-	-	-	-	-	b/	61	1.00	1.00	-
Depoe Bay	10	22	-	7	-	-	2	-	-	b/	-	-	-	126	-	-	-	b/	-	b/	181	1.00	1.00	-
Newport	63	6,769	3,388	1,639	1	1	143	-	46	3,094	b/	79	1,938	3,767	46	-	-	b/	3	127	21,045	1.00	1.00	-

TABLE 2-18. Exvessel value (1997, 1998) and number of reported buyers (not adjusted for inflation). [a/] (Page 2 of 3)

																						Percent Council Managed		
Port	Number of Buyers	Grndfish (not Whtg)	Whiting	Salmon	Cstl Pel Spp--Finfish	Cstl Pel Spp--Squid	Pacific Halibut	California Halibut	Hly Mig Shks& Swdf	Albacore Tuna	Tropical Tuna	Herring	Shrimp & Prawns	Dungeness Crab	Other Crab	Lobster	Sea Cucumbers	Sea Urchins	Mollusks	Other Species	Tot ExVes Value	Groundfish (w/wht)	Salmon	% Native American
Florence	20	211	-	140	-	-	16	b/	-	26	-	-	6	401	b/	-	-	-	b/	b/	802	1.00	1.00	-
Winchester	18	157	-	41	-	-	22	-	-	84	-	b/	b/	716	b/	-	-	-	b/	0	1,021	1.00	1.00	-
Charleston (Coos Bay)	33	7,290	8	417	1	48	60	b/	b/	523	b/	-	2,142	1,460	b/	-	-	-	b/	83	12,034	1.00	1.00	-
Bandon	5	b/	-	b/	-	-	b/	-	-	6	-	-	-	b/	-	-	-	-	b/	-	28	b/	b/	-
Port Orford	9	1,729	-	48	b/	-	25	-	b/	51	-	-	b/	589	-	-	b/	b/	-	46	2,676	1.00	1.00	-
Gold Beach	8	25	-	b/	-	-	-	-	-	b/	-	-	-	30	-	-	-	b/	-	2	107	1.00	b/	-
Brookings	22	1,857	-	89	-	-	b/	b/	b/	125	-	-	2,180	1,816	-	-	-	b/	-	28	6,116	1.00	1.00	-
1998																								
Blaine	9	b/	b/	1,036	-	-	b/	-	-	b/	-	-	-	1,878	-	-	b/	-	-	35	3,513	b/	0.00	0.29
Bellingham	34	1,665	b/	2,811	-	-	21	-	-	b/	-	-	131	4,267	-	-	b/	-	387	62	9,480	0.97	0.00	0.51
Friday Harbor	5	-	-	4	-	-	-	-	-	-	-	-	b/	58	-	-	b/	b/	-	b/	94	-	0.00	0.47
Anacortes	16	b/	-	25	-	-	b/	-	-	b/	-	b/	78	1,036	-	-	b/	38	b/	-	1,370	b/	0.00	0.13
LaConner	22	b/	-	264	-	-	-	-	-	b/	-	-	40	684	-	-	b/	-	b/	b/	1,040	b/	0.00	0.82
Everett	13	b/	-	933	-	-	-	-	-	-	-	-	53	282	-	-	-	b/	b/	-	1,462	b/	0.00	0.55
Seattle	54	126	-	716	-	-	b/	-	-	87	-	b/	304	1,684	-	-	b/	b/	2,033	b/	5,019	1.00	0.00	0.48
Tacoma	22	b/	-	516	-	-	-	-	-	-	-	240	-	-	-	-	b/	314	2,789	b/	4,023	b/	0.00	0.36
Olympia	9	-	-	45	-	-	-	-	-	-	-	-	-	b/	-	-	b/	-	871	-	916 [c/]	-	0.02	0.97
Shelton	20	-	-	828	-	-	-	-	-	-	-	b/	b/	36	-	-	b/	-	2,866	b/	3,792	-	0.00	0.99
Port Townsend	15	-	-	179	-	-	b/	-	-	b/	-	b/	490	385	-	-	b/	b/	1,570	-	2,899	-	0.00	0.58
Poulsbo	11	-	-	36	-	-	b/	-	-	-	-	-	b/	316	-	-	b/	-	1,801	-	2,226	-	0.00	0.60
Bremmerton	6	-	-	b/	-	-	-	-	-	-	-	-	b/	-	-	-	-	-	2,043	-	2,043 [c/]	-	b/	0.83
Port Angeles	34	137	-	572	-	b/	79	-	-	b/	-	-	35	833	-	-	b/	200	407	8	2,312	0.99	0.15	0.80
Neah Bay	8	1,573	-	468	-	-	b/	-	-	b/	-	-	-	132	-	-	b/	b/	-	279	2,834	0.99	0.46	0.45
La Push	5	b/	-	86	-	-	b/	-	-	b/	-	b/	-	b/	-	-	-	-	-	b/	865	b/	0.00	0.54
Taholah	3	b/	-	b/	-	-	b/	-	-	b/	-	b/	-	b/	-	-	-	-	-	b/	1,855	b/	b/	b/
Aberdeen	6	b/	-	b/	b/	-	-	-	-	b/	-	-	124	b/	-	-	-	-	b/	b/	554	b/	b/	b/
Westport (WA)	30	1,916	b/	58	b/	b/	11	-	b/	816	-	b/	939	8,215	-	-	-	-	b/	79	12,539	1.00	0.76	0.00
Tokeland	5	-	-	19	-	-	-	-	-	b/	-	-	b/	218	-	-	-	-	-	1	238 [c/]	-	0.00	b/
South Bend	6	b/	-	59	-	-	-	-	-	b/	-	-	b/	85	-	-	-	-	-	1	239	b/	0.00	-
Bay Center	2	-	-	b/	-	-	-	-	-	-	-	-	b/	b/	-	-	-	-	b/	b/	0 [c/]	-	b/	b/
Long Beach	5	-	-	b/	-	-	-	-	-	b/	-	-	b/	b/	-	-	-	-	b/	b/	164	-	b/	b/
Ilwaco	13	b/	b/	7	b/	b/	13	-	b/	7,280	-	b/	b/	1,576	-	-	-	-	-	20	9,514	b/	0.01	b/

TABLE 2-18. Exvessel value (1997, 1998) and number of reported buyers (not adjusted for inflation). [a] (Page 3 of 3)

Port	Number of Buyers	Grndfish (not Whtg)	Whiting	Salmon	Cstl Pel Spp--Finfish	Cstl Pel Spp--Squid	Pacific Halibut	California Halibut	Hly Mig Shks& Swdf	Albacore Tuna	Tropical Tuna	Herring	Shrimp & Prawns	Dungeness Crab	Other Crab	Lobster	Sea Cucumbers	Sea Urchins	Mollusks	Other Species	Tot ExVes Value	Percent Council Managed: Groundfish (w/wht)	Percent Council Managed: Salmon	% Native American
Chinook	6	b/	-	15	-	-	8	-	-	19	-	-	b/	877	-	-	-	-	-	29	1,013	b/	0.00	-
Columbia River	19	-	-	293	-	-	-	-	-	-	-	19	-	-	-	-	-	-	-	350	661	-	0.00	0.12
Astoria	26	7,126	1,608	b/	2	0	38	-	110	4,195	b/	0	1,188	3,346	-	-	-	-	b/	100	17,737	1.00	b/	-
Gearhart-Seaside	4	-	-	-	-	-	-	-	-	b/	-	-	b/	-	-	-	-	-	b/	-	10	-	-	-
Garibaldi (Tillamook)	25	67	-	118	-	-	35	-	-	154	-	-	b/	291	-	-	-	-	20	2	687 [c]	1.00	1.00	-
Pacific City	10	41	-	b/	-	-	b/	-	-	3	-	-	b/	22	-	-	-	-	-	b/	69	1.00	b/	-
Depoe Bay	14	10	-	3	-	-	5	-	-	b/	-	-	-	60	-	-	-	b/	-	b/	98	1.00	1.00	-
Newport	76	4,189	2,144	1,526	47	2	103	-	119	1,207	b/	5	1,239	3,528	b/	-	-	b/	b/	11	14,131	1.00	1.00	-
Florence	15	35	-	119	-	-	22	-	b/	37	-	-	b/	483	-	-	-	-	-	b/	699	1.00	1.00	-
Winchester	27	55	-	58	b/	-	25	-	b/	96	-	b/	b/	359	b/	-	-	-	b/	2	598	1.00	1.00	-
Charleston (Coos Bay)	41	5,057	7	324	3	1	21	0	24	679	-	-	622	1,326	b/	-	-	b/	b/	47	8,133	1.00	1.00	-
Bandon	8	1	-	32	-	-	b/	-	b/	8	-	-	-	b/	-	-	-	-	b/	-	44	1.00	1.00	-
Port Orford	11	819	-	82	-	-	4	-	b/	b/	-	-	-	780	-	-	-	b/	-	48	1,797	1.00	1.00	-
Gold Beach	9	21	-	b/	-	-	b/	-	-	b/	-	-	b/	b/	-	-	-	b/	-	5	85	1.00	b/	-
Brookings	27	1,458	-	30	-	1	b/	b/	b/	84	b/	-	382	2,294	-	-	-	b/	b/	34	4,319	1.00	1.00	-

a/ A zero value indicates more than 0 but less than 500.
b/ Not reported for confidentiality reasons (there were fewer than 3 buyers).
c/ 'Total exvessel value' for this row does not include values from columns for which there were fewer than 3 buyers.

3 OTHER APPLICABLE LAW

3.1 REGULATORY IMPACT REVIEW AND REGULATORY FLEXIBILITY ACT DETERMINATION

In compliance with Executive Order (EO) 12866 and the Regulatory Flexibility Act (RFA), National Marine Fisheries Service (NMFS) requires the preparation of a Regulatory Impact Review (RIR) and analysis of impacts under the RFA for all regulatory actions or for significant policy changes that are of public interest.

3.1.1 Executive Order 12866

EO 12866, Regulatory Planning and Review, was signed on September 30, 1993 and established guidelines for promulgating new regulations and reviewing existing regulations. While the EO covers a variety of regulatory policy considerations, the benefits and costs of regulatory actions are a prominent concern. Section 1 of the order deals with the regulatory philosophy and principles that are to guide agency development of regulations. The regulatory philosophy stresses that, in deciding whether and how to regulate, agencies should assess all costs and benefits of all regulatory alternatives. In choosing among regulatory approaches, the philosophy is to choose those approaches that maximize net benefits to society.

The regulatory principles in EO 12866 emphasize careful identification of the problem to be addressed. The agency is to identify and assess alternatives to direct regulation, including economic incentives such as user fees or marketable permits, to encourage the desired behavior. When an agency determines that a regulation is the best available method of achieving the regulatory objective, it is to design its regulations in the most cost-effective manner to achieve the regulatory objective. Each agency is to assess both the costs and the benefits of the intended regulation and, recognizing that some costs and benefits are difficult to quantify, propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify the costs. Each agency is to base its decisions on the best reasonably obtainable scientific, technical, economic, and other information concerning the need for and consequences of the intended regulation.

NMFS requires the preparation of an RIR for all regulatory actions of public interest, including those that either implement a new fishery management plan (FMP) or significantly amend an existing FMP or its implementing regulations. The RIR is part of the process of preparing and reviewing FMPs and provides a comprehensive review of the changes in net economic benefits to society associated with proposed regulatory actions. The analysis also provides a review of the problems and policy objectives prompting the regulatory proposals and an evaluation of the major alternatives that could be used to solve the problems. The purpose of the analysis is to ensure the regulatory agency systematically and comprehensively considers all available alternatives, so the public welfare can be enhanced in the most efficient and cost-effective way. The RIR addresses many of the items in the regulatory philosophy and principles of EO 12866.

EO 12866 requires that the Office of Management and Budget review proposed regulatory programs that are considered to be "significant." A "significant regulatory action" is one that is likely to (1) have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or state, local, or tribal governments or communities; (2) create a serious inconsistency or otherwise interfere with an action taken or planned by another agency; (3) materially alter the budgetary impact of entitlements, grants, user fees, loan programs, or the rights and obligations of recipients thereof; or (4) raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in this EO.

A regulatory program is "economically significant" if it is likely to result in the effects described in Item 1 above. The RIR is designed to provide information to determine whether the proposed regulation is likely to be "economically significant."

The exvessel value of the West Coast commercial salmon fisheries and total income impacts associated with the recreational salmon fisheries are well below $100 million. Therefore it is unlikely that the options considered by the Pacific Fishery Management Council (Council) would have been projected to have effects in excess of $100 million and; therefore, would not be economically significant. The actions do not create serious inconsistencies or interfere with the actions of other agencies, do not alter entitlements, grants, etc., and do not raise novel legal or policy issues. Therefore, the action is not likely to be found significant under EO 12866.

3.1.2 Regulatory Flexibility Act

3.1.2.1 Background

The RIR is also designed to determine whether the proposed rule has a "significant economic impact on a substantial number of small entities" under the RFA. The purpose of the RFA is to relieve small businesses, small organizations, and small governmental entities from burdensome regulations and record-keeping requirements. If the proposed action meets both the "significant" and "substantial" criteria, preparation of an initial regulatory flexibility analysis (IRFA) is required.

An IRFA is conducted to make a preliminary determination as to whether the action would have a "<u>significant</u> economic impact on a <u>substantial</u> number of small entities." In addition, the IRFA provides an estimate of the number of small businesses affected, a description of the small businesses affected, and a discussion of the nature and size of the impacts.

The Small Business Administration defines a small business in commercial fishing "as a fish harvesting or hatchery business that is independently owned and operated and not dominant in its field of operation" with "annual receipts not in excess of $3,000,000." The following definitions and criteria are from the current NMFS guidelines for determining whether or not a proposed action would have a substantial impact on a significant number of small entities. These guidelines are undergoing a NMFS review. In general, NMFS has defined a "substantial number" of small entities as more than 20% of those small entities engaged in the fishery. An IRFA should be prepared if the action is expected to result in any of the following (1) a change in annual gross revenues by more than five percent, for 20% or more of the affected small entities; (2) an increase in total costs of production by more than five percent as a result of an increase in compliance costs for 20% or more of the affected small entities; (3) compliance costs as a percent of sales for small entities are at least ten percent higher than compliance costs as a percent of sales for large entities for 20% or more of the affected small entities; (4) capital costs of compliance represent a significant portion of capital available to small entities, considering internal cash flow and external financing capabilities; or (5) two percent of small business entities being forced to cease business operations.

3.1.2.2 IRFA Summary

Regulatory flexibility analyses are only required for actions for which notice and comment rulemaking is required under the Administrative Procedures Act or other statutes. For the current plan amendment, notice and comment rule making will only be required for Issue 7, Recreational Harvest Allocations for Port Areas North of Cape Falcon; Issue 8, Selective Coho Fisheries North of Cape Falcon; and some editorial changes and clarifications in Issue 4, Stock Conservation Objectives and Overfishing Criteria. The editorial changes and clarifications in Issue 4 concern technical review procedures with regard to amending stock conservation objectives (see proposed regulatory change in Section 2.4.4) and do not have a significant economic impact on small entities. The reasons for the actions and the objectives for the rules for Issues 7 and 8 are found in Sections 2.7 and 2.8, respectively. These sections reference additional pertinent information in various portions of the draft FMP. Of particular relevance is Section 6 of Appendix B and Chapter 4 of Appendix C which contain additional information on the number of participating vessels and fishing effort by coastal community.

The proposed action to establish a separate allocation for the La Push area will not result in any substantial redistribution of fish as compared to the Council's management practices from 1990 through 1997. The action will essentially establish the Council's standard allocational practices over the last eight years as part of the plan. Therefore, the action would not have a substantial impact on a significant number of small business entities (see Section 2.7 for additional discussion).

The sectors directly affected by the selective fishery regulations are those operating in the north of Cape Falcon ocean fisheries and subsequent inside fisheries (primarily the Columbia River, Washington coast and Puget Sound). There is a potential for substantial reallocation of fish among north of Cape Falcon ocean and inside fisheries. The balance of harvest and impacts between inside and ocean fisheries north of Cape Falcon and between north of Cape Falcon fisheries and fisheries in other areas, such as south of Cape Falcon, are dependent on the outcome of negotiations. Outcomes of the negotiations are difficult to predict, especially when those negotiations occur largely outside the Council arena, which is the case with the North of Cape Falcon Management Forum (see Appendix B to the FMP, Section 3.1). Because it is not possible to determine the ultimate distribution of impacts for fisheries other than the north of Cape Falcon ocean fishery, it is not possible to certify that there would not be substantial and significant impacts on small entities resulting from the expansion of selective fisheries in ocean areas north of Cape Falcon. Impacts of the proposed selective fishery option are described in Section 2.8. It is possible to say that it is unlikely that total harvest will be reduced as a result of the reallocation. And, in fact, aggregate recreational and commercial harvest may be increased if selective fisheries allow the harvest of hatchery fish that would have otherwise been excess hatchery spawning escapement.

The RFA requires the identification of management alternatives that were considered that would reduce impacts on small entities. The Council received a presentation of the likely impacts of the proposed selective fishery option at its November meeting. At that time, the Council limited the application of the equivalent impact selective ocean fisheries option to the August through September time period. This will tend to limit the amount of reallocation and hence impacts on small entities because it is unlikely that enough effort could be mustered in the August through September time period to harvest the amount of fish that would be available under a fully implemented equivalent impact selective fishery (Section 2.8). No other alternatives have been identified for limiting impacts of selective fisheries. Since the selective fishery policy is by definition dependent on redistribution of harvest, it is unlikely that any alternative will be identified that could reduce the impact on small businesses without reducing in a similar proportion the implementation of selective fishery management. No alternatives have been identified that would allow a greater harvest of hatchery stocks with lesser impacts on small businesses. Part of the purpose of this IRFA is to solicit public comment on options that may have been overlooked that would have a lesser impact on small businesses while achieving the objective of harvesting more hatchery fish without increasing impacts on natural stocks.

3.2 ENDANGERED SPECIES ACT AND MARINE MAMMAL PROTECTION ACT

The purposes of the Endangered Species Act (ESA) are to provide a means whereby the ecosystems upon which endangered and threatened species depend may be conserved, to provide a program for the conservation of such endangered and threatened species, and to take such steps as may be appropriate to achieve the objectives of the treaties and conventions created for these purposes. Section 7 of the ESA requires all federal agencies to ensure that any action authorized, funded or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species. Endangered or threatened species under the ESA that may be present within the Council management area are listed in Section 4.2.2 and the impacts of the Pacific coast salmon fishery on these species is discussed in Section 5.2.2.

Marine mammal management is based on the Marine Mammal Protection Act of (MMPA) of 1972 and the ESA. Under the MMPA, marine mammals whose abundance falls below the optimum sustainable population level (the number of animals at which productivity is maximum, usually regarded as 60% of carrying capacity or maximum population size) can be listed as depleted. Populations listed as threatened or endangered under the ESA are automatically depleted under the terms of the MMPA. Fisheries that interact with species listed as depleted, endangered, or threatened may be significantly affected under the terms of the ESA and MMPA. The commercial salmon troll fishery in Council managed waters is listed as a Category III fishery, meaning that annual mortality and serious injury to marine mammals in those fisheries is less than or equal to 1% of the potential biological removal level of regional marine mammal stocks.

The management proposed in this salmon amendment should have a positive affect on listed species by preventing overfishing and meeting NMFS recovery standards. The Regional Administrator has determined that fishing activities conducted under this amendment would have no adverse impact on marine mammals.

3.3 COASTAL ZONE CONSISTENCY

Section 307(c)(1) of the Federal Coastal Zone Management Act (CZMA) of 1972 requires all federal activities which directly affect the coastal zone be consistent with approved state coastal zone management programs to the maximum extent practicable. The Council believes the proposed action is consistent to the maximum extent practicable with applicable state coastal zone management programs. The NMFS will correspond with the responsible state agencies under Section 307 of the CZMA to obtain their concurrence in this finding.

Under the CZMA, each state develops its own coastal zone management program which is then submitted for federal approval. This has resulted in programs which vary widely from one state to the next. The following is a review of the fishery relevant consistency criteria used in federal consistency determinations by each state.

3.3.1 Washington

Consistency with the Washington Coastal Zone Management Program requires compliance with the Washington Shoreline Management Act, the state and federal clean water acts, and the State Environmental Policy Act or National Environmental Policy Act (NEPA). Compliance with the Washington Shoreline Management Act requires consistency with the master plans for the affected coastal counties. The fishery activities covered in this action fall in the exempt category for the coastal county master plans. The proposed action has no water quality implications, meets the requirements of the NEPA, and was developed in consultation with the Washington Department of Fish and Wildlife.

3.3.2 Oregon

Federal fishery management decisions are reviewed against Oregon's statewide planning Goal 19 for ocean resources and the applicable requirements of the Oregon Territorial Sea Plan.

> **Goal 19, Ocean Resources**: "To conserve the long-term values, benefits, and natural resources of the nearshore ocean and the continental shelf. All local, state, and federal plans, policies, projects, and activities which affect the territorial sea shall be developed, managed and conducted to maintain, and where appropriate, enhance and restore, the long-term benefits derived from the nearshore oceanic resources of Oregon. Since renewable ocean resources and uses, such as food production, water quality, navigation, recreation, and aesthetic enjoyment, will provide greater long-term benefits than will nonrenewable resources, such plans and activities shall give clear priority to the proper management and protection of renewable resources."
>
> **Oregon Territorial Sea Plan**: "The principal focus of the Territorial Sea Plan is conservation and protection of marine habitat through clear procedures and standards for decision making." While the plan is not intended to be an ocean-fisheries management plan, marine habitat conservation and protection considerations may affect federal ocean-fisheries management decisions.

Prior to any decisions to approve or implement an action that will potentially affect the state's territorial sea, a resource inventory and effects evaluation is required. The inventory and effects evaluation must be sufficient to understand the short and long-term impacts of the proposed activity on resources and uses of the continental shelf and nearshore ocean. Inventory and evaluation content standards are listed in the Territorial Sea Plan (p. 44-47).

For **Fishery Resources**, the ocean policy goals are to:

- Develop scientific information on the stocks and life histories of commercial, recreational, and ecologically important species of fish, shellfish, marine mammals and other marine fauna.
- Designate and enforce fishing regulations to maintain the optimum sustainable yield while protecting the natural marine ecosystem.
- Develop and promote improved fishing practices and equipment to achieve the optimum sustainable yield while protecting the natural marine ecosystem.

- Develop a better scientific understanding of the effects of man's activities on the marine ecosystem.
- Encourage, where appropriate and in keeping with sound practices for conservation of ocean resources, the exploitation of unutilized and underutilized fish species.

For **Biological Habitat**, the ocean policy goals are to:

- Identify and protect areas of important biological habitat, including kelp and other algae beds, seagrass beds, rock reef areas and areas of important fish, shellfish and invertebrate concentration.
- Identify and protect important feeding areas; spawning areas; nurseries; migration routes; and other biologically important areas of marine mammals, marine birds, and commercial and recreational important fish and shellfish.
- Protect integrity of the marine ecosystem, including its natural biological productivity and diversity.

Permits or other approvals for actions potentially affecting ocean resources should:

- Designate any areas where certain activities will be prohibited.
- Specify methods and equipment to be used and standards to be met.
- Be available for public review and comment before issuance. Agencies and governments which use or manage ocean resources should also be consulted.

3.3.3 California

The following are the standards related to fishery harvest by which consistency with the California Coastal Zone Management Program is generally determined. Section references are to the California Coastal Act.

> **Section 30230.** Marine resources shall be maintained, enhanced, and where feasible, restored. Special protection shall be given to areas and species of special biological or economic significance. Uses of the marine environment shall be carried out in a manner that will sustain the biological productivity of coastal waters and that will maintain healthy populations of all species of marine organisms adequate for long-term commercial, recreational, scientific, and educational purposes.
>
> **Section 30234.5.** The economic, commercial, and recreational importance of fishing activities shall be recognized and protected.

3.3.4 Conclusion

Amendment 14 is consistent with the coastal zone management programs of Washington, Oregon, and California. In addition, annual fishery management implemented under this FMP as amended by Amendment 14 will continue to be consistent with the states' coastal zone management programs. Under the amended FMP, the annual management scheme ensures conservation of the stocks, achievement of optimum yield, and prevents overfishing. The annual measures will avoid jeopardizing any stocks of salmon listed under the ESA. The management regime allows as much harvest as possible, consistent with conservation and allocation objectives of the FMP and the needs of fisheries within state waters.

The annual salmon management measures are developed through an extensive and inclusive process during which the relevant scientific and fishery information is developed, analyzed, and made available to the public and the decision makers. The process allows extensive opportunity for public review and participation. The state fish and wildlife agencies are deeply involved in the annual process and each year the preseason reports that review and analyze the status of stocks and the annual management alternatives are sent to the States' coastal zone management agencies.

3.4 PAPERWORK REDUCTION ACT

The major purposes of the Paperwork Reduction Act of 1980 are (1) to minimize the federal paperwork burden for individuals, small businesses, state, and local governments; (2) to minimize the cost to the federal government of collecting, maintaining, using, and disseminating information; and (3) to ensure that the collection, maintenance, use and dissemination of information by the federal government is consistent with applicable laws relating to confidentiality.

The proposed action does not require any new federal collection of data, report requirements or record keeping.

3.5 FEDERALISM

EO 12612 of October 26, 1987, provides federal agencies with guidance on the formulation and implementation of policies that have federalism implications. Federal agencies are to examine the constitutional and statutory authority supporting any federal action that would limit the policy-making discretion of the states.

The proposed amendment does not result in policies or regulations that preempt state law. Council representatives of the affected states have been closely involved in reviewing the options considered in the amendment and have not expressed federalism related opposition to the options. The proposed action does not have sufficient federalism implications to require the preparation of a federalism assessment.

3.6 NATIONAL ENVIRONMENTAL POLICY ACT

In accordance with the National Environmental Policy Act (NEPA) and the Council on Environmental Quality regulations that implemented NEPA, the Council and NMFS have prepared a draft supplemental environmental impact statement (EIS) for Amendment 14 (integrated within this document) to supplement the original EIS of 1978, the annual supplemental EIS's from 1979 through 1983 and the supplemental EIS for the Framework Amendment in 1984. The table below provides a quick reference to the parts of the amendment which meet the NEPA requirements.

Statement, Description or Assessment	Reference
Need for Action	Chapter 1
Description of Alternative Actions and Options	Chapter 2; *Draft Pacific Coast Salmon Plan; and Appendix A*
Option Impacts (ecological, administrative, social, and economic)	Chapter 2
RIR/RFA and Other Applicable Law	Chapter 3
Affected Environment	Chapter 4
Environmental Consequences	Chapters 2 and 5, and Appendix B
Literature Cited	Chapter 6
List of Preparers	Chapter 7
Consultation and Coordination	Chapter 8
Response to Comments	Chapter 9

3.7 NORTHWEST POWER PLANNING ACT

The Northwest Power Planning Act (NPPA) of 1980 placed great emphasis on protection, mitigation and enhancement of fish and wildlife and their habitat within the Columbia River Basin. The Columbia Basin salmon runs are historically important contributors to the ocean salmon fisheries within the Council's jurisdiction north of Cape Falcon, Oregon.

Proposed actions to accomplish the NPPA goals for fish and wildlife were adopted by the Northwest Power Planning Council in 1982 and amended in 1987 and 1992. The Council, NMFS, states and treaty Indian tribes have participated with the Northwest Power Planning Council in developing and carrying out the fishery provisions of the NPPA. The objectives of these fishery related activities were found to be generally consistent and compatible with the conservation and management goals of the salmon FMP.

The proposed salmon management action should have almost negligible impact on the current fish and wildlife program of the Northwest Power Planning Council.

3.8 PACIFIC SALMON TREATY ACT

The Pacific Salmon Treaty Act (PSTA) of 1985 was established to implement the Pacific Salmon Treaty between the U.S. and Canada. The treaty provides for bilateral cooperation in salmon management, research and enhancement by establishing a bilateral commission with coastwide responsibilities for management of "intercepting" salmon fisheries. The PSTA provides for coordination with the Council-managed fisheries by requiring that at least one representative to the PSC's southern panel be a voting member of the Council and by requiring consultation with the Council in the promulgation of regulations necessary to carry out the obligations under the treaty.

The proposed actions are consistent with the management requirements of the PSTA.

3.9 FEDERALLY RECOGNIZED INDIAN FISHING RIGHTS

Several Indian tribes which fish in Council-managed waters or whose fisheries may be impacted by Council managed ocean fisheries possess federally recognized fishing rights. Ocean fishing tribes with treaty fishing rights include the Makah, Quileute, Hoh, and Quinault. Other tribes with fishing rights that may be impacted by Council management actions include Puget Sound, Columbia River and Klamath River Indian tribes.

The proposed action is consistent with federally recognized Indian fishing rights.

4 AFFECTED ENVIRONMENT

4.1 PHYSICAL ENVIRONMENT

The physical environment includes coastal streams and river systems from central California to Alaska and oceanic waters along the United States and Canada seaward into the north central Pacific Ocean, including Canadian territorial waters and the high seas. Some of the more critical portions of this environment are the freshwater spawning grounds and migration routes. Previous fishery management plan (FMP) documents have cited the serious problems associated with hydroelectric dam construction and operation. Hydroelectric projects have flooded or blocked access to many areas of productive habitat. Operation of these hydroelectric projects has resulted in reduced flows during migration, flow fluctuations in salmon spawning areas, increased turbidity and sedimentation of gravel, and temperature modifications. These major physical changes have completely eliminated many areas from salmon production and have seriously reduced salmon production potential for other areas.

The oceanic environment off the coasts of Washington, Oregon, and California is contained within the Central Pacific Gyre. The southern flowing California Current forms the eastern boundary of this ecosystem. Seasonal variation in the pattern of coastal circulation is the result of changes in direction of the dominate winds associated with large-scale atmospheric pressure cells over the eastern north Pacific Ocean (Aleutian Low and Equatorial High). As currents flow south along the West Coast during the spring and summer, a combination of the northwesterly winds and the earth's rotation causes the surface waters to be deflected offshore. As the surface water moves offshore, it is replaced with cold nutrient rich waters from below. This process of upwelling introduces the nitrates, phosphates, and silicates that are essential for the high phytoplankton production that forms the basis for the oceanic food chain.

Environmental fluctuation in this annual process can significantly change the total production capacity of the Central Pacific Gyre ecosystem. The sea-surface temperature patterns in the eastern north Pacific Ocean exhibit an alternation between warm and cool eras, with an average period of about 17 years (Wooster 1995). Near-surface ocean conditions in the eastern North Pacific are linked to behavior of the Aleutian Low, which is intense and east of its average position during warm eras. The initiation of such eras and the occurrence of anomalous warm years are related to certain El Niño-Southern Oscillation events that have a strong extratropical effect. These events intensify surface warming along the West Coast which in turn increases the vertical distance, or thermocline, between the nutrient rich cold water and the warmer less nutrient rich surface water. This effectively reduces the amount of nutrients available for phytoplankton production during the spring and summer and impacts the entire ecosystem as plankton is the base of the aquatic food chain.

The West Coast salmon resource is impacted by salmon fisheries which occur in oceanic and freshwater areas from Mexico to the Bering Sea off Alaska and extends inland as far east as central Idaho. This FMP covers the ocean salmon fisheries occurring in the exclusive economic zone (EEZ) (three to 200 miles) off the coasts of Washington, Oregon, and California. Salmon fisheries occur predominately along the continental shelf within 60 km of the coastline. These fisheries are discussed in detail in Appendix B. Discussion of the interaction between salmon and salmon fisheries with other resources is covered in the following section.

4.2 OVERVIEW OF BIOTA

4.2.1 Status of Target Species

This FMP covers all stocks of salmonids which occur along the West Coast from the U.S./Canada border south to near Point Conception, California, with rare occurrences even as far south as Los Angeles. Ocean salmon fisheries in Council managed waters are directed toward and harvest primarily chinook and coho salmon. Small numbers of pink salmon also are harvested, especially in odd-numbered years. There are no directed fisheries for other Pacific salmon species and they occur only rarely in Council-managed harvests. Although some of these species also support inshore and freshwater fisheries as they migrate to their spawning grounds. Major runs originate in Puget Sound, the Columbia River system extending into

Idaho, the Klamath River, the Sacramento-San Joaquin River systems in California, and coastal Oregon streams.

In recent years, native, naturally spawning salmonid populations have declined as a result of habitat loss and degradation; inadequate riverine passage and flows due to hydropower, agriculture, logging, and other developments; overfishing; negative interactions with other species and hatchery fish; and environmental fluctuations and declines in freshwater (drought) and marine (El Niño) productivity. These declines have been observed and resulted in reduced harvest levels throughout the Council coverage area. Recent efforts to preserve salmonids have focused on federal protection under the Endangered Species Act (ESA). Currently, coast wide status reviews are completed for chinook, sockeye, chum, pink and steelhead, the coho salmon status review is currently being updated.

The overall abundance of chinook salmon has been depressed coast wide in recent years, with the exception of fall chinook returns to the Sacramento River. In 1998, the Pacific Council projected that all FMP spawner escapement objectives would be achieved or exceeded for chinook stocks south of Cape Falcon. The number of Klamath River fall chinook spawners is expected to meet the floor escapement of 35,000 natural adults. Sacramento River fall chinook spawner escapement is projected to significantly exceed the top of the goal range which is 180,000 adults. Constraints for Klamath River fall chinook prevent harvesting more of the very abundant Sacramento River fall chinook stock in ocean fisheries. With very limited inside fisheries, all Columbia River chinook stocks are expected to meet their framework goals, except for the upper river spring and summer stocks which have been chronically depressed and are only rarely encountered in Council-area fisheries. Washington coastal chinook stocks are expected to meet their spawner goals and Puget Sound stocks continue to be depressed. Ocean fishery impacts on both of these stock groups occur nearly exclusively in fisheries outside of Council jurisdiction.

In the last several years the abundance of coho salmon also has been depressed coast wide. The Oregon and California coastal coho stocks have been at low to very low levels. The Council took special emergency measures to reduce impacts on coho in its annual management recommendations for fisheries south of Cape Falcon from 1991 through 1993. Beginning in 1994, all retention of coho in the ocean fisheries south of Cape Falcon has been prohibited and the Council has structured chinook-directed seasons to maintain low incidental exploitation rates (primarily hook-and-release mortality) on coho. North of Cape Falcon, coho stock abundance is mixed with some stocks healthy and others in depressed status. In 1998, even if all Council-area fisheries were closed, established long-term spawner escapement goals or goal ranges (generally based on approximations of maximum sustainable yield) could not be attained for Queets and Grays Harbor natural coho stocks. Both stocks attained spawner escapements within their ranges in 1995 and 1996. In most years, a high percentage of impacts on coho stocks originating from areas North of Cape Falcon occur in Canadian fisheries which were reduced in 1998.

The abundance of pink salmon has remained healthy and stable along the West Coast. Pink salmon in Council waters are comprised of two basic populations, even-numbered and odd-numbered year spawners. Studies have found these two populations to be genetically distinct from one another. Abundance and incidental harvest of pink salmon in the Council management area is only significant in odd-numbered years and occurs almost exclusively off the north coast of Washington. Preseason abundance projections are based on stocks from Puget Sound and the Fraser River in British Columbia, Canada. Both of these stocks groups have been relatively stable with Puget Sound pink stocks averaging 2.1 million and Fraser River stocks averaging approximately 14.6 million during the period of 1977 through 1995 (odd-numbered years only) (STT 1997). Recent returns for both stocks have been above the long-term average.

Overall West Coast fisheries for the majority of salmonid stocks remain depressed, specifically the native stocks. Since the last FMP in 1984, there have been numerous stocks that have become listed under the ESA as either threatened or endangered (see Section 3.3.1 of the *Proposed Draft Pacific Coast Salmon Plan*), with more on the proposed and candidate lists. Although there are a few stocks on the West Coast that have actually remained stable or have increased, these usually have extensive hatchery components that hide the actual overall health conditions of these stocks. Future management of the West Coast salmon stocks will have to address all of the factors affecting these salmonid stocks: harvest; hatchery; habitat; to turn around the current depressed trend.

4.2.2 Status of Species Listed Under the Endangered Species Act

The federal Endangered Species Act (ESA) provides for the conservation of endangered and threatened species of fish, wildlife, and plants. The program is administered jointly by the Department of Commerce (through National Marine Fisheries Service [NMFS] for most marine species) and the Department of the Interior (through the U.S. Fish and Wildlife Service [USFWS]) for terrestrial and freshwater species.

The ESA procedure for identifying or listing imperiled species involves a two-tiered process, classifying species as either threatened or endangered, based on the biological health of a species. Threatened species are those likely to become endangered in the foreseeable future [16 U.S.C. §1532(20)]. Endangered species are those in danger of becoming extinct throughout all or a significant portion of their range [16 U.S.C. §1532(20)]. The U.S. Secretary of Commerce (Secretary), acting through the NMFS, is authorized to list marine mammal and fish species. The Secretary of the Interior, acting through the USFWS, is authorized to list all other organisms.

The following species are currently listed as threatened or endangered under the ESA and occur, or may occur, in the subject marine waters of the EEZ off Washington, Oregon, and California:

Name	Status
BIRDS	
Brown Pelican (*Pelicanus occidentalis*)	endangered
Marbled Murrelet (*Brachyramphus marmoratus*)	threatened
Least Tern (*Sterna antillarum*)	endangered
Short-tailed Albatross (*Diomedea albatrus*)	endangered
REPTILES	
Green Turtle (*Chelonia mydas*)	threatened
Leatherback Turtle (*Dermochelys coriacea*)	endangered
Loggerhead Turtle (*Caretta caretta*)	threatened
Olive Ridley Turtle (*Lepidochelys olivacea*)	threatened
MAMMALS	
Blue Whale (*Balaenoptera musculus*)	endangered
Fin Whale (*Balaenoptera physalus*)	endangered
Guadalupe Fur Seal (*Arctocephalus townsendi*)	threatened
Humpback Whale (*Megaptera novaeangliae*)	endangered
Right Whale (*Eubalaaena glacialis*)	"
Sei Whale (*Balaenoptera borealis*)	"
Sperm Whale (*Physeter catodon*)	"
Steller Sea Lion (*Eumetopias jubatus*)	threatened
FISH	
Central California Coho Salmon (*Oncorhynchus kisutch*)	threatened
Southern Oregon/Northern California Coho Salmon (*O. kisutch*)	"
Oregon Coast Coho Salmon (*O. kisutch*)	"
Sacramento River Spring Chinook Salmon (*Oncorhynchus tshawytscha)*	"
Sacramento River Winter Chinook Salmon (*O. tshawytscha*)	endangered
California Coastal Chinook Salmon (*O. tshawytscha)*	threatened
Snake River Fall Chinook Salmon (*O. tshawytscha*)	"
Snake River Spring/Summer Chinook Salmon (*O. tshawytscha*)	"
Puget Sound Chinook Salmon (*O. tshawytscha*)	"
Lower Columbia River Chinook Salmon (*O. tshawytscha*)	"
Upper Willamette River Chinook Salmon (*O. tshawytscha*)	"
Upper Columbia River Spring Chinook Salmon (*O. tshawytscha*)	endangered
Snake River Sockeye Salmon (*O. nerka*)	endangered
Ozette Lake Sockeye Salmon (*O. nerka*)	threatened
Hood Canal Summer Chum Salmon (*O. keta*)	"
Columbia River Chum Salmon (*O. keta*)	"

Name	Status
FISH (continued)	
Southern California Steelhead (*Oncorhynchus mykiss*)	endangered
South-Central California Coast Steelhead (*O. mykiss*)	threatened
Central California Coast Steelhead (*O. mykiss*)	"
California Central Valley Steelhead (*O. mykiss*)	"
Snake River Basin Steelhead (*O. mykiss*)	"
Upper Columbia River Steelhead (*O. mykiss*)	endangered
Upper Willamette River Steelhead (*O. mykiss*)	threatened
Middle Columbia River Steel head (*O. mykiss*)	"
Lower Columbia River Steelhead (*O. mykiss*)	"
Umpqua River Sea-run Cutthroat (*O. clarki clarki*)	endangered

Because the establishment of regulations for the salmon fishery in the EEZ is a federal action, any adverse effect of the fishery on listed species or critical habitat and any taking that may occur are subject to ESA Section 7 consultation. NMFS initiates the consultation and the resulting biological opinions are issued to NMFS. The Council may be invited to participate in the compilations, but has not been involved in consultations related to directed salmon fishery thus far. The determination of whether the action "is likely to jeopardize the continued existence of" endangered or threatened species or to result in the destruction or modification of critical habitat, however, is the responsibility of the appropriate agency (NMFS or USFWS). If the action is determined to result in jeopardy, the opinion includes reasonable and prudent measures that are necessary to alter the action so that jeopardy is avoided. If an incidental take of a listed species is expected to occur under normal promulgation of the action, an incidental take statement is appended to the biological opinion.

In addition to listing species under the ESA, the critical habitat of a species must be designated concurrent with its listing to the 'maximum extent prudent and determinable" [16 U.S.C., S1533(b) (1) (A)]. The ESA defines critical habitat as those specific areas that are essential to the conservation of a listed species and that may be in need of special consideration. The primary benefit of critical habitat designation is that it informs federal agencies that the listed species are dependent upon these areas for their continued existence, and that consultation with NMFS on any federal action that may affect these areas is required.

Section 7 consultations that have been done or are in the process for the listed species are summarized below. For any ESA listed species, consultation must be reinitiated if: the amount or extent of taking specified in the Incidental Take Statement is exceeded, new information reveals a consequence of the action that may affect listed species in a way not previously considered, the action is subsequently modified in a manner that causes an effect to listed species that was not considered in the biological opinion, or a new species is listed or critical habitat is designated that may be affected by the action.

4.2.2.1 Reptiles

Sea Turtles

Studies of sea turtle distribution and abundance in the North Pacific Ocean are progressing, but there are many gaps on the knowledge base. Pacific sea turtles nest on beaches in the tropics and subtropics but have been sighted in the eastern North Pacific as far north as the Gulf of Alaska. Many species are highly mobile and may migrate thousands of miles. Sea turtle populations have been have been declining world wide (National Research Council 1990).

Aerial surveys of California, Oregon, and Washington waters have shown that most leatherbacks occur in slope waters, while fewer occur over the continental shelf. Adult green turtles are benthic herbivores, subsisting mainly on algae and sea grasses. Their diet would seem to restrict them to the photic zones surrounding islands and continents. Loggerheads inhabit continental shelves, bays, estuaries and lagoons. They are generally found feeding on benthic invertebrates in hard bottom habitats. Olive Ridleys are widely distributed in the Pacific and appear in both coastal and pelagic habitats. Forges appears confined mainly to tropical neritic waters, where individuals may dive as deep as 300 meters to feed on benthic crustaceans (Eckert, 1991).

NMFS determined that commercial fishing by coastal fisheries poses a negligible threat to the pacific species (NMFS 1990). Research indicated that the incidental involvement of sea turtles with commercial fisheries on the West Coast is rare. No turtles have been reported taken in the salmon fisheries of Washington, Oregon, and California. Leatherback turtles have been taken in experimental shark drift gillnets (1986 through 1988) off California, Oregon, and Washington; however, federal permits for the shark drift gillnet operations were not renewed after 1998.

4.2.2.2 Mammals

Steller Sea Lion

Steller sea lions range along the North Pacific Ocean rim from northern Japan to California (Loughlin et al. 1984), with centers of abundance and distribution in the Gulf of Alaska and Aleutian Islands, respectively. The Steller sea lion is listed under the ESA throughout its U.S. range, which extends from California and associated waters to Alaska, including the Gulf of Alaska and Aleutian Islands, and into the Bering Sea and North Pacific and the Russian waters and territory. In 1997, NMFS reclassified the Steller sea lion as two distinct population segments under the ESA (62 FR 24345); the population west of 144 W. Longitude (a line near Cape Suckling, Alaska) is listed as endangered and the populations east of that line (subject area of this Environmental Impact Statement [EIS]) is listed as threatened. A recovery plan for Steller sea lions has been adopted (NMFS 1992).

NMFS designated critical habitat (58 FR 45278, August 27, 1993) for the Steller seas lion based on the Recovery Team's determination of habitat sites that are essential to reproduction, rest, refuge, and feeding. Critical habitats include all rookeries, major haul-outs, and specific aquatic foraging habitats. This designation does not place any additional restrictions on human activities within the designated areas.

Steller sea lion population declines have been documented in the core of their range in Alaska resulting in the species being listed as threatened under the Endangered Species Act. The overall trend of the eastern population segment of Steller sea lions since 1980 is stable to increasing although significant declines in the number of Steller sea lions occurring within California prior to 1980 have been documented (NMFS 1995b). California experienced a large decline in Steller sea lion numbers prior to 1980. An estimated 50% decline between about 1950 and 1980. Some of the available data indicate that a northward shift in Steller sea lion range may be occurring, which may exacerbate the decline at southern rookeries.

NMFS has determined that for Steller sea lions, the mortality and serious injury incidental to commercial fishing operations will have negligible impact (60 FR 45399; August 31, 1995). A 'negligible impact' is defined as an impact resulting from the specified activity that cannot be reasonablely expected to, and is not reasonably likely to, adversely affect the species or stock through an effect on annual rates of recruitment or survival. Section 7 consultation was completed on this determination (NMFS 1995b) including issuance of an incidental take statement for commercial fishing operations of up to 106 Steller sea lion from the eastern population annually (east of 144° W longitude).

4.2.2.3 Fish

Salmon

Within the coverage area of the Pacific Council, several evolutionarily significant units of salmon stocks have been listed under the ESA process. By species they include: Chinook - Sacramento River spring and winter, California coastal, Snake River fall, Snake River spring/summer, Lower Columbia River, Upper Willamette, Upper Columbia River spring, and Puget Sound; Coho - Central California Coast, Southern Oregon/Northern California Coastal, and Central Oregon Coast; and Sockeye - Snake River. Coast wide, the review of stock status is continuing for all salmon species.

Critical habitat was designated by NMFS for Snake River sockeye, Snake River fall chinook, and Snake River spring/summer chinook in 1992 (57 FR 57051, December 2, 1992). The designated critical habitat did not include any marine waters; therefore, none of the habitat where the West Coast salmon fishery is promulgated is designated as critical. A draft recovery plan for ESA listed Snake River salmon has been proposed (NMFS 1995c).

In 1993, NMFS designated critical habitat for Sacramento River Winter chinook salmon (58 FR 33212, June 26, 1993). The designed critical habitat did not include any marine waters outside San Francisco Bay: therefore, none of the habitat where the West Coast salmon fishery is promulgated is designated as critical. A recovery plan for this species is under development.

In 1997, NMFS proposed critical habitat for Central California Coast coho and Southern Oregon/ Northern California Coastal coho listed under the ESA (62 FR 62741, November 25, 1997). Also proposed this same year was critical habitat for Umpqua River Cutthroat trout (62 FR 62741). The proposed critical habitat did not include any marine waters; therefore, none of the habitat where the West Coast salmon fishery is promulgated is designed as critical. Recovery plans for these populations are under development.

These listed salmon species originate in freshwater habitat from river basins within California, Oregon, Idaho, and Washington. During the ocean phase of their life cycle these listed stocks resided in or transient the coastal waters off California, Oregon, and Washington. In the ocean environment, they mix with a multitude of other salmon stocks originating from California, Oregon, Idaho, Washington, and Canada. Some components of these listed stocks also migrate further north to waters off Canada and Alaska where they intermingle with other stocks originating other areas ranging from California to Japan.

The ESA listed salmon stocks are not visually distinguishable from other unlisted salmon. Incidental "take" of listed salmon in the West Coast salmon fishery is assumed based on either life history traits, genetic stock indication analysis, or coded wire tag (CWT) recoveries. Generally, harvest impacts are projected based on the occurrence of coded wire tags retrieved from indicator stocks, often hatchery stocks, that also migrate into and through these waters and are assumed to mature and to taken in the fishery at the same rate as the naturally spawning fish. The amount of take is theorized using proportional estimates of escapement sizes for the two stocks, the hatchery indicator and the natural spawning stock.

Formal consultations for listed salmon resulted in biological opinions and no jeopardy determinations annually for the West Coast salmon fishery from 1993 through 1999 (NMFS 1995d, NMFS 1996, NMFS 1997a, NMFS 1998, NMFS 1999a, NMFS 1999b). Conservation measures contained in these opinions varied, but generally were recommendations related to limiting coho and chinook impacts in the commercial and recreational fisheries off the coasts of California, Oregon, and Washington.

Council fisheries do not have identifiable impacts on any of the listed ESUs outside those for chinook and coho salmon. Of the listed species of chinook and coho, Council managed fisheries have the most significant impacts on Sacramento River winter chinook, Snake River fall chinook, and all three of the coho stocks. Council area salmon fisheries generally account for a small portion of the total harvest impact on Snake River fall chinook by all ocean salmon fisheries. Based on the 1988-1993 average, the total mortality of Snake River fall chinook due to all ocean salmon fisheries is proportioned as: 26% for the Council-area, 12% for southeast Alaska and 62% for Canada. (Further discussion of ocean fishery impacts on all listed stocks will be provided in preseason report III.)

The NMFS guidance under the various pertinent biological opinions required the Council to meet the following objectives to avoid jeopardizing the recovery of the listed stocks in 1999:

- Sacramento River winter chinook - Achieve a 31% increase in the age-3 adult cohort replacement rate relative to the 1989-1993 mean rate of 1.35. Such an increase would result in a 1.77 adult cohort replacement rate.

- Snake River fall chinook - Failing agreement among the parties to the Pacific Salmon Treaty to meet conservation needs of chinook salmon, harvest impacts of ocean fisheries in the Council area and Alaska fisheries, or of all ocean fisheries, cannot exceed 50% or 70%, respectively, of the 1988-1993 average exploitation rate on age-3 and age-4 fish. If there is a NMFS approved Pacific Salmon Treaty agreement, but neither of the two criteria listed above are met, the Council must achieve a 50% reduction from the base period exploitation rate in Council-area fisheries.

- Central California coast coho - Prohibit retention of coho in commercial and recreational fisheries off California.
- Southern Oregon/northern California coho - As a surrogate for this ESU, limit impacts on Rogue/Klamath hatchery coho to no more than 13% in marine fisheries.
- Oregon coast coho - Limit impacts on OCN coho from all marine and freshwater fisheries to no more than 15% (as provided in Amendment 13 to the salmon fishery management plan).

Trout

Umpqua River Cutthroat Trout was listed as endangered in August 1996 (61 FR 41514). Their spawning range is within the Umpqua River Basin in Oregon. Proposed critical habitat is all Umpqua River reaches, estuarine areas, and tributaries, excluding areas upstream of Toketee Falls on the North Umpqua River [62 FR 62741]. The catch of cutthroat trout in ocean fisheries off Washington, Oregon and California is a rare occurrence and would be expected to result in an insignificant impact on this resource. Landings of cutthroat trout in the ocean fishery off Oregon is illegal.

Steelhead

NMFS has listed several Evoluntionarily Significant Units of steelhead within the coverage area of the Pacific Council. These steelhead ESUs include: California Central Valley, Southern California, South-Central California Coast, CCC, Lower Columbia River, Upper Columbia River, and Snake River Basin. Stock status reviews of other populations of steelhead continue coast wide.

Steelhead are caught only rarely in ocean fisheries. Steelhead retention is prohibited in nontreaty commercial fisheries, but is permitted in recreational and treaty ocean salmon fisheries. Recreational sampling programs provide the basis for estimating ocean impacts. On board sampling of recreational vessels in 1993 and 1994 indicated the landed catch in California waters to average ten or less annually (Grover 1995). In recreational fishing off Oregon, the catch of steelhead since 1978 has ranged from zero to 281, but since 1988 has averaged only 28 fish-per-year (Bodenmiller 1995). Analysis of recreational fishing off the Washington coast indicated catch from 1976 to 1987 ranged from zero to 72 steelhead, while averaging 40 fish-per-year (PFMC 1988). The steelhead catch in the treaty troll fisheries off the north coast of Washington is assumed to be similar to the recreational landings.

Steelhead are probably also caught on occasion in nontreaty commercial fisheries. Since retention if prohibited in the nontreaty fishery, impacts can not be assessed directly, but it is reasonable to assume that encounter rates of steelhead are rare as suggested by the recreational monitoring programs. Steelhead that are caught and released would presumably be subject to some hooking mortality.

Available information indicates that steelhead are caught only rarely in ocean fisheries directed at salmon, and that it is unlikely that West Coast salmon fisheries significantly impact any of the steelhead ESUs currently proposed for listing. NMFS has determined, based on the available information, that West Coast salmon fisheries are not likely to jeopardize the continued existence of California Central Valley steelhead, Southern California steelhead, South-Central California Coast steelhead, Central California Coast steelhead, Northern California Coast steelhead, Klamath Mountain Province steelhead, Oregon Coast steelhead, Lower Columbia River steelhead, Upper Columbia River steelhead, and Snake River Basin steelhead.

4.2.3 Status of other Fish Species Taken Incidently

Overall impact of the salmon fishery on other fish species is limited due the gear type (hook and line) used in the commercial and recreational salmon fisheries off the West Coast. The primary species taken incidently in the salmon fisheries include: halibut, yellowtail rockfish, canary rockfish, lingcod, and sablefish. Halibut stocks off the Washington, Oregon, and California are in good condition. The majority of groundfish species are presently are thought to be in fair to poor condition. Canary rockfish, lingcod, and sablefish stocks are declining and appear to be in poor condition; they are fully utilized by the groundfish fleet. Yellowtail rockfish also are fully utilized, but the stock appears to be stable. Various factors such as ocean conditions and over exploitation are thought to be the primary factors for those groundfish stocks in decline (PFMC 1998a).

Management regulations and catch restrictions have been established for halibut and groundfish species taken incidental to the salmon fishery. The retention of incidental catch within the recreational fishery is dependent upon bag limit restrictions for the species in question (i.e., rockfish and Pacific halibut). In the commercial troll fishery, Pacific halibut and rockfish may be retained in accordance to annual landing restrictions for these species. A limited entry program was developed by the Council in response to the fishing industry request to address the conditions of excessive effort that developed in the 1980s in the groundfish fishery. The license limitation plan was approved and became effective January 1, 1994, details of the program are provided in Amendment 6 to the Pacific Coast Groundfish FMP (PFMC 1998). Groundfish are allocated roughly with 90% of all groundfish to the limited entry fleet and ten percent to the open access fleet. The majority of commercial salmon fishers do not have a groundfish limited entry permits, so their landings of groundfish have are governed by the regulations for the open access groundfish fishery, even though taken while fishing for salmon. Increasing participation by displaced salmon fishers in the open access groundfish fishery has resulted in greater effort, higher landings, and more restrictive limits for some species.

4.2.4 Status of Higher Trophic Level Species

Mature chinook, coho, and pink salmon in marine waters are generally at the top of the food chain. Marine mammal and birds are primarily feeding on juvenile salmon, smaller fish, and invertebrates. The status of these populations is determined at any given time by the combination of temporal and spatial factors played out over many years. Any meaningful analysis of status requires recognition that continual change in size and importance of any given population is the operative norm. Status discussions have limited utility dependent on the window of time in which they are viewed and recognition of forces bring about population shifts. Attempting to analyze population changes annually is problematic because change may be occurring slowly and may be lagging years behind the causes.

Pinniped and cetacean species that interact with salmon fisheries either in the fishery themselves through entanglements and possibly mortalities, or through competition for prey directly or indirectly. The pinniped species present in the management area are California and steller sea lions; Guadalupe fur, northern fur, northern elephant, and harbor seals. Cetacean species present in the management area include Baird's beaked, blue, Cuvier's beaked, false killer, fin, gray, Hubb's beaked, humpback, killer, minke, North Pacific beaked, pilot, Pygmy sperm, right, sei, and sperm whales; Dall's and harbor porpoise; common, north right whale, Pacific white-sided, Risso, and striped dolphins. The Steller sea lion was discussed in Section 4.2.2.2, the population status and management actions concerning these other species are summarized below.

California Sea Lion

California sea lions (*Zalophus californians*) range from offshore islands of Mexico to Vancouver Island, British Columbia. California sea lions use open water for feeding, and near shore islands, reefs, and rocks for hauling out. In the United States, California sea lions breed primarily on the California Channel Islands of Santa Barbara, San Nicolas, San Miguel, and San Clemente. After breeding, many adults and sub-adult males migrate northward into British Columbia, Washington and Oregon. The peak of the northward migration occurs in September through October on the Oregon Coast, in December in Washington, and in January and February in British Columbia. In the spring, most subadults and adult males migrate south, returning to the breeding rookeries in Southern California and western Baja California, Mexico.

The California sea lion population has increased dramatically in this century. The population off the West Coast of the United States has increased steadily at an average annual rate of more than five percent since the mid 1970s and now may be greater than any historical level (Barlow et al. 1995, and Low 1991). The California sea lion off the West Coast of the United States in 1994 was estimated at between 161,066 and 181,355 animals (Barlow et al. 1995).

Guadalupe Fur Seal

Historically, the Guadalupe fur seal (*Arctocephalus townsendi*) ranged from Point Conception, California, to the Revillagigedo Islands, Mexico. At the present time Guadalupe fur seals pup and breed only at Guadalupe Island, Mexico, but individuals have been sighted in the Channel Islands and central California and in the Gulf of California (Gallo 1994). The population is considered to be a single stock because they pup and breed only at Guadalupe Island, Mexico. In 1993, the population was estimated by Gallo (1994) to comprise 7,408 animals. These counts were of breeding populations and indicated the population is increasing exponentially at an average annual growth rate of 13.7%.

Northern Fur Seal

Northern fur seal (*Callorhinus ursinus*) in U.S. waters consists to two distinct stocks - an eastern Pacific stock composed of animals breeding on the Pribilof Islands and Bogoslof Island, and a San Miguel Island stock in southern California. In 1994, stock assessment estimates projected the size of the U.S. population of fur seals to be 1,019,192 animals of which the San Miguel Island stock represented 10,036 animals (Barlow et al. 1997). The eastern population migrates southward in to the eastern North Pacific Ocean during the late fall and early winter, reaching peak numbers of 86,000 off Washington in April (Antonelis and Perez, 1984). Northward migration begins by early spring with fur seals mostly absent from the area from July through December. The San Miguel Island stock is present in California waters year-round. Unlike the Eastern Pacific northern fur seal stock, the San Miguel stock has been increasing in population and is not considered depleted (NMFS 1993).

Northern Elephant Seal

The northern elephant seal (*Mirounga angustirostris*) is the largest of the pinnipeds in the North Pacific. They breed between January and March on islands from central California south to Baja California, Mexico. After the breeding season, they move into coastal and offshore waters with males traveling as far north as southeast Alaska. Current population estimates for the California stocks is 84,000 animals, with the number of pups appearing to be leveling off in the last two years (Barlow et al. 1997).

Pacific Harbor Seals

Pacific harbor seals (*Phoea vitulina richardsi*) inhabit coastal and estuarine waters off Baja California, north along the western coast of North America to Cape Newenham in the Bering Sea. Within Council waters two stocks are recognized: Oregon and Washington coastal stock, and a California stock. They are present year-round and pupping occurs in all three states. Harbor seals use near shore rocks, reefs, and sand bars for rookery and haulout sites. They frequent logs and floating structures, shallow bays, and tidal flats near abundant food sources. The harbor seal population for the West Coast of the United States has been increasing and currently is estimated at 27,131 animals in the coastal waters of Washington and Oregon, and 30,293 animals for California (Barlow et al. 1997).

Dall's Porpoise

Dall's porpoise (*Phocoenoides dalli*) are widely distributed across the entire north Pacific Ocean (Leatherwood and Reeves 1983). Stock structure if the eastern North Pacific Dall's porpoise is not known, but for management and stock assessment purposes the population is divided into two stocks based on geographical areas: Alaskan waters, and California, Oregon, and Washington waters. Off the U.S. West Coast, they are commonly seen in shelf, slope and offshore waters. Typically, they are seen in groups of two to ten animals, although they sometimes aggregate in larger numbers (Ellis 1989). The California/Oregon/Washington population is estimated at 47,661 animals (Barlow et al. 1997). No reliable information on trends in abundance exits.

Harbor Porpoise

Harbor porpoise (*Phocoena phocoena*) in the eastern North Pacific Ocean range from Point Barrow, Alaska, down the West Coast of North America to Point Conception, California (Gaskin 1984). This species is divided into four stocks that may be present within waters under Council jurisdiction: Central California stock, Northern California, Oregon and Washington coastal stock, and Washington inland waters stock. The harbor porpoise is a year round resident that often inhabits bays and inshore waters, however its shyness makes it difficult to acquire accurate population data. Generally observed in small groups of two to ten animals, but are reports of larger aggregation especially when animals are actively feeding (Ellis 1989). Aerial and ship surveys conducted between 1988 and 1993 estimate a population of about 43,000 animals along the coasts of California, Oregon, and Washington (Barlow et al. 1997). Recent population trends for the species along the West Coast appear to be stable, although the distribution and abundance of the Central California stocks appears to be correlated with changes in sea surface temperatures (Forney 1996).

Bottlenose Dolphin

Bottlenose dolphins (*Tursiops truncatus*) are distributed world-wide in tropical and warm-temperate waters. This species primarily inhabits coastal habitats, but surveys also regularly find them in offshore waters (Forney et al.1995). Based on potential fishery interaction this species is divided into three stocks: 1) California coastal stock, 2) California, Oregon and Washington offshore stock, and 3) Hawaiian stock. Since the 1982 through 1933 El ñNiño which increased water temperature off California, California coastal stock have been consistently sighted in central California as far north as San Francisco (Barlow et al. 1997). The California, Oregon and Washington offshore stock may range into Oregon and Washington during periods of warm-water intrusions. The total population of this species (coastal and offshore) occurring off the West Coast of the United States is estimated at 2,695 animals (Barlow et al. 1997). No reliable estimate can be made regarding trends in abundance for this species.

Northern Right Whale Dolphin

Northern right whales (*Lissodelphis borealis*) are endemic to temperate waters of the North Pacific Ocean. Off the U.S. West Coast, they are found primarily in shelf and slope waters, with some evidence of seasonal north-south movement (Forney et al. 1995). For potential fishery interaction purposes this species is defined as a single stock including only animals found within the U.S. EEZ of California, Oregon and Washington. The population is estimated at 21,332 animals off the U.S. West Coast (Barlow et al. 1997). No information is available regarding trends in abundance of northern right whale dolphins in California, Oregon, and Washington.

Pacific White-Sided Dolphin

Pacific white-sided dolphins (*Lagenorhynchus obliquidens*) are endemic to temperate waters of the North Pacific Ocean, and are common both on the high seas and along the continental margins. Off the U.S. West Coast, Pacific white-sided dolphins have been seen primarily in shelf and slope waters. Based on potential fishery interactions, the population has been divided into two stocks: California/Oregon/Washington stock and the Alaskan stock. The population size for the California, Oregon and Washington stocks is placed at 121,693 animals (Barlow et al. 1997). No reliable information exists on trends in abundance for this stock.

Risso's Dolphin

Risso's dolphins (*Grampus griseus*) are distributed world wide in tropical and warm-temperate waters. Off the U.S. West Coast, Risso's dolphins are commonly seen on the shelf in the Southern California Bight and in slope and offshore waters of California, Oregon and Washington. Based on potential fishery interactions the population is divided into two discrete, non-continuous areas 1) waters off California, Oregon and Washington, and 2) Hawaiian waters. The California, Oregon and Washington population is estimated at 32,376 animals obtained from aerial surveys (Forney et al. 1995). No reliable information exists on trends in abundance for this stock.

Striped Dolphin

Striped dolphins (*Stenella coeruleoalba*) are distributed world-wide in tropical and warm-temperate waters. Recent ship board surveys observed this species within 100 nautical miles to 300 nautical miles from the coast (Barlow et al. 1997). For the Marine Mammal Protection Act (MMPA) stock assessment reports, striped dolphins within Pacific U.S. EEZ are divided into two discrete non-contiguous areas 1) waters off California, Oregon, and Washington, and 2) waters around Hawaii. In recent analysis combining data from 1991 and 1993 ship board surveys within 300 nautical miles of the California coast, (Barlow and Gerrodette 1996) estimate the abundance of striped dolphins to be 24,910 animals. There is insufficient data available to evaluate potential trends in abundance for this species.

Short-Beaked Common Dolphin

Short-beaked common dolphins (*Delphinus delphis*) are the most abundant cetacean off California and are widely distributed between the coast and at least 300 nautical miles distance from shore. The abundance of this species off California has been shown to change on both seasonal and inter-annual time scales (Forney et al. 1995). For the MMPA stock assessment reports, this is a single pacific management stocks for this species off the coast of California, Oregon and Washington. This species population is estimated at 372,425 animal within 300 nautical miles of the California coast. Abundance of this species in Council waters varies with oceanographic condition, recent events appear to have increased both the relative and absolute abundance of this species off California (Barlow et al. 1997).

Long-Beaked Common Dolphin

Long-beaked common dolphins (*Delphinus capensis*) have only recently been recognized as a distinct species (Rosel et at. 1994). Along the U.S. West Coast their distribution overlaps with that of the short-beaked common dolphin, and much historical information has not distinguished between these two species. Long-beaked common dolphins are commonly found within about 50 nautical miles of the coast from Baja California, Mexico, northward to about central California (Barlow et al. 1997). Ship board surveys in 1991 and 1993 off the California coast project abundance of long-beaked common dolphins as 8,980 animals (Barlow and Gerrodette 1996). Due to the historical lack to distinguish between the two species of common dolphins it is difficult to establish trends in abundance for this species.

Baird's Beaked Whale

Baird's beaked whales (*Berardius bairdii*) are distributed throughout deep waters and along the continental slopes of the North Pacific Ocean. They have been sighted in virtually all areas north of 35° N latitude, particularly in regions with submarine escarpments and sea mounts (Kasuya and Ohsumi 1984). They are the most commonly seen beaked whales within their range, perhaps because they are relatively large and gregarious, traveling in schools of a few to several dozen, which makes them more noticeable to observers. Baird's beaked whales are migratory, arriving in continental slope waters during summer and fall months when surface temperatures are the highest (Dohl et al. 1983). Baird's beaked whales found in the waters off California, Oregon, and Washington are managed as a single stock based on potential fishery interaction considerations. The population estimate for this stock is 252 animals (Barlow et al. 1997). Reliable estimates of trends in abundance for this stock is currently unavailable.

Blue Whale

Blue whales (*Balaenoptera musculus*) are distributed in temperate and tropical waters of both hemispheres. Along the coast of the eastern north Pacific, blue whales range from Alaska to Mexico. Generally, observed migrating individually or in groups of three to four along the continental slope. The current population estimate for blue whales is 1,785 animals for the California/Mexico stock (Barlow et al. 1997). No reliable data is available on the current trend in abundance for this stock.

Cuvier's Beaked Whale

The distribution of Cuvier's beaked whales (*Ziphius cavirostris*) is known primarily from strandings, which indicate it is the most widespread of the beaked whales and is distributed in all oceans and most seas except in high polar waters (Moore 1963). In the northeastern Pacific from Alaska to Mexico no obvious patterns of seasonality to strandings have been identified (Mitchell 1968). Populations found in the waters of California, Oregon and Washington are considered a single stock for management and stock assessment purposes. The population estimate for the California, Oregon and Washington stock is 9,163 animals and is considered conservative because survey work did not cover the waters of Oregon and Washington (Barlow et al. 1997). Reliable estimates of trends in abundance for this stock is currently unavailable.

Fin Whale

Fin whales (*Balaenoptera physalus*) are found world wide in coastal waters of temperate oceans and are uncommon in tropic and polar regions. Actual population structure and seasonal distribution of fin whales in the eastern Pacific is uncertain. The population of fin whales in California has been estimated at 933 animals based on ship surveys (Barlow et al. 1997). No estimates exist for Oregon or Washington waters at this time.

Mesoplodont Beaked Whales

Mesoplodont beaked whales (*Mesoplodon* spp.) Are distributed throughout deepwater and along the continental slopes of the North Pacific Ocean. At least five species in this genus have been recorded off the U.S. West Coast, but due to the rarity of records and the difficulty in identifying these animals in the field virtually no species specific information is available (Mead 1989). The five species known to occur in this region are: Blainville's beaked whale (*M. densirostris*), Hector's beaked whale (*M. hectori*), Stejneger's beaked whale (*M. stejnegeri*), Gingko-toothed beaked whale (*M. gingkodens*), and Hubbs' beaked whale (*M. carlhubbsi*). Until methods of distinguishing these five species are developed, all the *Mesoplodon* whales located in the waters of California, Oregon and Washington are considered one stock. The collective population estimate for this stock is 2,106 animals (Barlow et al. 1997). No reliable data exists on trends in abundance of these species.

Gray Whale

The gray whale (*Eschrichtius robustus*) is primarily a coastal, near shore species usually found in water depths of less than 50 meters. Its range extends from breeding grounds off of Baja California, Mexico, to major feeding areas in the Bering and Chukchi Seas. Two stocks are recognized in the North Pacific, the eastern Pacific Stock and the western Pacific stock or "Korean" stock. The population of Eastern North Pacific gray whales is estimated to be 22,571 animals (Hobbs et al. 1996). The population has been increasing over the past several decades with estimated annual rate of increase at 3.29% (Buckland et al. 1993a). In June 1994, the eastern North Pacific stock of gray whale was removed for the list of Endangered and Threatened Wildlife.

Humpback Whale

Humpback whales (*Megaptera novaeangliae*) are found throughout the North Pacific. Based on genetic differences and sighting of distinctive marked individuals, the population found in the coastal waters of California, Oregon, Washington, and Mexico are considered one stock. This stock ranges from Costa Rica (Steiger et al. 1991) to southern British Columbia (Calambokidis et al. 1993), but is most common in coastal waters off California in summer and fall, and in Mexico in the winter and spring. The stock abundance estimate for this population is 597 animals, however, no reliable data is available on the current trend in abundance for this stock (Barlow et al. 1997).

Killer Whale

Killer whale (*Orinus orca*) populations have been observed in all oceans and seas of the world (Leatherwood and Dahlheim 1978). These animals prefer the colder waters of both hemispheres, with the greatest abundances found within 800 kilometers of major continents. Based on genetic differences and consideration of potential fishery interaction, there are three killer whale stocks that may reside in waters under Council jurisdiction: Eastern North Pacific southern resident stock (inland waters of Washington); Eastern North Pacific transient stock (Alaska-inland waters of Washington); the California/Oregon/Washington Pacific coast stock. Survey techniques utilized for obtaining population estimates of killer whales is a direct count, and a correction factor is currently unavailable. Given that scientists continue to identify new whales, the estimate of abundance on number of uniquely identified individuals known to be alive is likely conservative. No abundance estimates have been made for offshore Oregon and Washington waters. Population estimate for California and inland waters of Washington do exist and combined produce an estimate of 843 animals (Barlow et al. 1997). Reliable data on trends in abundance for either of these two stocks is considered unavailable.

Minke Whale

Minke whales (*Balaenoptera acutorostrata*) are usually seen over the continental shelves in the eastern Pacific Ocean from near the equator north to the Bering Sea (Leatherwood et al. 1982). Minke whales in Washington, Oregon and California are considered a separate stock as it appears they have established a home range within this region (Dorsey et al. 1990). No estimates have been made for the number of minke whales in the entire North Pacific or for the number that occur in the collective waters of Washington, Oregon, and California. In California coastal waters, the number of Minke whales is estimated at 201 animals (Barlow et al. 1997). No data exists on trends on abundance for this stock.

Right Whale

Right whales (*Eubalaaena glacialis*) inhabit temperate and cooler coastal waters of the north Pacific. Based on sighting data, Wada (1973) estimated a total population of 100 to 200 in the north Pacific. The lack of confirmed sightings of juveniles since the 1900 has raised concerns on the viability of this species. However, a group of three to four right whales were sighted in western Bristol Bay (July 4, 1996) which appears to have included a juvenile animal (Goddard and Rush in press). A reliable estimate of abundance for the North Pacific right whale stock is currently not available (Hill et al. 1997).

Sei Whale

Sei whales (*Balaenoptera borealis*) are distribute far out to sea in temperate regions of the world and do not appear to be associated with coastal features. Sei whales are now rare in California coastal waters (Dohl et al. 1983), but were the fourth most common whale taken by California coastal whalers in the 1950s through 1960s (Rice 1974). Lacking additional information on the Sei whale population structure, Sei whales in the eastern North Pacific are considered a single stock. There are no abundance estimates for Sei whales along the West Coast of the U.S. or in the eastern North Pacific (Barlow et al. 1997).

Short-Finned Pilot Whale

Short-finned pilot whales (*Globicephala macrorhynchus*) inhabit coastal areas of the tropics and warm-temperate waters of the eastern North Pacific Ocean. Short-finned pilot whales were commonly seen off southern California, with an apparent resident population around Santa Catalina Island, as well as, seasonal migrants (Dohl et al. 1980). After a strong El Niño event in 1982 through 1983, short-finned pilot whales virtually disappeared from this region, and despite increased survey efforts along the entire U.S. West Coast, few sighting were made from 1984 through 1992 (Green et al. 1992, Carretta and Forney 1993). Approximately nine years after virtual disappearance of short-finned pilot whales following the 1982 through 1983 El Niño, they appeared to have returned to California waters, as indicated by an increase in sighting records, as well as, incidental fishing mortality (NMFS, unpublished data; Julian and Beeson, in press). Based on potential fishing interactions this species is managed as one stock in the waters of California, Oregon and Washington. The population size is estimated as 1,004 animals, but until movement contributed to environmental factors are better documented, no inferences can be drawn regarding trends in abundance of short-finned pilot whales off California, Oregon, and Washington (Barlow et al. 1997).

Sperm Whale

The sperm whale (*Physeter catodon*) is an open-water species and is found mainly in temperate to tropical waters in both hemispheres. They feed mainly on medium - to large-size squid, but may also feed on large dermsal and mesopelagic sharks, skates, and fishes (Gosho et al. 1984). Sperm whales are found year round in California waters (Dohl et al. 1983), but they reach peak abundance from April through June and from the end of August through mid-November (Rice 1974). They are seen in every season except winter (December through February) in Washington and Oregon (Green et al. 1992). The populations of this stock in California, Oregon, and Washington is estimated at 1,231 animals which is considered conservative as the population assessment survey utilized did not include waters of Oregon and Washington (Barlow et al. 1997). Data regarding trends in population of this species in the eastern North Pacific is currently unavailable.

Pygmy Sperm Whale

Pygmy sperm whales (*Kogia breviceps*) are distributed throughout deep waters and along the continental slopes of the North Pacific and other ocean basins. Sightings along the U.S. West Coast have been rare, probably due to their pelagic distribution and cryptic behavior (Barlow et al. 1997). Based on potential fishery interactions, this species is managed as a single stock in the waters off California, Oregon and Washington. The population abundance is estimated at 3,145 animals for this species, but is considered conservative as it is generated from ship surveys of only California waters (Barlow et al. 1997). Insufficient data is available to evaluate potential trends in abundance of this species.

Dwarf Sperm Whale

Dwarf sperm whales (*Kogia simus*) are distributed throughout deep waters and along the continental slopes of the North Pacific and other ocean basins. Along the U.S. West Coast, no at sea sightings of this species have been reported, although strandings have been recorded in California on several occasions (Barlow et al. 1997). It is unclear whether records of dwarf sperm whales are so rare because they are not regular inhabitants of this region, or merely because of their cryptic habits and offshore distribution. No information is available to estimate the population size of dwarf sperm whales off the U.S. West Coast, and the lack of sightings or strandings records since 1981 makes it unclear whether their current distribution includes this region (Barlow et al. 1997).

4.2.5 Status of Seabirds

Seabird populations are found to be most densely concentrated over the continental shelf and least so eastward of the continental slope (i.e., waters deeper than 2,000 meters). Approximately, 4.5 million seabirds are estimated to reside and nest in the contiguous West Coast of the United States (Strategic Assessment Branch, NMFS, 1990). The size and diversity of the breeding seabird community in this region is reflective of nearshore prey conditions; subtropic waters within the California Bight; large estuaries at San Francisco Bay, Columbia River, and Grays Harbor-Willapa Bays; complex tidal waters of Puget Sound; and the variety of nesting habitats used by seabirds throughout the region, including islands, mainland cliffs, old growth forests and artificial structures.

Every area over the continental shelf harbors dense concentrations of birds during the year. However, a few locations stand out prominently. The major colony complexes are located in the Channel Islands and Farallon Islands off California, southern and northern Oregon, and along the Olympic Peninsula of Washington (MMS 1992 and Carter et al. 1998). Offshore of these sites, nesting birds foraged in dense aggregations to about 50 kilometer radius. Foraging areas differ somewhat for each species. Petrels, shearwaters, and alcids commonly use shelf-edge banks and the broad shelf areas foraged by shearwaters, gulls, murres, and auklets. These seabird populations generally feed upon zooplankton, small schooling fish, and squid.

Overall abundance has remained stable or increased for most species of seabirds in recent years (Carter et al. 1998). Some species have experienced declines in localized areas as a result of habitat destructure, human interaction, predation, and oil spills. All populations have fluctuated in response to El Niño conditions and experienced lower productivity and some degree of colony abandonment during intense El Niño events (e.g., 1982 through 1983 and 1992 through 1993). The major exception to this trend would be the common murre (*Uria aalge*) which is the dominate member of the breeding seabird community on the West Coast. This species declined substantially after the 1982 through 1983 El Niño event and has yet to recovery in central California and Washington. The primary factors thought to be precluding their recovery is the combined effects of high mortality from gillnet fishing and oil spills, plus poor reproduction during subsequenct El Niño events (Carter et al. 1998).

4.2.6 Status of Lower Trophic Level Species

Forage species perform a critical role in the complex ecosystem by providing the transfer of energy from the primary or secondary producers to higher trophic levels. Many species undergo large, seemingly unexplainable fluctuations in abundance. Most of these species have high reproductive rates, are short lived, attain sexual maturity at young ages, and have fast individual growth rates such as herring, anchovy, sardines, smelt, capelin, and sand lance. These biological characteristics make the species more susceptible and responsive to seasonal, interannual and decadal shifts in oceanographical conditions within the ecosystem.

Spring and summer upwelling off the coasts of California, Oregon, and Washington supports the high production of phytoplankton and zooplankton which forms the basis for the oceanic food chain. The same environmental factors that determine distribution, abundance, and species composition of these resources also affects fish communities. For the purposes of this analysis, the summary of the status of lower trophic level species is limited to the primary prey items of the targeted species. As stated earlier, the targeted species are adult chinook, coho, and pink salmon in the salmon fisheries off the coasts of Washington, Oregon, and California..

Squids, euphausiids, amphipods, and small schooling fish are important prey taxa for salmonids. Research indicates juveniles salmonids appear to be opportunistic predators which feed upon the available mix of prey items (Pearcy 1998). Young coho and chinook salmon occur in the shelf zone in summer-autumn and consume small fish and squid (Gorbatenko 1989). Pink salmon move to deep sea areas as juveniles and fed on plankton, then return to the shelf waters in summer as prespawning adults to fed on small fish and squid (Gorbatenko 1989).

Of the salmon forage species, only Pacific herring (Clupea harengus), Pacific sardine (*Sardinops sagax*), northern anchovy (*Engraulis mordax*), and market squid (*Loligo opalescens*) are subject to a directed commercial fishery. These species represent the primary components of the coastal pelagic species (CPS) fishery and currently two of the most important species are Pacific sardine, and market squid. The fishery for coastal pelagic species is one of the largest on the West Coast. In 1997, CPS finfish contributed 32% and CPS finfish plus squid contributed 68% of total commercial landings in California (PFMC 1998b). Market squid (70,683 mt), sardine (38,419 mt), northern anchovy (47,416 mt), and Pacific herring (7,300 mt) were four of the top five species in terms of total landings, with total landings for all species at 193,184 mt (PFMC 1998b).

In recent years, the abundance and landings of northern anchovy has been stable at low levels. Landings of Pacific sardine have increased in recent years with increased biomass and higher quotas. In 1997, sardine supported the second largest (by volume, not value) fishery in California. Squid landings increased recently to record high levels due to increased availability and prices but decreased dramatically during the El Niño of 1997 through 1998. In 1997, squid supported the largest and most valuable fishery in California. Pacific herring are primarily harvested in inshore waters under state jurisdiction, with recent landing trends being well below historical long term averages (CDFG, ODFW, WDFW, personal communications).

4.3 OVERVIEW OF SOCIOECONOMICS

A detailed description of socioeconomic characteristics of the fishery is provided in Appendix B to the FMP. The following is a brief summary for those who may not be familiar with this fishery.

In the ocean fishery area managed by the Council, only state licensed ocean troll vessels are allowed to harvest salmon for the commercial market. Certain trawl vessels are allowed to retain salmon taken as bycatch, however, they may not receive payment for the fish and the fish must be donated to charities such as food banks. In 1997, there were approximately 1,300 vessels active in the fishery and 3,700 state limited entry troll vessel licenses. In 1980 there were 11,200 ocean troll vessels on the West Coast. The number of active vessels has generally been on a downward trend since that time. The exvessel value of the 1997 harvest was $9.8 million, and the average 1976 through 1996 exvessel value of the harvest was $25.0 million. In addition to declining opportunities to harvest fish, salmon trollers have been hit by declining prices due to the increasing presence of farmed salmon on world markets.

Recreational salmon anglers in the ocean fish primary from charter and private fishing vessels. Very small amounts of salmon are taken in marine waters by anglers from jetties and piers and mainly in inside fisheries. In 1997, 292 thousand salmon angler trips were made. Of these 59% were from private vessels and 41% from charter vessels. Recreational ocean fisheries from Eureka, California and northward have been severely depressed in recent years as compared to their historic levels. In this northern region, angler participation on charter vessels has generally declined more than participation on private vessels. The number of charter vessel operations are not counted consistently from one state to the next. For 1997, California reported that there were 120 vessels that made some landings of salmon (compared to 149 in 1987, the earliest year for which data is available), Oregon reported that it had 122 recreational charter vessels that could potentially participate in the salmon fishery (down from 194 in 1980), and Washington reported that it had 209 vessels licensed specifically for the recreational salmon fishery (down from 510 in 1980).

Treaty Indian fishers harvest in ocean waters off Washington, taking most of their fish using troll gear in tribal commercial fisheries, but also harvesting small amounts for ceremonial and subsistence purposes. Other tribal fisheries occur in inside waters including the Klamath River, Siletz River, Columbia River system, Washington coastal rivers and inside Washington marine waters and rivers.

As with the Indian fisheries there are inside non-Indian recreational and commercial fisheries. The primary inside commercial fisheries occur in Puget Sound, the Strait of Juan de Fuca, Grays Harbor, Willapa Bay and the lower mainstem of the Columbia River below Bonneville Dam. Recreational fisheries occur in these areas as well, along with numerous other fresh water streams in Washington, Oregon, California, and Idaho. These fisheries, while impacting Council conservation goals, are not directly under the Council jurisdiction. Similarly, recreational and commercial harvesters in Canada and Alaska take West Coast salmon stocks. In addition to their affect on stock abundances, these other fisheries compete in the market place with the West Coast ocean production of salmon for food and recreational uses.

Others who may be characterized as users of the salmon resource include Northwest residents who value salmon as a regional symbol, individuals who value salmon as an indicator of ecosystem health and contributor to biological diversity, those who value salmon as a future use option for themselves or their progeny, and those who value salmon simply because they like knowing the salmon exist.

5 ENVIRONMENTAL IMPACTS

In this chapter, the assessment of fishery environmental impacts is updated by (1) comparing the fisheries of the early and mid 1980s to fisheries of the 1990s, an era with more stocks in a depressed state and reduced fishing opportunities, and (2) discussing the consequences of continued decline in stock abundance and increased listings under the Endangered Species Act (ESA). In order to understand the interactions between fishery impacts and harvest reduction to protect weak stocks, it is important to understand the nature of the management measures by which the harvest reduction is achieved. This chapter first reviews management measures used to achieve harvest reductions (Section 5.1), then discusses impacts of the reduced fisheries on the marine environment (Section 5.2), and concludes by discussing impacts of the reduced fisheries on the human environment (Section 5.3).

In general, the potential marine environmental impacts associated with harvest in directed salmon fisheries, as compared to no harvest, include 1) reduced abundance of sexually mature salmon bound for the spawning habitat, which may, at the same time, both increase the potential production of healthy stocks and decrease potential production of weak stocks; 2) increased mortality of immature salmon present in the harvest area; 3) changes in the marine habitat as a result of interaction with fishing gear; 4) some harvest of non-target species (deliveries in concurrent fisheries and bycatch mortality); and 5) results in changes in abundance and composition of the marine community structure as a result of the removal of top-level predators, salmon (also known as "cascading effect" National Research Council 1996). All of these impacts can be controlled to some extent by the wise management of the West Coast salmon fisheries and some are not believed to be significant, such as hook-and-line salmon fishing gear impacts on marine habitat.

Human environmental impacts associated with the salmon fisheries include economic and social consequences to direct and indirect users and impacts on nonusers related to existence values held for the fish and/or fisheries. The groups most subject to socioeconomic impacts of the directed salmon fisheries include California, Oregon, and Washington troll permit holders, recreational anglers, recreational charter vessel owners, treaty fishers, salmon processors, and consumers. Additionally, businesses in all the coastal communities along the West Coast benefit from fishing industry related expenditures in the communities.

5.1 MANAGEMENT MEASURES USED TO TARGET THE SALMON FISHERY

In an extreme case, complete closure of the ocean fishery or portions thereof could be used to limit impacts on stocks of concern in the mixed stock ocean fishery. However, the fishery management plan (FMP) provides the latitude to use a broad range of fishery management techniques to minimize impacts to species, stocks, or sizes of fish of concern while trying to maximize access to harvestable fish. Categories of restrictive measures to protect fish of concern and target harvestable fish include gear restrictions, time/area management, and catch or retention restrictions (e.g., number, species, or marked fish). The protection of certain species, stocks or sizes of fish through the use of restrictive fishery management measures may or may not reduce total catch and often allows greater aggregate ocean fishing opportunity and harvest.

With a growing list of stock-specific conservation concerns, the need for discerning fishery management techniques grows. Whether a particular management technique is appropriate or effective depends on the specific application. The biological, social, and economic implications also differ by management technique. The sections below provide a summary of the basic fishery management techniques that are utilized within the coverage area of the Pacific Fishery Management Council (Council) to target harvestable salmon.

5.1.1 Gear Restrictions

Gear restrictions limit the type, amount or usage of fishing equipment. Sometimes these restrictions are out right bans, at other times they are only limits on the type or amount of gear used.

Restriction on gear configuration is a common management technique to reduce total catch or impacts on certain species. In the recreational fishery this can come in the form of restrictions on the number of rods that can be fished at one time by an individual. Within the commercial fishery, a corresponding restriction is reducing the standard gear configuration from eight to four spreads (hooks) per line. When this restriction is used in conjunction with a chinook only fishery, it can reduce or minimize the catch of coho salmon. This restriction exploits behavior differences between species, as coho are generally found higher in the water column than chinook. Studies have shown that with more spreads per line, more hooks are near the surface where coho encounter rates are greater (Lawson 1990, NRC 1997).

Another type of gear restriction is the limitation on the type or size of hooks. These restrictions generally are employed to reduce catches of certain sizes or species of fish. Regulations may require the use of only a certain type of hook such as barbless or circle hooks in the fishery. These restrictions reduce the mortality of fish encountered by decreasing the probability of the occurrence of fatal wounds (Butler and Loeffel 1972, Grover and Palmer-Zwahlen 1996, Grover et al. 1997). Lower mortality can be used to save fish or lengthen the fishing season. Hook size also may be regulated in attempts to produce further savings of fish through reduced mortality of juvenile or nontargeted fish (NRC 1994, Grover et al. 1996, NRC 1997).

5.1.2 Time/Area Restrictions

Time and area closures seek to reduce impacts on specific species or portions of the overall population that dominate a particular area or time. These come in the form of closures of particular areas, such as off the mouth of a given river system or stretch of coast line. This type of regulation also can be applied inside or outside of a specific depth contour or distance from shore. These actions can allow protection of a specific stock only if they exhibit a distinct spatial or temporal distribution.

5.1.3 Catch Restrictions

Catch restrictions reduce or save harvest impacts by reducing a certain portion of the catch or dampening the overall catch of the population. The general objective of these regulations is to produce savings of fish by releasing a greater portion of the total amount of fish encountered. This action will still result in some loss of fish to nonlanded mortality. Within the Council process, estimates of nonlanded mortality represent a variety of mortality sources (e.g., drop-off mortality, hook-and-release mortality, and other unaccounted mortality sources) which are associated with the different recreational and commercial salmon fisheries (STT 1994). Annually, during the preseason process, estimates for nonlanded mortality are applied and quota adjustments made based on the proposed fishing regimes. Examples of the various catch restrictions utilized within the Council process include: size limits, landing ratios, nonretention fisheries (species specific), and selective harvest of mass marked fish.

Size limit restrictions decrease impacts by lowering the proportion of fish encountered that are legal for retention. Generally, the intent is to focus harvest on mature adult fish and limit impacts on the juvenile population only to hooking mortality. The biological benefit is the number of fish required to be released less the hooking mortality related impacts. However, if abundance of juveniles greatly out numbers adults in the same area the savings may be non existence.

Ratio fisheries involve limitations on the mixture of species of salmon that can be landed and generally are only utilized in commercial fisheries. The management purpose is to prevent targeting of one species (generally the less abundant species) over another. The regulatory objective is to increase the probability that the fishery will achieve both quotas simultaneously through manipulation of the catch rate of both species in a given fishery or management area.

Nonretention fisheries are the next graduated step up from ratio fisheries. This is the prohibition of landing one or more species in a mixed stock fishery. These catch restrictions establish species specific fisheries in a given time or area. This action affords access to the more abundant species and minimizes impacts on prohibited species to hooking mortality.

The most recent variation of selective fishery management techniques considered for ocean salmon fisheries involves restricting harvest only to mass marked fish. Generally, mass marking has been applied to hatchery coho stocks. This management technique establishes fisheries to selectively harvest stocks of fish readily distinguishable by external marks, thereby, allowing fisheries to target on hatchery stocks and avoid or minimize impacts on wild segments of the population. Impacts on unmarked stocks are limited to nonlanded mortality and some degree of incidental impacts due to miss identification of unmarked fish as marked.

5.2 PHYSICAL AND BIOLOGICAL IMPACTS

Physical and biological impacts of the West Coast salmon fisheries would be the same whether conducted under the existing FMP or an amended FMP in compliance with the new Magnuson-Stevens Act requirements. The act of fishing, through reduction of one component of an ecosystem, may affect other components, especially predators, competitors, and prey of the target species. The following are interpretations of the physical and biological impacts of the current salmon fisheries conducted off the coasts of Washington, Oregon, and California.

Physical impacts are those that would be caused by (1) fishing gear on the substrate and associated benthos (e.g., attached animals and plants) and (2) deposition of fish wastes resulting from processing activities.

The fishing gear (hook and line) used in the West Coast ocean salmon fisheries has minimal impact, if any, on the physical environment. The activity targets only adult salmon in the water column, successfully avoiding any significant disturbance of the benthos, substrate, or intertidal habitat. The fishing activity and subsequent fish processing is not considered to introduce significant waste or offal into adjacent marine waters. Thus, the West Coast salmon fisheries have no significant physical impacts on substrate or benthos, and contribute no significant amounts of organic waste into the marine environment.

Biological impacts on the environment are changes in the status of targeted species of salmon, other fish species, marine mammals, seabirds, and other predators and prey. These impacts are discussed below.

5.2.1 Impacts on Target Species

Impacts on targeted species should be managed under a framework that (1) ensures sustainable harvest, (2) protects against resource depletion, and (3) rebuilds depressed stocks.

The Council's management of the salmon fisheries is based on optimum yield as defined by maximum sustainable yield which may be reduced upon consideration of conservation, fishery, or allocation objectives. The conservation objectives are to protect, rebuild, and enhance the runs contributing to the ocean fisheries. Fishery objectives seek to provide for economically viable commercial, recreational, and tribal fisheries consistent with conservation objectives and with other applicable law, including those related to treaty Indian fishing rights. Allocation objectives seek to provide a fair and equitable sharing of the available harvest both among parties within a particular fishery and between respective management fora governing fisheries that also impact this shared resource.

Optimum yield is the resulting harvest which occurs after balancing the conservation objectives for each stock or stock group covered by this framework management plan. Annually, the salmon fisheries are limited by impacts to the "weakest stock" contained within the FMP relative to its management objective. Under this "weak stock management" approach, the constraining stock or stock group is determined based on the current year's abundance forecast and ocean impacts then are limited by their specified conservation objectives.

The status quo alternative is represented by continued implementation of the existing FMP. This is not a viable alternative as it leaves the FMP in violation of the amended Magnuson-Stevens Act. Such action would force the U.S. Secretary of Commerce, via National Marine Fisheries Service (NMFS), to comply with the Magnuson-Stevens Act requirement and develop a salmon management plan independent of the Council process. A further potential consequence of the status quo alternative is it may result in separate Section 7 or Section 10 consultations for each ocean salmon fishery.

The preferred alternative is for the Council to modify the FMP to comply with the amended Magnuson-Stevens Act requirements regarding essential fish habitat, optimum yield, overfishing, and bycatch. Under this proposed action the management of the West Coast salmon fisheries continues to be regulated to protect to the extent possible, any depressed stock originating from within the coverage area. Continuation of this comprehensive and coordinated approach to management will have no adverse effect on the targeted species. Revising the existing FMP to incorporate the new essential fish habitat, optimum yield, overfishing, and bycatch standards will, if anything, lead to more conservative management.

5.2.2 Impacts on ESA Listed Species

Impacts of ocean salmon fishing activity on ESA listed species occurs in direct contact from targeted harvest and incidental mortality due to encounters with fishing gear (hook-and-release mortality). Indirect impacts include competition with fisheries for prey and alteration of the food web dynamics due to fishing removals.

The only ESA listed species likely to be impacted directly by the West Coast salmon fisheries are the listed inter-related populations of salmon, steelhead, and trout or Evolutionarily Significant Units (ESUs). The assumed impacts to listed salmon ESUs are fully explained in the 1998 biological assessment (NMFS 1998). Since 1992, NMFS has, through Section 7 consultation process, determined that West Coast ocean salmon fisheries do not jeopardize the continued existence of the various listed salmon populations or result in the destruction or adverse modification of their critical habitat and have issued incidental take statements for the fisheries (NMFS 1993, 1994, 1995, 1996, 1997, 1998). Given the completion of the sixth consultation process and issuance of an incidental take permit, this EIS concludes that the status quo and preferred alternatives do not jeopardize the continued existence of ESA listed salmon.

Available information indicates that West Coast ocean salmon fisheries only rarely catch steelhead (STT 1997). Steelhead retention is prohibited in the nontreaty commercial fisheries, but permitted in recreational and treaty fisheries. Some of the steelhead caught may be from ESUs that are not listed. Others may be hatchery-origin fish. Potential impacts are limited further by non-retention requirements on nontreaty commercial fisheries. NMFS determined, based on the available information, Council managed salmon fisheries are not likely to jeopardize the continued existence of the listed steelhead ESUs (NMFS 1998).

Cutthroat trout are neither targeted or caught incidently on ocean salmon fisheries. There is no record of any cutthroat trout being caught in West Coast salmon fisheries. The Salmon Technical Team (STT) of the Council has concluded that the catch of cutthroat is almost nonexistent (STT 1996). NMFS has determined, based on the available information, that Council managed fisheries are not likely to jeopardize the continued existence of Umpqua River cutthroat trout (NMFS 1998).

The remaining ESA listed species of pinnipeds, sea turtles, cetaceans, and seabirds are assumed only to be indirectly impacted by ocean salmon fishing activities.

Steller sea lion interaction with the West Coast salmon fisheries is rare. Available information indicates that the West Coast salmon fisheries are not likely to jeopardize the continued existence of the Steller sea lion eastern population. NMFS has determined that for Steller sea lions, the mortality and serious injury incidental to commercial fishing operations will have negligible impact (60 FR 45399; August 31, 1995). A 'negligible impact' is defined as an impact resulting from the specified activity that cannot be reasonablely expected to, and is not reasonably likely to, adversely affect the species or stock through an effect on annual rates of recruitment or survival. Section 7 consultation was completed on this determination (NMFS 1995b) including issuance of an incidental take statement for commercial fishing operations of up to 106 Steller sea lions from the eastern population annually (east of 144° W longitude).

There is no record of any Guadalupe fur seal being killed or injured by ocean salmon fishing activity. The primary range for the Guadalupe fur seal is south of the US/Mexico border. Only a few Guadalupe fur seals are known to inhabit California sea lion rookies in the Channel Islands (Stewart et al. 1987). The total U.S. fishing mortality and serious injury for this stock is less than ten percent of the calculated potential biological removal under Marine Mammal Protection Act (MMPA) standards and; therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate (Barlow et al. 1997). Thus, available information indicates that West Coast salmon fisheries are not likely to jeopardize the existence of this species.

No sea turtles have been reported taken by the ocean salmon fisheries off Washington, Oregon, and California. NMFS has determined that commercial fishing by coastal fisheries poses a negligible threat to the pacific species (NMFS 1990). Research indicated that the incidental involvement of sea turtles with commercial fisheries on the West Coast is rare. Available information indicates that the West Coast salmon fisheries are not likely to jeopardize the continued existence of the sea turtles populations in the north Pacific Ocean.

With regard to ESA listed cetaceans and seabirds, the ocean fisheries harvest salmon which are not among the primary prey items for these species and; therefore, do not compete with these listed species for the salmon. The harvested fish are taken late in the salmon's life cycle and, consequently, are beyond the size of prey suitable for foraging cetaceans and seabirds. Fish ingested by the large baleen whales eat almost exclusively small schooling fish such as capelin, herring, and eulachon, or juvenile of commercially exploited groundfish fisheries, such as pollock, cod, and atka mackerel (Perez and McAllister 1998). Whales and salmon; therefore, complete for food directly. It is not known to what degree salmon and whales compete for prey or if either population is, as a result, limited.

Salmon fishing activity may occur in locations frequented by migrating or feeding cetaceans. The vessels used in the fisheries, and operators thereof, have occasional interactions with cetaceans; however, any possible adverse effect on these species is minimized. Interactions are largely mitigated though NMFS sponsored education programs sensitizing harvesters to marine mammals protection laws and providing approach and watching guidance. Harassment of marine mammals is against the law. Violators are prosecuted individually as opposed to holding the entire fishery accountable for the conduct of an individual fisher.

In summary, either continuing the status quo for the West Coast ocean salmon fisheries or proceeding with the preferred alternative would have approximately the same effect on the continued existence and recovery of ESA listed species within the coverage area, including salmon, steelhead, and trout.

5.2.3 Impacts on Other Fish Species Taken Incidentally

Impacts of ocean salmon fishing activity on other fish species occurs through 1) harvest, 2) incidental mortality due to encounters with fishing gear (hooking mortality), and 3) alteration of the food web dynamics due to fishing removals.

The impacts on other fish species taken incidentally to ocean salmon fishing is assumed not to be significant. Some non-salmon species are landed in concurrent fisheries by commercial and recreational fishers under the appropriate corresponding fishery regulations. The primary species involved are halibut, rockfish, sablefish, and lingcod. These landing and harvest impacts are regulated and monitored under separate fishery management plans for the species in question.

Incidental mortality (hooking mortality) of non-salmon species in directed salmon fisheries not subject to species-specific fishing regulations, generally are not monitored or quantified, since the widely held assumption is that no population level impacts exist. Should this situation change, the FMP would be amended to address these impacts in the future.

5.2.4 Impacts on Higher Trophic Level Species

Impacts on higher trophic level species occur through 1) entanglement with fishing gear, 2) competition with fisheries for prey, and 3) alteration of the food web dynamics due to fishery removals.

Changes in the abundance of high-level predators may be indications of major shifts in the ecosystem. Limited data sets preclude a definitive analysis of the effect of fish and marine mammal removals on other populations within the ecosystem (Wooster 1993).

Some populations of marine mammals and seabirds are known to be declining since the early 1980s. These declines may be attributed to the effect of commercial fishing activity off the West Coast; however, the complexity of ecosystem interaction and lack of data make it difficult to distinguish between a natural or anthropogenic effect on the carrying capacity of the ecosystem of marine mammals or seabirds in the central north Pacific Ocean. Different trophic levels and key species have different response times and scales. The salmon fisheries off the West Coast are not thought to contribute one way or the other to marine mammal or seabird populations changes.

Salmon and the salmon fisheries also interact with other species, notably with marine mammals. Marine mammals, particularly seals and sea lions on the West Coast, are known to forage on salmon, as well as other fish. Many fishers point to the natural feeding behavior of marine mammals on oceanic and inshore salmon stocks as one of the reason for decline in salmon abundance over the last two decades. While it is true that the harbor seal and California sea lion populations have generally increased under the protection of the MMPA of 1972, it is not possible to attribute a decrease in salmon abundance to this effect alone because of the complexity of the ecosystem interactions (NMFS 1997b).

Fish generally comprise a greater proportion of the diet of pinnipeds and smaller cetaceans, with over 50% being reported for the killer whale, harbor porpoise, and Dall's porpoise (Perez and McAllister 1998). These species are considered opportunistic and feed on a wide variety of fish species including Pacific whiting, rockfish, eulachon, anchovy, sardine, herring, smelt, lamprey, and flatfish. Salmon either in the adult or juvenile stages are not known to be the primary prey item for any of these species. However, in areas where salmon runs are depressed or constricted by man-made structures (i.e., dams or locks) there is a concern, and evidence, that pinniped predation can negatively impact these runs (NMFS 1997b). Still, for most areas of co-occurrence of pinniped and salmonid populations, there is insufficient information to determine whether pinnipeds are currently having a significant impact on the salmon populations.

The marine mammal species interactions with salmon fisheries include fishing vessels that approach marine mammals, marine mammal depredation on hooked salmon, and very rarely marine mammals that become snagged or entangled in fishing gear. Under Section 118 of the MMPA, commercial fisheries must be classified in one of three categories based on the frequency of incidental mortality and serious injury of marine mammals. The commercial troll fishery off the coasts of Washington, Oregon, and California is classified as a Category III fishery, indicating a remote or no likelihood of known incidental mortality or serious injury of marine mammals. The recreational fisheries basically utilize the same gear and techniques as the commercial fisheries and can be assumed to realize the same frequency of encounters and results.

After excluding ESA listed marine mammals, only three species of marine mammals are defined as "strategic" under MMPA within the coverage area: short-finned pilot whales; mesoplodont beaked whales; and Minke whales (Barlow et al. 1997). This "strategic" classification denotes that projected human caused mortality exceeds the species annual potential biological removal estimate under MMPA standards. As with the ESA listed marine mammal species, there is no record of these species being impacted by the ocean salmon fisheries managed by the Council. Therefore, available information indicates that the West Coast salmon fisheries are not likely to jeopardize the continued existence of these species or any other marine mammal species found off the coasts of Washington, Oregon, and California.

5.2.5 Impacts on Seabirds

Impacts of fishing activity on seabirds occurs through direct mortality from 1) collisions with vessels, and 2) entanglement with fishing gear. Indirect impacts include 1) competition with fisheries for prey, 2) alteration of the food web dynamics due to commercial fishing removals, 3) disruption of avian feeding habits resulting from developed dependance on fishery waste, and 4) fish-waste related increases in gull populations that prey on other bird species.

Direct impacts on seabirds from the salmon fisheries are minimal, if any. The types of vessels used in the fishery and the conduct of the vessels are not conducive to collisions or the introduction of rats or other non-indigenous species to seabird breeding colonies. Fishing gear and techniques utilized in the ocean salmon fisheries are not known to catch seabirds. Anecdotal information suggest the occurrence of accidental bird encounters are a rare event for both the commercial and recreational ocean salmon fisheries.

Indirect impacts on seabirds from the ocean salmon fisheries are also felt to be minimal. The salmon harvested in the fishery are mature, fully grown salmon, not the size range of forage fish utilized by seabird populations. Salmon troll fishing is not known to provide significant waste and offal to attract scavenging birds. Fish processing however does provide food directly to scavenging species such as Northern Fulmars and large gulls. This can benefit populations of some species, but it can be detrimental to others which they may displace or prey upon (Furness and Ainley 1984). The amount of salmon waste represents the total amount generated by the fish processing industry is minor. This potential impact is site specific and assumed not to represent a significant threat to the overall abundance and diversity of the seabird population along the West Coast. Thus no adverse impacts by the salmon fisheries have been identified either under the preferred or status quo alternatives.

5.2.6 Impacts on Lower Trophic Level Species

Impacts of fishing activity on lower trophic levels species occur through the alteration of the food web dynamics due to fishery removals.

Marine ecosystems in the central north Pacific Ocean are complex webs of predator/prey relationships. Since the status of each component stock may change from year to year, predator/prey relationships are also expected to vary. Any amount of harvest removes animals that otherwise would have remained in the ecosystem where they would have preyed on other animals and /or would be preyed upon. The removal of adult salmon by the ocean fisheries are not considered to significantly impact the lower trophic levels or the overall marine ecosystem as salmon are not the only or primary predator in the marine environment.

The primary factors in changes in abundance and distribution of lower trophic level species are shifts in oceanographic conditions, such as warm water occurrences and El Niño events. Years of observations off the California coast show that zooplankton have declined while the surface layers of the ocean have warmed by over 70% since the mid-seventies (McGowan et al. 1998). The decline is a major disturbance in the biota of the region because macrozooplankton, which forms a significant part of the food web, are the main diet of some seabirds and many schooling, commercially important fish species. On long time scales, zooplankton biomass is controlled by the net effect of decreases due to excess mortality over reproduction versus increases through advection by ocean currents from the north. The result of surface intensified warming, the vertical distance, or thermocline, between the warm, nutrient poor surface water and the colder, nutrient rich water increases. Therefore, less cold water comes into contact with the atmosphere in the upwelling zones and ultimately decreases the amount of zooplankton.

Little is known about the effects of reduced offshore flow on salmon, smolts to adults. Although some generalizations are emerging, prediction of year class strength in a form useful to fishery managers may initially deal with response to extreme environmental conditions (e.g., El Niño events). The abundance-based coho and chinook stock assessment models included an adjustment factor for natural mortality and predation, although the algorithm is limited by incomplete understanding of the dynamic parameters for growth, recruitment, and mortality.

5.3 ECONOMIC AND SOCIAL IMPACTS

In this section, direct economic and social impacts from changes in the ocean salmon harvest are analyzed. The primary focus is on the industries, consumers, and fishing communities affected. However, impacts of salmon harvest management have affects that are broader than the direct impacts. Limits on harvest are put in place for conservation benefits. These conservation benefits are related to the economic values to be derived from long term sustained harvest, as well as a wide variety of other benefits and values that individuals in our society place on salmon. Only 11%of the national population would give "highest priority to economic considerations of natural resource management even if there are negative environmental consequence" (Steel et al. 1992 as cited in NRC, 1996). The other types of values individuals place on salmon can be categorized as indirect and option values and include symbolic values (e.g. a regional symbol), biological diversity, environmental quality indicator, and spiritual values (additional description of these values can be found in Chapter 5 of NRC, 1996).

5.3.1 Approach to Analysis

In characterizing the effects of the salmon fishery from a social-economic standpoint, it is important to consider the broad range of outcomes that may occur. This can best be done by comparing a baseline condition represented by relatively healthy fisheries observed in past years with those that have occurred since stocks have weakened and listings began in 1989, as discussed in the introduction to this chapter. The socioeconomic analysis will first provide a qualitative review of the regulations used to impose harvest reductions and their socioeconomic impacts and then compare 1981 through 1988 harvest levels and impacts with those for 1993 through 1997. As part of the comparison, qualitative discussion is provided on the impacts which may occur if the recent downward trend in ocean harvests continues.

The 1981 through 1988 time period is used as a baseline for comparison because it precedes the first ESA listings, post dates most of the period prior to reallocation of salmon to tribes in the north of Cape Falcon area, and includes some very good years for chinook (1987 and 1988) as well as some very bad years (the El Niño influenced years of 1983 and 1984). Coho abundance began to decline in the mid 1970s, but the 1981 through 1988 years provided sufficient coho to have retention fisheries. While the current framework FMP was not implemented until 1984, Council management before and after that FMP did not vary so much in terms of the types of regulations generated as in terms of the process used to generate the regulatory recommendations. The 1993 through 1997 period is used to represent the recent regime, because it reflects the harvest limitations which phased in largely between 1989 and 1992 and, in particular, captures the effect of the depressed coho abundances.

5.3.2 Impacts of Specific Management Measures Used to Impose Harvest Reductions

5.3.2.1 Conservation Measures

With the declines in stock abundance and increase in ESA listings, the Council has turned increasingly to fishing management measures that help target on harvestable fish. In fact, most of the conservation measures used by the Council can be classified as measures to target harvest. The ocean salmon fisheries are mixed stock/species fisheries (generically referred to as "mixed stock" fisheries). Fishery management measures that help target on harvestable fish allow as much harvest of healthy stocks as is possible, and hence allow greater social and economic benefits, while meeting conservation needs for weaker stocks. Sometimes, even with selective management measures, it is not possible to harvest the surplus of healthy stocks available. When situations such as this occur, the additional fish are taken in inside fisheries or escape to spawn, so that spawning escapement targets are exceeded. When taken in inside fisheries, social and economic benefits are derived in addition to those which result from ocean fishing and normal levels of inside harvest. When escapement objectives are exceeded, future harvests may be increased or diminished depending on the level of total escapement, density dependent stock-recruitment relationships, and freshwater and marine habitat conditions. The following is a discussion of the social and economic effects of the fishery measures reviewed in Section 5.1 which help target the fisheries on the harvestable salmon.

Most of the fishery regulations used to target harvest have the effect of lowering the efficiency of the individual fishing unit, thereby raising the cost per unit of retained catch for commercial and/or recreational anglers, depending on the regulations. Not all of the regulations or restrictions will effect the fishery or fleet uniformly. Many of these regulations or restrictions are focused on a specific gear type or fishing practice. The effects of regulations on different areas of the coast will vary depending on the geographic distribution of user groups and harvest strategies. The actual social and economic cost of an individual regulation is difficult to predict and monitor as there is very limited data on costs in the commercial fishing and processing sectors, exprocessor prices, and costs and angler preferences in the recreational fisheries. Assessment of effects is also difficult, because the impact of individual regulations are often masked by the effect of the overall regulatory package. Consequently, this analysis of selective fishery management techniques is limited to a general discussion of the types and directions of social and economic impacts.

Gear Restrictions

Gear restrictions lower the efficiency of individual fishing units (commercial or recreational) and thereby increase cost per unit of retained catch and increase the incentive to develop fishing methods or technologies to counteract their effects. For some gear regulations the immediate short term effect can be an increase in costs resulting from the need to obtain the new gear. These impacts are often difficult to predict and monitor as effects will differ among and between areas, depending on the extent of gear usage.

Time/Area Restrictions

Time and area closures affect particular areas, such as off the mouth of a given river system or a stretch of coast line, at a particular time during the season. Such closures are implemented either on a predetermined date or on an inseason determination that a certain amount of fish (a catch quota) has been taken for a particular period and fishing area. The effects of time-area closures vary depending on the fishery dependent group considered and the availability of fishing opportunities elsewhere along the coast.

Commercial Fishers and Processors - During a particular time-area closure, if a commercial vessel is able to relocate to an open area and experience a similar catch per unit effort and similar fishing and in-port costs, the economic effect may be minimal on the individual vessel's operations. At the same time, there may be a social impact associated with moving the fishing operation away from the fisher's family and local social network. While time-area closures may increase the catch per unit of effort (CPUE) in an adjacent area by allowing more fish to pass through the closed area, fish migration patterns vary from year to year and time-area closures make it more difficult for harvest effort to follow the fish, potentially decreasing CPUEs, and increasing the cost per unit of catch. Processors on the other hand are more tied to the activities in the location of their processing plants. Processors in a closed area may either have to forgo the processing opportunity or pay to have fish shipped in from a buying station at a more distant port. Processors in an open area may experience an increase in the availability of product due to a shift of effort into the area in response to a closure elsewhere along the coast. Even if during a closure commercial fishers are able to shift their effort to a remaining open area and experience the same or better CPUE, the total fish available for processing coastwide is likely to go down as experience has shown that, whether for reasons of social or economic costs, a substantial portion of the commercial salmon fishers will stop fishing rather than transfer their effort out of the closed area.

Charter Vessels - Recreational charter vessels are probably more dependent on their home port than commercial vessels, though recreational charter vessels are known to exhibit some mobility between ports. It is the marketing aspects of the charter operations that tend to be dependent on the location. Thus the charter agents and vessels that serve as their own booking agents are less able to respond to local area closures by movement to a different port than vessels that rely on charter offices to recruit clientele. Charter vessel operators and crew which do attempt to move operations to a port in an open area will face obstacles in recruiting clientele or developing new relationships with booking agents. The operator and crew may experience social effects associated with distance from family and social networks.

Recreational Fishers - There are three groups of recreational fishers that will be considered here (1) those that travel to an area primarily because of the opportunity to go salmon fishing, (2) those that travel to an area to take part in a suite of activities which include salmon fishing, and (3) those that live in an area and take part in the recreational salmon fishery.

Recreational fishers from outside a fishing area are probably the most mobile part of the harvest effort. However, for those who travel to a particular area to go salmon fishing, the decision to transfer their trip to a different area or time in response to a time-area closure likely implies a change to a lower value experience. The fisher deciding to travel to an area at a particular time to go fishing has variety of choices available. Presumably, the first choice time and location offers the best value to the fisher. Thus, the move of the trip to another area and/or time, in most cases, is likely to be a move to a lower value experience.

Those for whom recreational salmon fishing is only one of the activities for which they travel to an area may exhibit somewhat less mobility. The elimination of their opportunity to fish may not change their travel plans but may reduce the value of their experience forcing them into second choice activities. However, for some of these anglers, the elimination of the salmon fishing activity will be the marginal change that changes their preferred location ("I can't go salmon fishing at Port A, but Port B offers many things almost as nice as Port A and at Port B I can go salmon fishing too") or time of travel ("Its not the best time to take my vacation but if I delay for a month I'll still be able to go to my favorite salmon fishing area at Port A and do all the other things I like to do there as well").

Those that live in an area may respond to a time-area closure by, (1) not going salmon fishing at all and spending their time and money in the same community on an alternative activity; (2) going salmon fishing at a different, less optimal, time; or (3) traveling to a different area to go fishing or take part in an alternative recreational activity. All cases reflect a loss of value to the individual associated with a shift to second choice activities.

While time-area closures generally reflect a loss to the individual angler forced to change from his or her optimal fishing plans, such closures are generally imposed to provide more extended fishing opportunity coast wide. This increase in fishing opportunity allows for more angler trips and, depending on complementary regulations, a greater ocean catch. From a national or coast-wide point of view, the losses to the individual anglers in terms of quality of trips taken may be made up by an increase in the total number of anglers able to participate in the ocean fishery.

Communities and Local Businesses - While time area closures may result in an overall increase in harvest and harvest opportunity on the West Coast, there may be substantial negative effects in individual communities. Closure in the area of a particular community will likely decrease fishing benefits for that community. On the one hand, losses may be less than the reduced harvest if fishers and processors maintain their base in the community but make adjustments to take part in or acquire fish from fisheries occurring outside the area.[1/] On the other hand, extensive closures over a number of seasons may cause fishers or processors to relocate their entire operations reducing benefits to the community by more than just the reduced local area harvest. When fishers adjust by remaining a part of the community but fishing in more distant waters, communities may have to deal with family and social stresses related to absent fishers and reduced family incomes for those unable to make up their income at other times or in other areas. The communities located in the Klamath management zone (KMZ) provide one example of communities strongly impacted by time-area closures. Effects of declining fisheries on these and other communities will be discussed below in Section 5.3.3.6.

Catch Restrictions

Examples of the catch restriction measures the Council uses to manage salmon include size limits, landing ratios, species specific non-retention fisheries, and selective harvest of mass marked fish.

Size limits in the commercial fishery increase the cost per unit of retained catch. With the imposition of or increase in a size limit, despite relatively constant expenditures of time and money, the amount of retainable catch declines. The fisher response may be to attempt to avoid small fish, depending on the frequency of encounters and relative harvest rates expected from changing fishing methods or locations. Net returns in the ocean fisheries may be increased or decreased depending on the degree to which fishing season can be lengthened by imposing the size limit and the costs associated with the additional fishing time. Similarly, in the recreational fishery size limits may allow the Council to set longer seasons providing opportunity for more fishers to make more trips. However, at the same time, the average amount of retained catch by each angler is reduced, hence, reducing to some degree the value of the individual angler's recreational experience.

Ratio fisheries generally are only utilized in commercial fisheries. Species specific non-retention fisheries are used for both commercial and recreational fisheries. Both ratio fisheries and non-retention fisheries are similar to size limit fisheries in that they require the discard of a portion of the potential harvest. The economic effects are similar to those described in the above paragraph on size limits.

The most recent variation of selective fishery management techniques considered for ocean salmon fisheries involves restricting harvest only to mass marked fish. In general, the effects are similar to those of the size limits, ratio and non-retention fisheries in that a portion of the potential catch must be discarded to provide greater overall harvest opportunity in the ocean. There is an additional program cost for selective fisheries, because there are government expenses and some other costs associated with the mass marking of the fish, including, as a cost, some mortality resulting from the application of the mark. However, the mass marking is an ongoing legislatively mandated activity. Therefore, the only question to be analyzed here pertains to whether or not the Council will recommend utilizing the mass marks in its harvest measures. Section 2.8

1/ There may be less ability for sectors of the community reliant on recreational fisheries to adjust in such a manner than for those taking part in and reliant on the commercial fisheries.

analyzes a plan amendment proposed to allow the Council to take fuller advantage of the opportunity to select for mass marked fish in north of Cape Falcon fisheries. That section provides an example assessment of the effects of a specific selective fishery.

5.3.2.2 Socioeconomic Measures

On occasion measures similar to those discussed with respect to selective fisheries are imposed for socioeconomic purposes. The use of such measures for socioeconomic purposes is likely to increase with declining harvest opportunities. For example, the north of Cape Falcon recreational fishery is generally open for five days a week (usually Sunday through Thursday). The purpose of this regulation is to extend the season for charter vessel and community stability and to encourage the development of alternative fishing opportunities on the closed days (e.g., fishing for groundfish). By limiting the level of participation by the individual, the two-day closures combined with a limit on number of fish that can be taken in a given period (e.g., four fish in seven consecutive days) provide a longer season and opportunity for more people to participate. To the degree that charter vessel clients tend to limit their fishing activity to a few days and private vessel anglers tend more to participate over an extended period of time that might include an entire week, the effect may also be to shift some effort from private to charter vessels.[2/] Weekly and annual take limits have also been imposed elsewhere along the coast to limit harvest rates and spread harvest opportunity among more anglers (e.g., in some years no more than 10 or 20 fish a year limits for some openings off Oregon).

In the commercial fishery limits on numbers of fish caught per day and area of landings have been used to increase the probability that local vessels will benefit from the fishery and that harvest by those vessels will benefit local communities. For example, in 1998, the troll seasons between Sisters Rocks and Mack Arch in August and between the Oregon-California border and Humboldt South Jetty in September both required that all fish be landed in local ports. In addition, the seasons included intermittent openings or daily landing limits. These regulations likely imposed some inefficiencies for vessels that would incur lower costs with a continuous season and unrestricted daily landings, and/or that might receive better prices at a port of landing outside the area. Such regulations may also reduce the incentive for participation by trip vessels from outside the area. However, the Council's intent with the special restrictions was to control the pace of the fishery to insure the small harvest quotas are not exceeded and that the community has a local supply of fish over a longer period. In this way, the Council was able to provide limited benefits to the local fishers and communities in areas which may have high impacts on critical stocks.

5.3.2.3 Season Structures

In this section, the general pattern of openings the recreational salmon fisheries will be examined for 1978, 1984, 1988, 1994, and 1997 to compare recent season structures with those during periods of greater salmon abundance.

When the Council first implemented its salmon FMP in 1978, the fishery seasons were extensive both in the areas covered by the openings and the duration of the openings. As the condition of some stocks have deteriorated, attempts to harvest remaining healthy stocks in the mixed stock ocean fishery have lead to more complex management measures with shorter openings over a more limited geographic scope. One of the most restrictive years has been 1994. In that year there was no recreational or commercial fishing north of Cape Falcon due to depressed Washington coastal and Puget Sound coho populations and Columbia River chinook populations. Commercial harvest in the KMZ was closed due to the low abundance of Klamath River fall chinook. Fishing on much of the rest of the coast was reduced to limit impacts on Klamath River fall chinook as well as OCN coho. There were no coho retention opportunities coast wide. In the mid and recent 1990s, the most consistent wide spread harvest opportunities have occurred off Central California south of Horse Mountain. Additional discussion of trends in management regulations can be found at the start of Section 5.3.2.

2/ The marginal cost for each additional fishing day for a charter vessel angler is substantially higher than the private vessel angler's marginal additional cost for each additional day of effort.

Commercial

Some of the major changes in seasons in recent years as compared to the 1980s include the elimination of coho fishing south of Cape Falcon and increasing closures in the KMZ. Season maps for recent years show increasing closures in the KMZ and generally more restrictions in the south of Cape Falcon fisheries close to the KMZ than those further away (Table 5-1 through Table 5-5). North of Cape Falcon the change in season durations is not that apparent in comparing the season maps. The average season lengths for the 1993 through 1997 recent period compared to the 1981 through 1988 base period do not decline substantially.

Number of troll season days for north of Cape Falcon fisheries.

	All-Except-Coho	All Salmon	Total
1981-1988 average	25	13	38
Range	8-45	0-38	
1993-1997 average	22	12	34
Range	0-64	0-29	
1994-1997 average	12	8	20
Range	0-46	0-18	

However, the average is strongly influenced by the 1993 season. Removal of the 1993 season from the average shows substantially shorter seasons in the last four years as compared to the average in the eight year base period. The 1994 complete closure also influences the average, however, removing 1994 from the average would add only three days each to the all-except-coho and all salmon seasons.

Recreational

In the recent period the seasons in northern areas have been reduced substantially more than in southern areas (Tables 5-6 through 5-10). For the north of Cape Falcon area, the 1984 and 1988 example years do not illustrate well the range of seasons observed during the 1981 through 1988 base period. The number of days in the 1984 and 1988 seasons are within the range and below the average for the 1993 through 1997 period, with the exception of Neah Bay. However, in the 1993 through 1997 recent period the average season durations have declined between one third and two thirds compared to 1981 through 1988. Consistent with the broader pattern coast wide, the proportional reduction in the average season durations increases as one moves from south (Columbia River) to the north (Neah Bay).[3/]

Number of recreational season days for north of Cape Falcon port areas.

	Neah Bay	La Push	Westport	Columbia River
1993-1997				
Average	19	31	33	32
Range	0-61	0-59	0-59	0-61
1984/1988	52/25	19/25	15/22	15/10
1981-1988				
Average	56	52	55	50
Range	25-96	19-96	15-107	10-107

3/ Off Neah Bay, Area 4B is considered part of the ocean area when ocean fisheries are open but is managed under separate state regulations when the ocean fishery is closed. State managed seasons provided to Area 4B are not reflected in this discussion.

TABLE 5-1. Geographic outline of West Coast commercial ocean troll seasons, 1978.

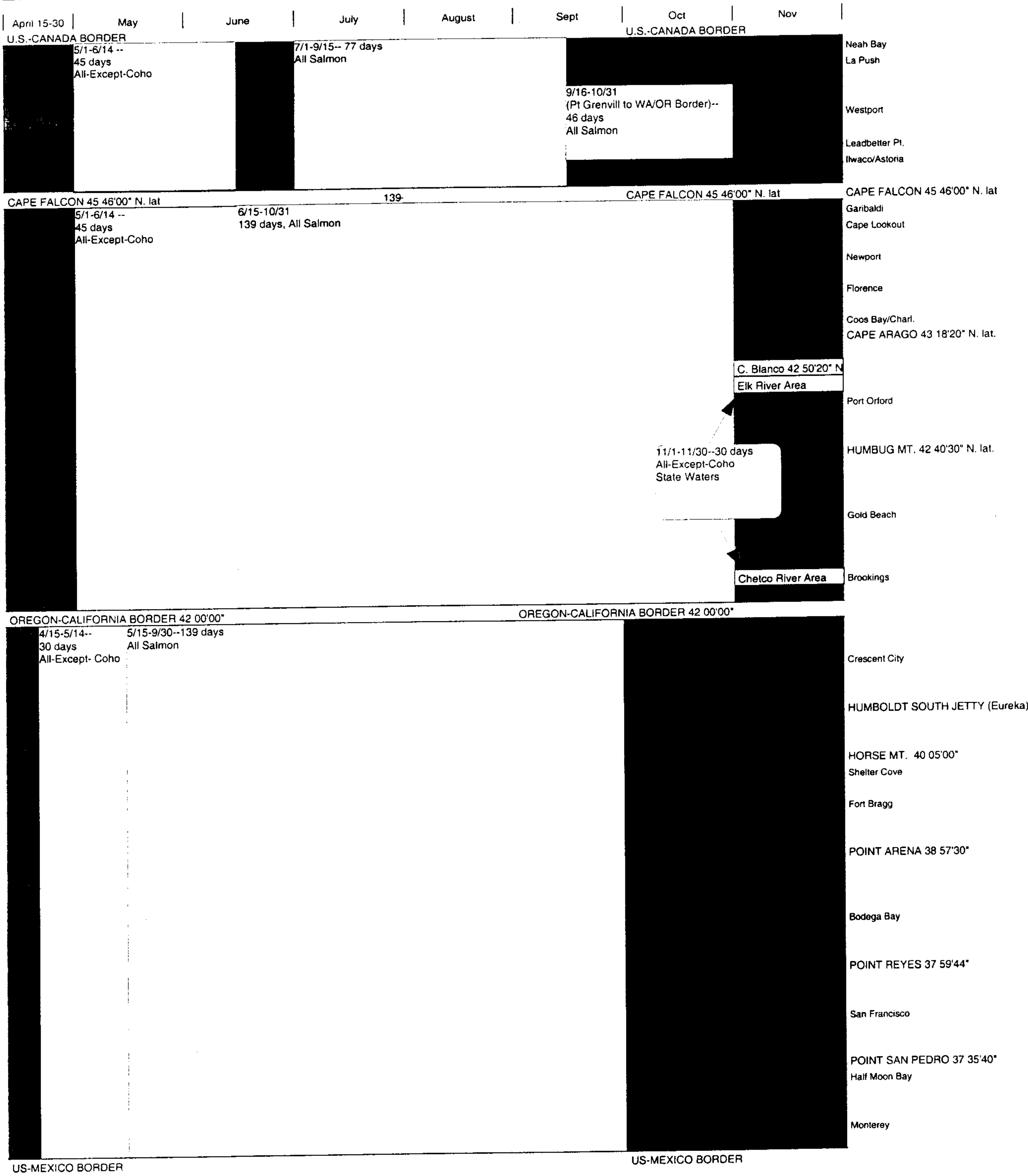


TABLE 5-2. Geographic outline of West Coast commercial ocean troll seasons, 1984.

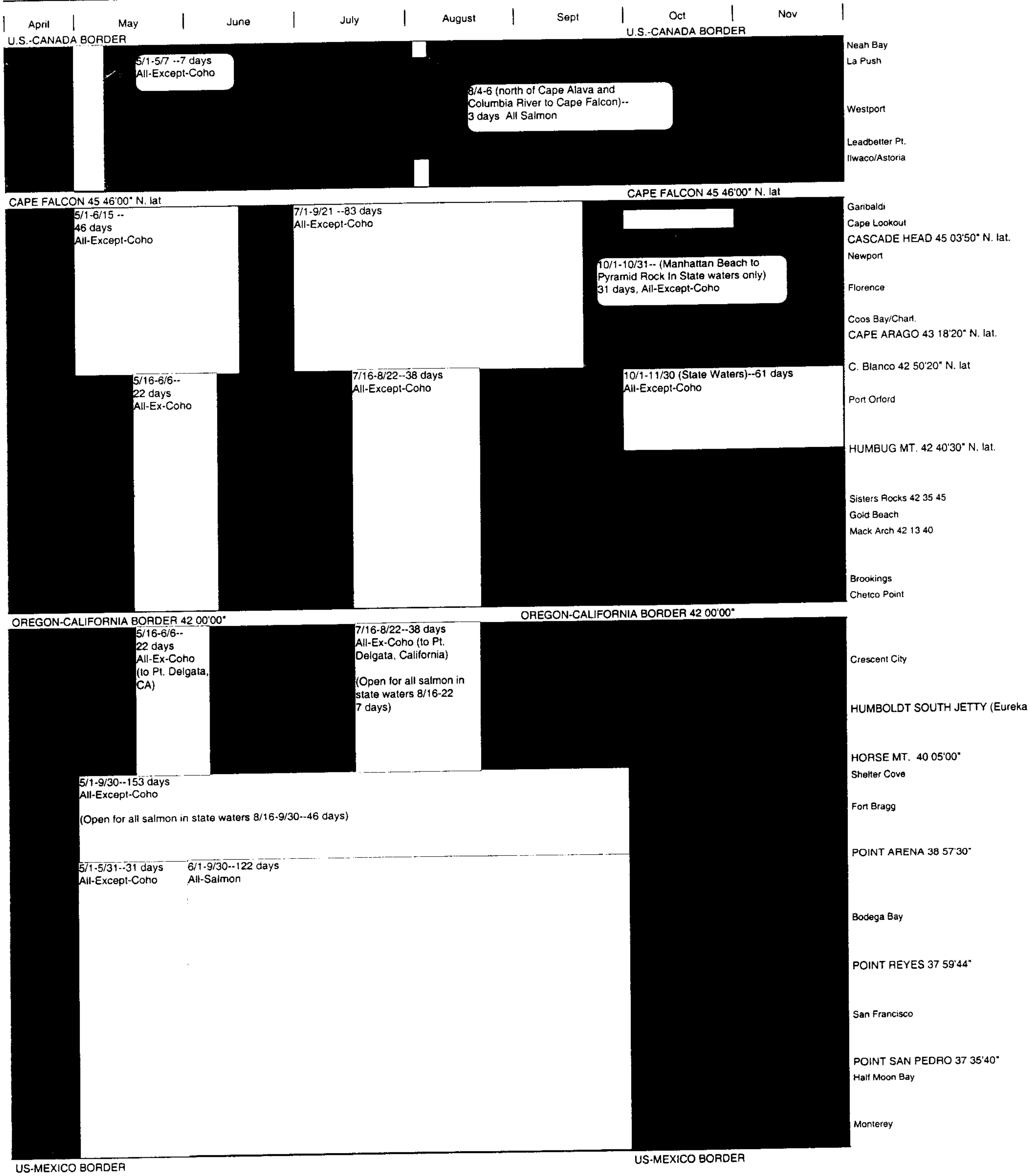


TABLE 5-3. Geographic outline of West Coast commercial ocean troll seasons, 1988.

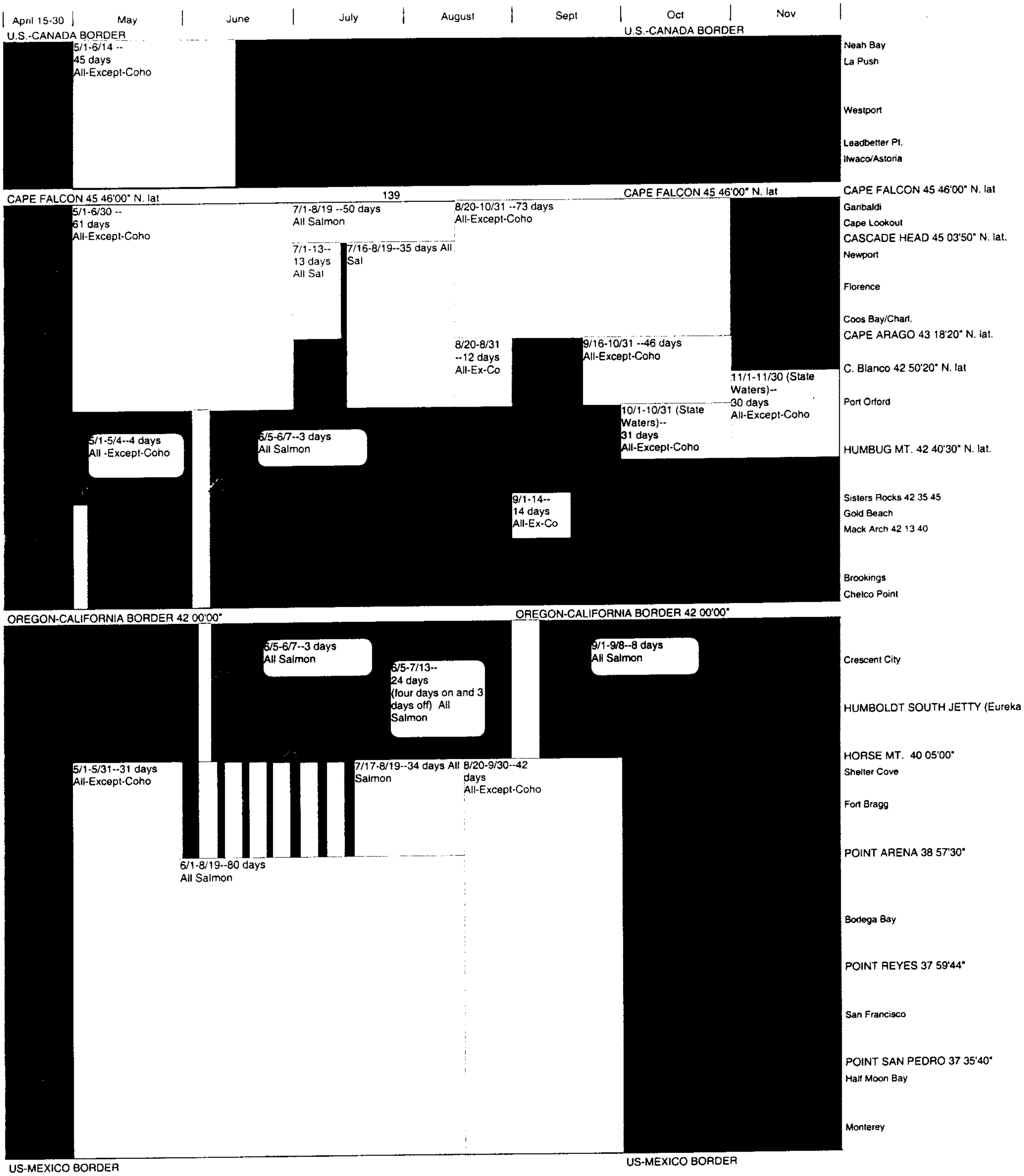


TABLE 5-4. Geographic outline of West Coast commercial ocean troll seasons, 1994.

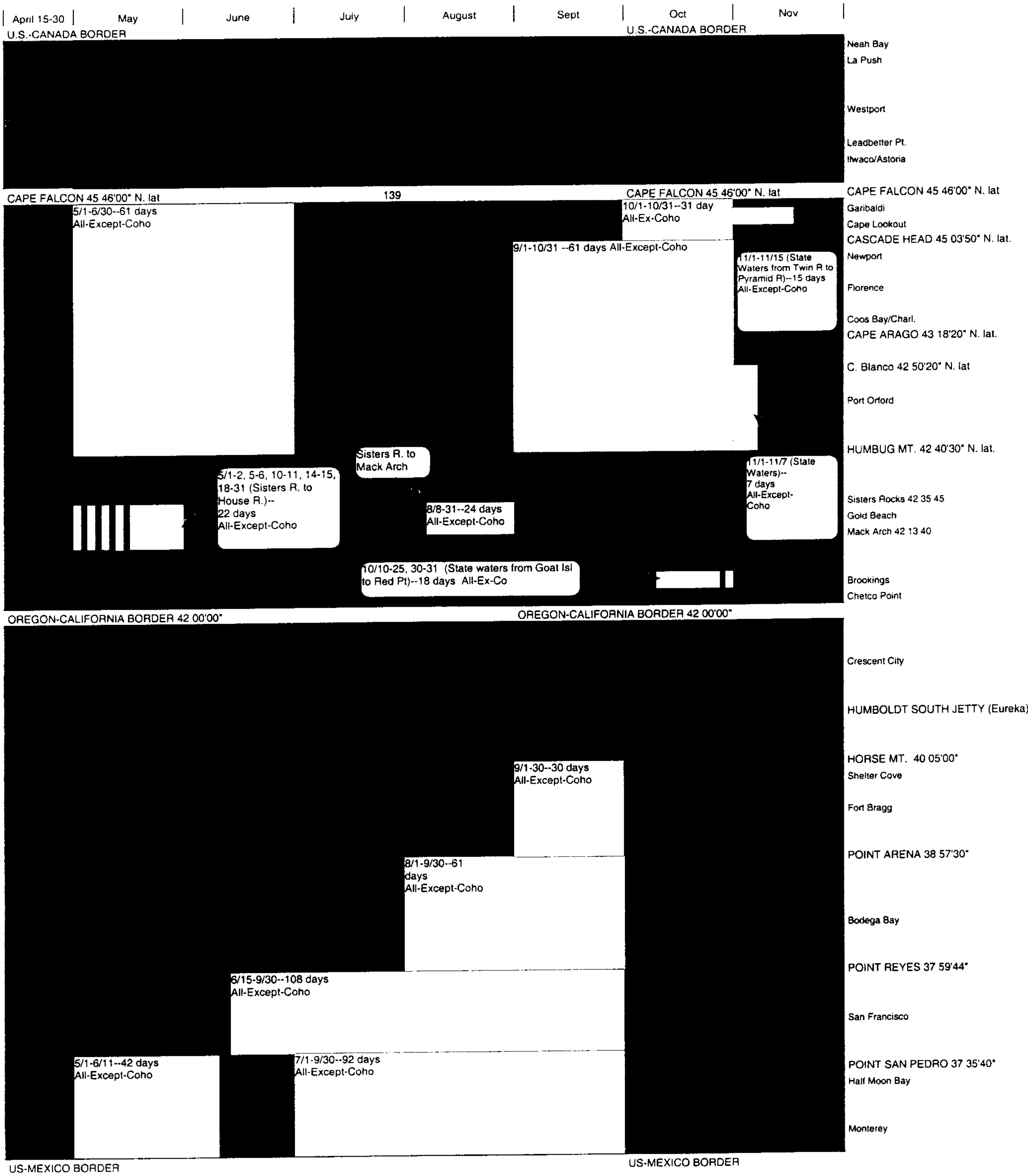
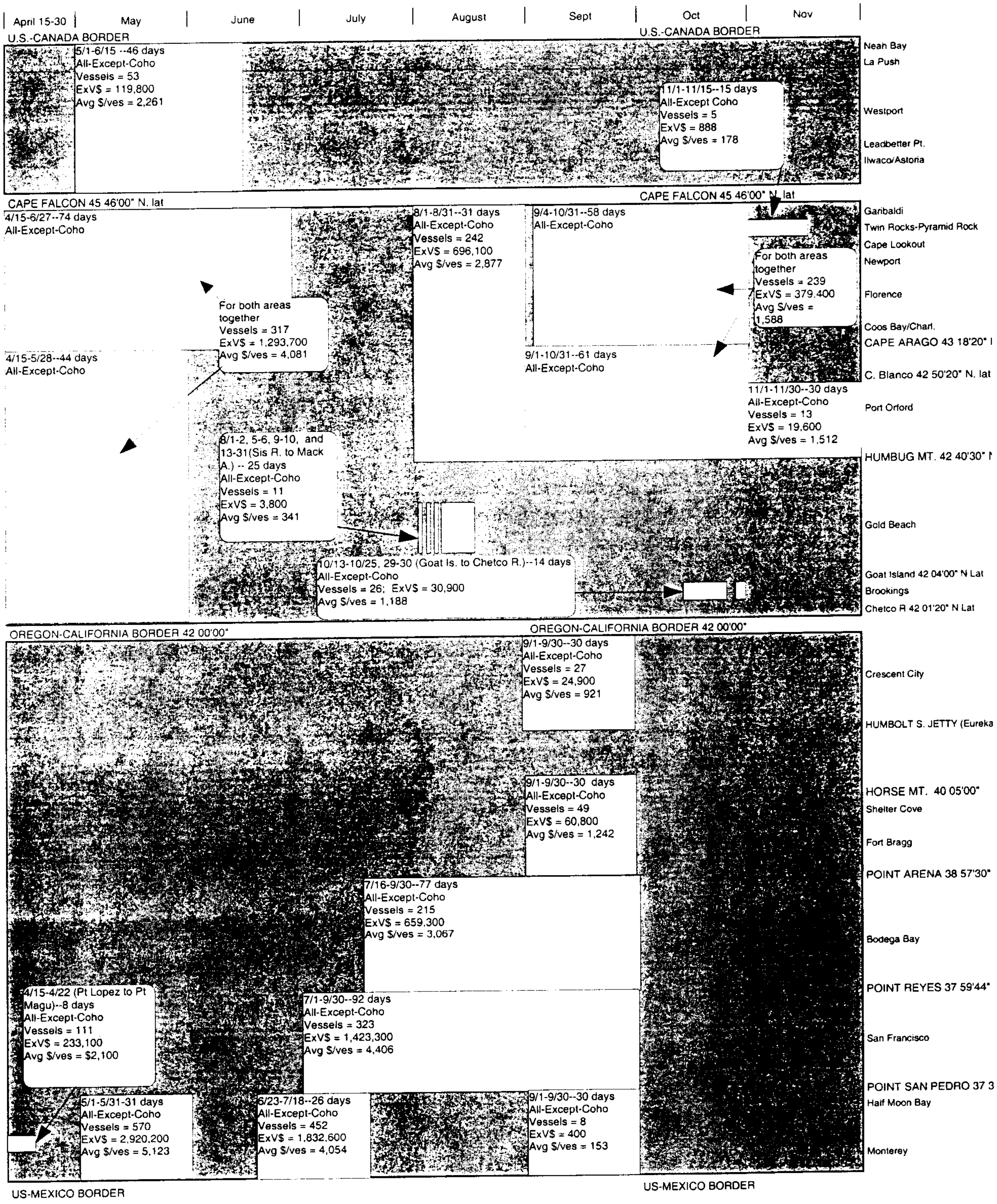


TABLE 5-5. Geographic outline of West Coast commercial ocean troll seasons, 1997. a/ b/



a/ The Information source for this table is state fish ticket data maintained in the redefined PacFIN database. The data were retrieved January 13, 1998, and may vary somewhat from summary information presented elsewhere in the review. Catch area recorded on tickets is sometimes based on the point of landing. When there is no opening in an area for which catch is reported it was assumed that landings made during a closure came from the nearest open area.

b/ Excludes information on 53,900 pounds of landings for which West Coast catch area was unknown. Total revenue for these landings was $79,500.

TABLE 5-6. Geographic outline of West Coast recreational ocean seasons, 1978.

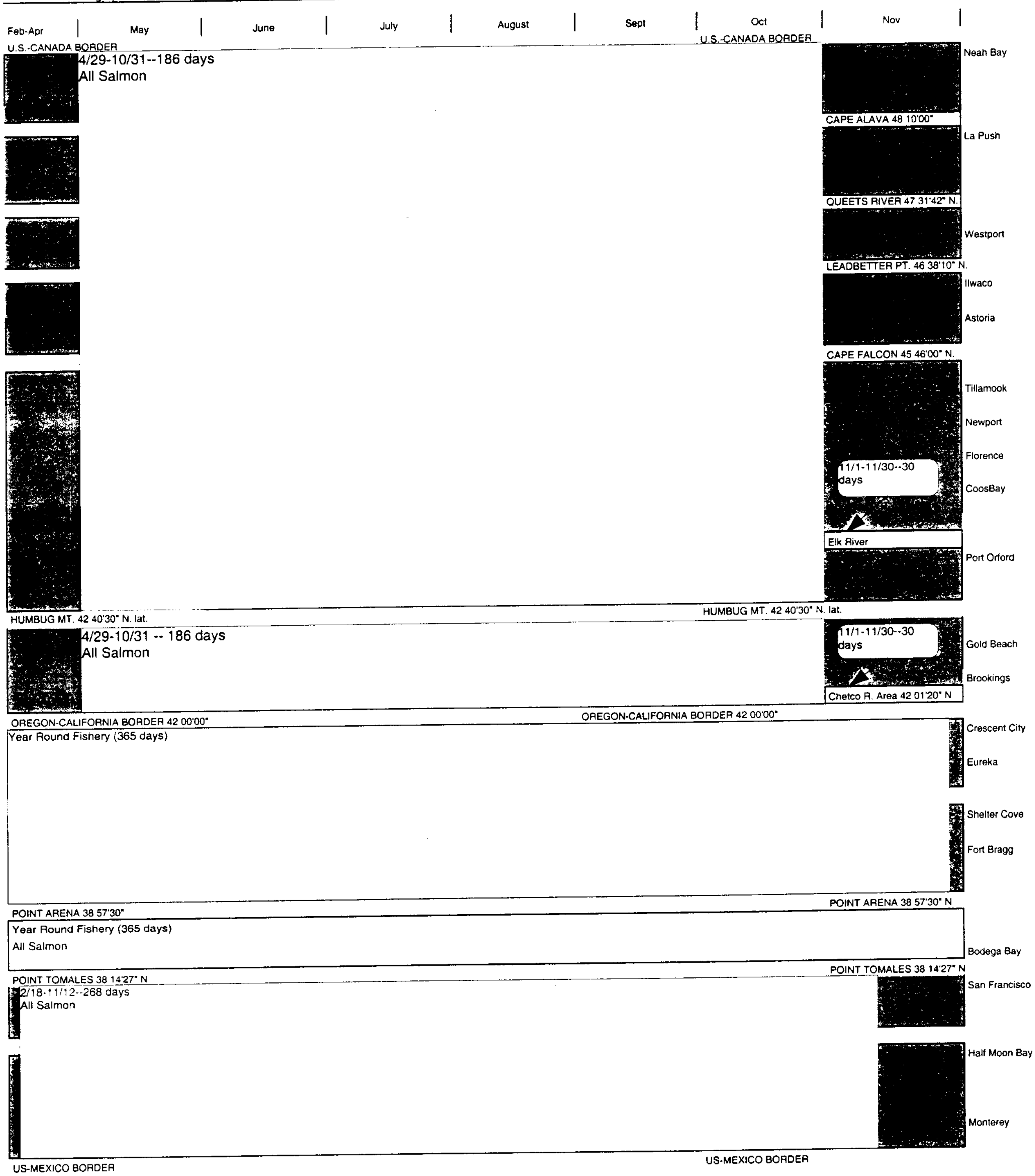


TABLE 5-7. Geographic outline of West Coast recreational ocean seasons, 1984.

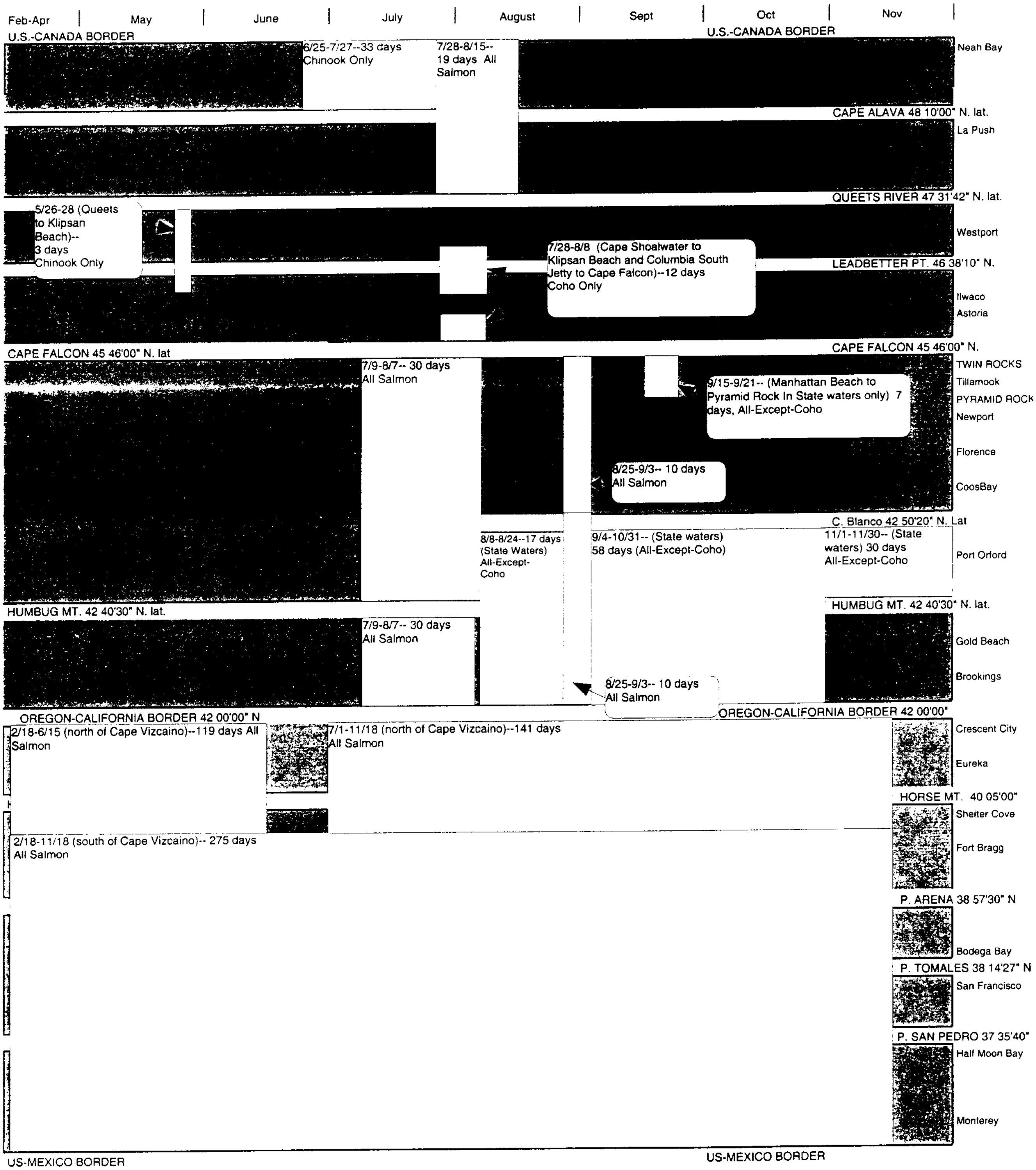


TABLE 5-8. Geographic outline of West Coast recreational ocean seasons, 1988.

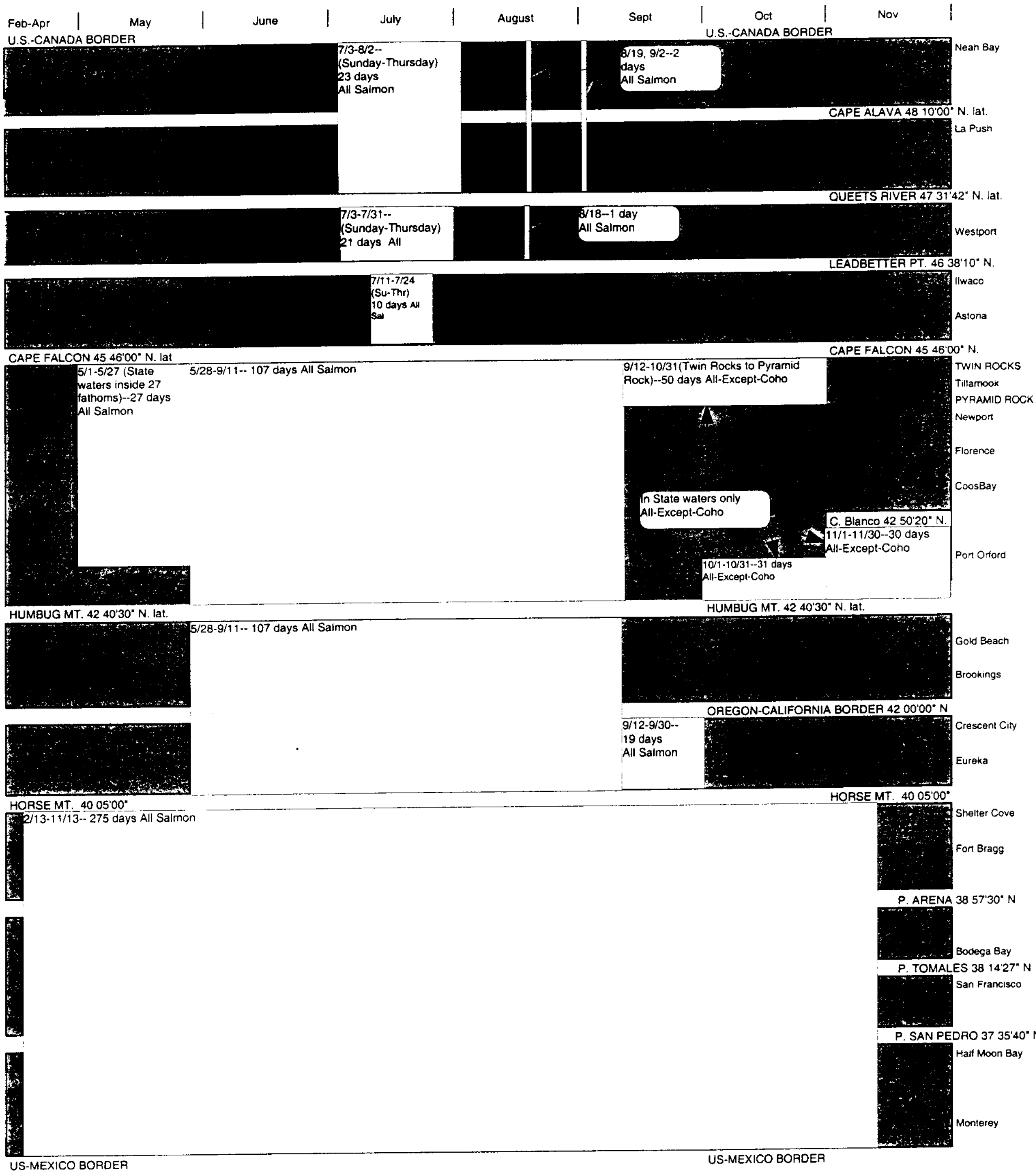


TABLE 5-9. Geographic outline of West Coast recreational ocean seasons, 1994.

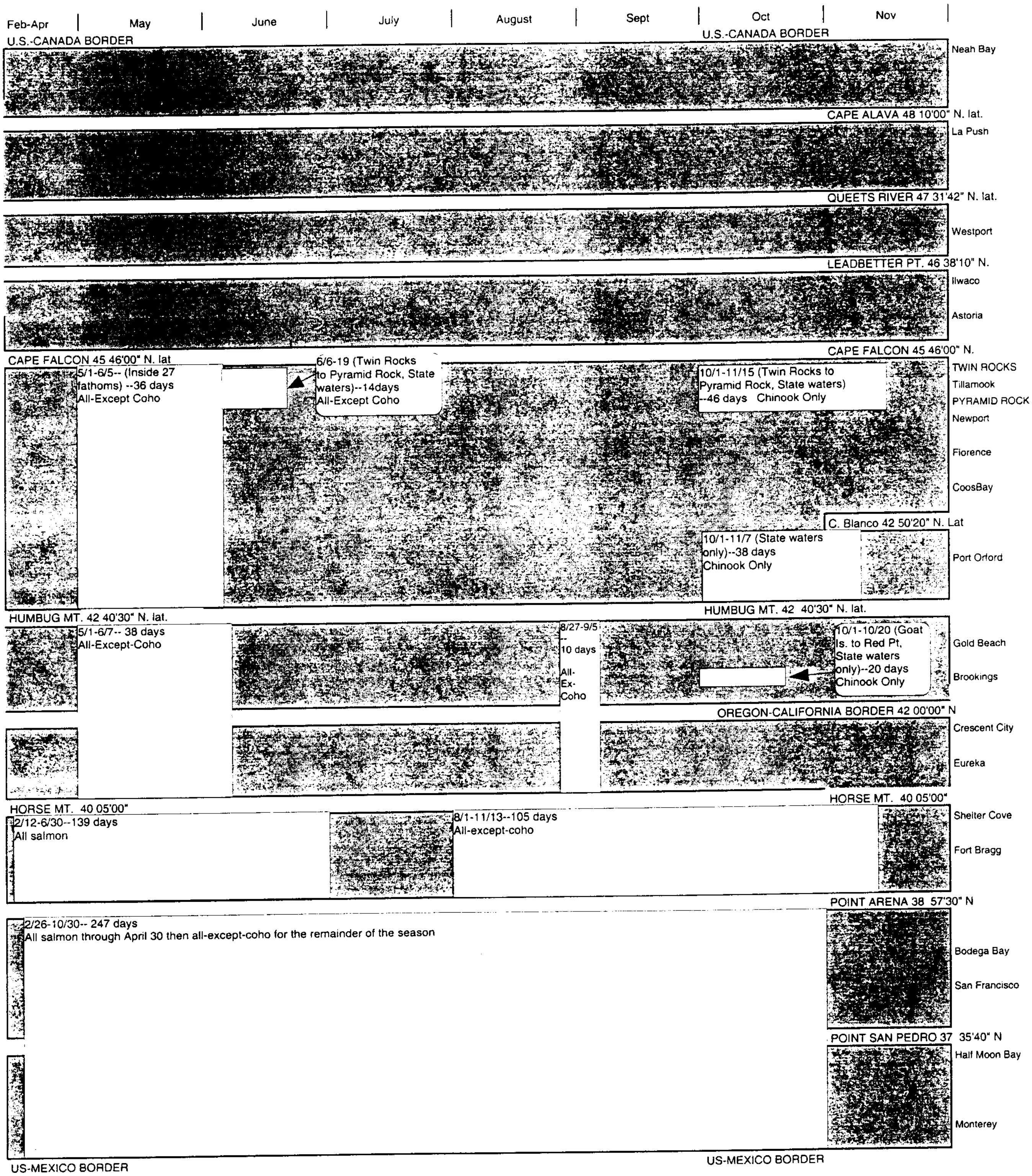
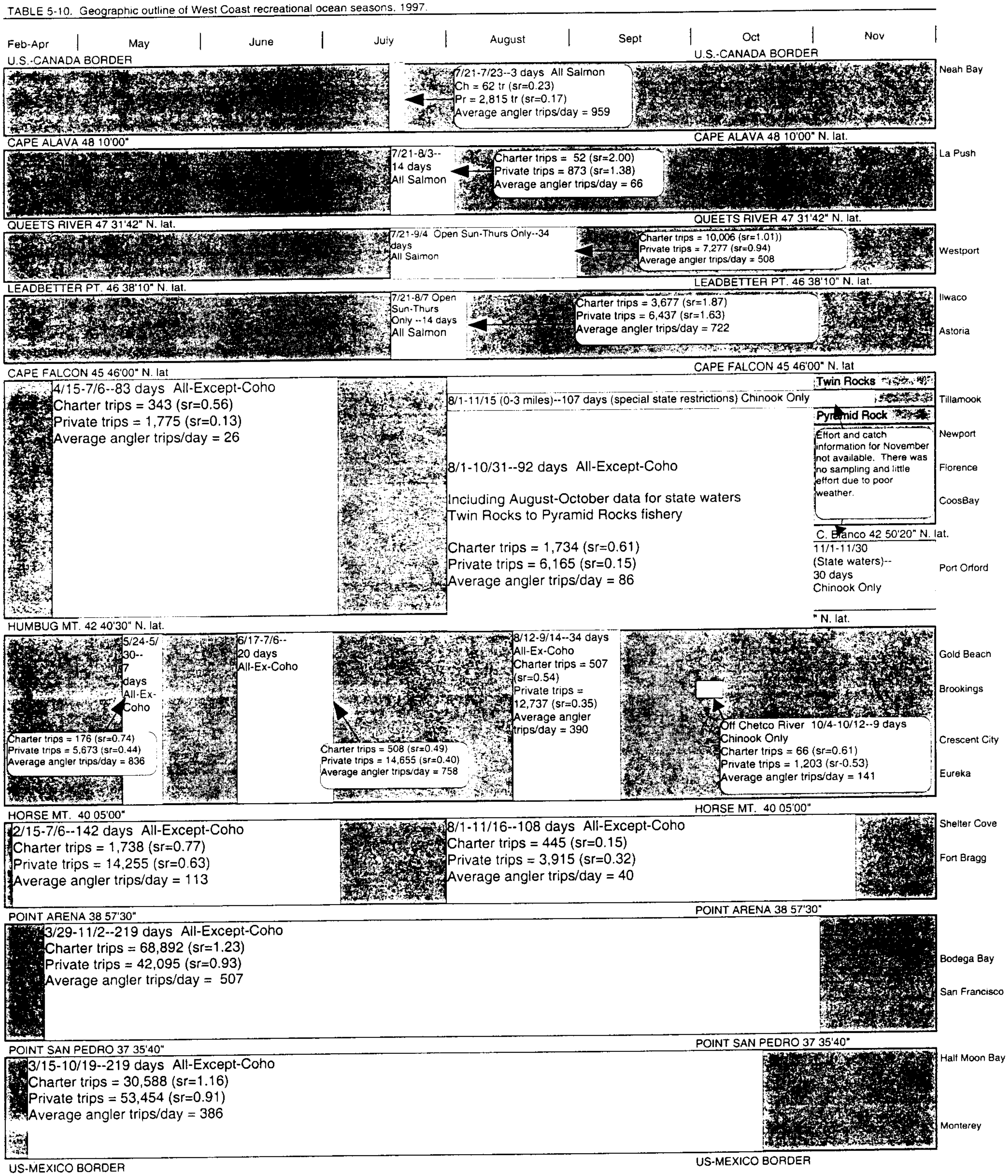


TABLE 5-10. Geographic outline of West Coast recreational ocean seasons, 1997.



The exception to the general south to north trend of increasingly restrictive fisheries are fisheries in the KMZ. Recreational fisheries in the KMZ have been reduced more relative to the reductions in areas to the north and south. The reduction in the KMZ is reflected both in the season maps and in the amounts of recreational effort and associated community effects that will be discussed in the following section.

5.3.3 Impacts of Diminishing Salmon Harvest

5.3.3.1 Measures of Impacts

Impacts of diminishing harvest are described in the following sections for different sectors in terms of changes in exvessel revenue, numbers of participants, effort levels, and community income impacts. Available information is not sufficient for a quantitative cost benefit analysis.

5.3.3.2 Qualitative Cost-Benefit Analysis

The cost information and consumer preference information available is not sufficient to allow for a complete quantitative assessment of net economic value. In evaluating costs and benefits it should be remembered that prices reflect only part of a resource's full value to society (see the discussion at the start of Section 5.3). A qualitative cost benefit assessment for changes in ocean harvest levels in the commercial and recreational ocean salmon fisheries, taken from the perspective of a reduction in harvest, is provided on the following page. While a quantitative analysis cannot be completed, the information in this qualitative assessment can be combined with the quantitative information provided in the following sections to provide some feel for the dimensions of the effects of reductions in the ocean salmon fishery on net economic value.

The consumer in the recreational market is in a different position than the consumer in the food market. In the food market, fish are allocated by an increase in price which then reduces the quantity demanded to match supply. As a result of the price change, it is the marginal consumer that drops out of the market (the consumer that places the lowest value on the salmon, or has the lowest ability to pay for the salmon). In the recreational market, fish are allocated on a first come first serve basis. In the recreational market, the consumer excluded from access is more likely to place values on the experience similar to the average recreational angler.

Initially administrative and enforcement costs tend to increase as restrictions increase and ocean regulations become more complex. However, as regulations continue to become more restrictive, the regulations may simplify, becoming closures, with lower administrative and enforcement costs.

5.3.3.3 Impacts on Commercial Non-Indian Ocean Troll Fishery

Aggregate Harvest

The non-Indian ocean troll fishery will be evaluated in terms of differences in chinook and coho exvessel values for the ocean troll fishery as a whole and by state. The state level analysis is made more relevant to the condition of the commercial fleet, because each state has its own license limitation program for the salmon fisheries and Washington and California generally do not allow vessels without limited entry permits for the state to land salmon in ports of the state (for additional information on the license program, see Section 3.2 of Appendix B).

COSTS OF REDUCED OCEAN HARVEST	BENEFITS AND MITIGATING FACTORS FOR REDUCED OCEAN HARVEST
	General
--	Potential utilization of increased ocean escapement in inside fisheries or potential for increased future production as a result of additional escapement and preservation of the stocks and species.
	Commercial Harvest
Reduced exvessel salmon revenue plus loss of processor mark-up. (Note: exvessel prices do not reflect any other compensations the fishers may receive such as financing, food, fuel boat storage or any other non-price benefits. The extent of these non-price benefits for West Coast salmon fisheries are unknown.) Reduction in lifestyle benefits to the degree that fishing is valued as a lifestyle over other types of employment and that nonfishing work activities are substituted for fishing activities.	Reduced harvest and processing costs. (Only "Opportunity Costs" are counted as savings. For example, expenditures on harvest such as the cost of labor, do not count as an economic opportunity cost if the labor would otherwise be unemployed. Additionally, if the labor would have been employed but at a lower earning rate, then the difference between the earnings in the fishery and next best alternative employment would not be counted as a cost, i.e. only the next best wage rate would be counted as a cost. Estimates of net benefits from commercial vessel salmon harvest activities suggest that on average net benefits are very roughly about 50% of exvessel value, but that net benefits from the marginal fish might be as high as 100% of exvessel value (Rettig and McCarl, 1985). Where labor and the vessel would otherwise be unemployed (i.e., there is a zero opportunity cost for labor and the vessel) average net benefits are likely be higher than the 50% suggested.)[a/]
Loss to consumers of their first choice protein purchase (in this case, the ocean caught chinook or coho).	To the degree that prices increase as a result of reduced availability of product, most of the lost consumer benefits are transferred to producers. The consumers' ability to buy a wide variety of second choice food products and the function of price changes to match quantities demanded to quantities supplied means that the loss to consumers who cease or reduce their consumption of salmon is likely to be substantially less than the shelf price of the fish (see discussion prior to this table). Alternative products include salmon from Alaska or Canada, farmed salmon, other fish products and other protein sources.
	Recreational Harvest
Charter Vessels–reduced revenue from salmon charter	Reduced costs. No estimates are available for net benefits from the charter vessel operation. The above opportunity cost discussion for commercial harvesters would also apply to recreational harvesters. Possibility of some revenue recovery from other fishing/eco-tourism activities.
Recreational anglers–loss of first choice recreational opportunity (ocean salmon fishing). Average values that anglers place on the recreational experience have been estimated at $107 for ocean salmon trips off the Oregon and Washington coast (Olsen et. al, 1991, adjusted for inflation to 1997 dollars) .	None identified (the manner in which the estimate of the average value for a recreational angler is derived takes into account the alternative recreational activities available to the recreational fisher).

a/ A relatively higher percentage may also be reasonable because there may be some additional value to the processing sector that is not included by the evaluation of exvessel prices (Crutchfield et. al., 1982).

The 1993 through 1997 total West Coast exvessel values (chinook and coho combined) have been below the depressed levels of the 1983 through 1984 El Niño, in inflation adjusted terms, and close to those levels if no adjustment is made for inflation. For 1993 through 1997, the total exvessel value of landed coho has been 99% below the 1981 through 1988 base period and the total exvessel value of landed chinook has been 61% below the 1981 through 1988 base period (without adjusting for inflation).

Exvessel Values ($ thousands).

	Chinook		Coho		Chinook+Coho	
	Nominal	Real	Nominal	Real	Nominal	Real
1981-1988 Avg	25,214	36,160	4,430	6,644	29,645	42,804
1993-1997 Avg	9,807	10,225	45	48	9,852	10,273
Percent Change	-61%	-72%	-99%	-99%	-67%	-76%
1983	6,686	10,272	1,683	2,586	8,369	12,858
1984	8,618	12,759	966	1,430	9,583	14,188

Comparing the recent period to the base, reductions have been most severe in Washington, followed in order by Oregon and California. Within California, reductions in northern California (north of Horse Mountain) have been nearly severe as those in Washington. Finer scale geographic differences in harvest distributions will be discussed in the section on communities.

Exvessel values by state ($ thousands).

	Chinook		Coho		Chinook+Coho	
	Nominal	Real	Nominal	Real	Nominal	Real
			Washington			
1981-1988 Avg	1,809	2,752	891	1,417	2,700	4,169
1993-1997 Avg	223	193	54	57	277	250
Percent Change	-88%	-93%	-94%	-96%	-92%	-94%
1983	1,152	1,770	313	481	1,465	2,251
1984	255	378	155	229	410	607
			Oregon			
1981-1988 Avg	6,412	9,092	3,014	4,436	9,425	13,528
1993-1997 Avg	2,224	2,306	3	2	2,226	2,308
Percent Change	-65%	-75%	-100%	-100%	-76%	-83%
1983	1,244	1,911	1,052	1,616	2,296	3,527
1984	1,488	2,203	124	183	1,611	2,386
			California			
1981-1988 Avg	16,994	24,316	526	790	17,520	25,107
1993-1997 Avg	7,404	7,727	0	0	7,404	7,727
Percent Change	-56%	-68%	-100%	-100%	-58%	-69%
1983	4,290	6,591	318	489	4,608	7,080
1984	6,875	10,178	687	1,017	7,562	11,196

While much of the reduction in exvessel value is the result of reduced harvest and harvest opportunity, a good portion is the result of declining exvessel prices. Compared to the 1981-1988 base period, the average for the recent period is down 48% for chinook and 58% for coho.

Price per pound (inflation adjusted $s).

	Chinook	Coho
1981-1988 average	3.63	2.26
Range	2.72-4.10	1.49-2.97
1993-1997 average	1.89	0.96
Range	1.43-2.44	0.87-1.13

The vast majority of the pink salmon harvest occurs in odd numbered years off Washington. Pink salmon is generally not included in the exvessel values and assessments of community impacts provided in this analysis. The exvessel price for pink salmon is substantially below prices for coho and chinook, never rising above $1.00 per pound in odd numbered years. Peak pink salmon landings in Washington occurred in 1977, 1979, and 1981 and totaled 1.4, 2.5 and 0.9 million pounds, respectively. From 1981 through 1988 the average harvest in odd numbered years was about 0.5 million pounds. From 1993 through 1997, the average harvest in odd numbered years was about 0.1 million pounds. In Oregon, the 1981 through 1988 average harvest for odd numbered years was 90,000 pounds and the average odd year harvest for 1993 through 1997 was 200 pounds. From 1993 through 1997 exvessel pink prices have ranged from $0.20 to $0.54 per pound in Washington and $0.56 to $0.62 per pound in Oregon.

Troll Vessel Participation and Harvest

The first year for which permit counts are available for all three states is 1982. From 1982 through 1988 the number of permits declined from 12,122 to 7,427. The percentage of active permits generally ranged from 66% to 79%. The one year outside this range is 1984, when only 39% of all permits were active. This decline was due to declines in fishing opportunity, and hence participation, related to an El Niño event. In the last five years (1993 through 1997), the number of permits declined from 5,221 to 3,678 and the percentage of active permits has varied between 35% and 45% with an average active permit rate of 39%.

Average chinook and coho revenue per vessel for 1993 through 1997 is only five percent below the 1981 through 1988 base period, however, care is required in interpreting the average. The averages may increase as much from small producers dropping out at a higher rate relative to larger producers as from an increase in revenue earned by remaining vessels.

Coast wide numbers of vessels and average vessel revenue.

	Number of Vessels Participating	Average Revenue Per Vessel (Inflation Adjusted Dollars)
1981-1988 average	6,761 [a]	$6,761
Range	3,721-10,156	$1,564 -$16,265
1993-1997 average	1,649	$6,439
Range	1,316 -2,326	$3,848 -9,384

a/ It is a coincidence that the value for number of vessels matches the average revenue per vessel.

Average numbers of vessels and average vessel revenue, by state.

	Washington		Oregon		California	
	Vessels	Avg Rev	Vessels	Avg Rev	Vessels	Avg Rev
1981-1988 average	1,395	$2,805	2,390	$5,865	2,976	$8,884
1993-1997 average	142	$4,460	469	$4,928	1,037	$7,532
Percent difference	-90%	59%	-80%	-16%	-65%	-15%

As with the coast wide values for average revenue per vessel, care must be taken in interpreting the state averages. In Washington, average revenue per vessel appears to have increased by 59%, however, for the 142 vessels active in recent years, the $4,460 average may represent a drop from their 1981-1988 average. Similarly the degree of decline in average vessel revenues for Oregon and California may be greater than indicated for those vessels remaining in the fleet, if vessels with lower revenues tended to drop out of the fleet at a faster rate than vessels with higher revenues.

Assuming that permits bought out would have participated at the same rate as those permits not bought out in the recent round of buyouts, vessels in Washington averaged 14% greater average per vessel income than they would have in the absence of the buyout program.

5.3.3.4 Impacts on Commercial Treaty Tribal Ocean Troll

Historic information is not available for the value of the tribal ocean troll harvest. Therefore, the comparison of recent to base period will be made in terms of number of fish harvested. Indian troll chinook harvest has declined 39% from the base period and coho harvest has declined 57%.

Numbers of fish harvested.

	Chinook	Coho
1981-1988	25,700	71,200
Range	16,100-40,800	32,800-124,000
1993-1997	15,700	24,600
Range	5,700-32,500	0-59,100

The averages are strongly influenced by 1993. If 1993 were excluded from the recent year averages, the chinook average would be 11,500 fish and the coho average would be 21,200. In 1994, there was a substantially reduced Indian chinook fishery an no Indian coho fishery. Removal of 1993 and 1994 from the recent year averages would put the averages at 13,500 chinook and 21,200 coho.

5.3.3.5 Impacts on Processors/Buyers

There were 442 firms that received salmon from 1995 to 1997. The top 22 of these firms handled 73% of all ocean caught salmon (see Section 5.0 of Appendix B to Amendment 14). For three quarters of the top firms, salmon purchases represent less than 50% of their total fish purchases. The recent harvest reductions have affected processor revenue opportunities. In Appendix B, some information is provided on exprocessor prices; however, because of the limited information available and uncertainty about the mix of products and markets to which West Coast salmon go, it is not possible to assess the exprocessor value of the salmon.

5.3.3.6 Impacts on Treaty Tribal Ocean Ceremonial and Subsistence Harvest

Treaty Tribe ceremonial and subsistence harvest takes only minor amounts of salmon in the ocean fisheries. Most such harvest occurs in inside fisheries. The ocean ceremonial and subsistence harvest has not been substantially constrained in recent years as compared to the 1981 through 1988 base period being used for this comparison. The Treaty Tribes have chosen bear their conservation burden for the ocean fisheries by constraining their commercial harvests rather than their ceremonial and subsistence fisheries.

5.3.3.7 Impacts on Recreational Fishery

Angler Trips

Coast wide, annual total angler trips are down 41% for the recent year average as compared to the 1981 through 1988 base period.

West Coast ocean salmon angler effort levels by mode (number of trips, thousands).

	Charter Vessel	Private Vessel	Total
1981-1988 average	211	344	555
Range	116-289	241-406	357-670
1993-1997 average	119	210	329
Range	74-175	143-287	217-462

The number of trips taken on charter vessels is down slightly more than the number taken on private vessels (down 44% compared to down 39%). The average number of trips taken on charter vessels in the recent period is slightly above the low end of the 1981 through 1988 average while the average number of trips taken on private vessels in the recent period is 13% below the low end of the 1981 through 1988 average.

On a state by state basis, the number of trips are up in California and down in Washington and Oregon (Table 5-11 and Figure 5-1). The decline has been substantially greater for angler trips on charter vessels than for angler trips on private vessels and the increase in California is smaller for charter vessels and larger for private vessels. Trips taken on Oregon charter vessels are down 88% and trips on Washington charter vessels are down 79%, comparing the recent year average to the 1981 through 1988 base period.

Average angler success rates in California were higher in the 1993 through 1997 recent period than in the 1981 through 1988 base comparison period, but lower in Oregon and Washington.

Average angler success rates by state (salmon per angler trip).

	California	Oregon	Washington
1981-1988 average	0.86	0.95	1.50
Range	0.74-0.97	0.74-1.29	1.22-1.80
1993-1997 average	0.91	0.49	1.21
Range	0.73-1.05	0.22-0.82	1.06-1.33

Success rates in Oregon declined substantially, primarily as a result of the prohibition on retention of coho. California angler success rates in 1995 (1.05 fish per angler day) and 1997 (0.98 fish per angler day) were at record levels for the 1976 through 1997 period. Angler participation in California appears to have responded significantly to the 1995 angler success rates (Figure 5-1).

Charter Vessels

The charter vessel counts available for each state are different in terms of what is counted. The count for Washington is a count of charter vessels licensed for salmon (including vessels that operate in Puget Sound), the count for Oregon is a count of all ocean recreational charter vessel regardless of whether or not they target on salmon in a particular year, the count for California is a count of only those vessels that are licensed and participate in the ocean salmon fishery each year (Table 5-12). In addition to the differences between the types of vessel counts for each state, the trends in vessel counts are influenced by different factors in each state.

In Washington there were 510 salmon charter vessels in 1980. By 1987 the count had declined to 280 and in 1997 was down to 209. The Washington charter vessels were under a license limitation system which included individual transferable angler effort units (see Section 3.2.1 of Appendix B to Amendment 14). Under this system, each charter vessel was assigned a maximum number of anglers it could carry. These capacity units could be sold to other vessels however, if all units were sold the vessel license would expire. The reduction in numbers of vessels was likely the result of a combination of the buyback program (118 charter vessel permits were bought back between 1980 and 1986), some consolidation under the system of transferable effort units and attrition.

In Oregon there were 194 charter vessels operating in 1980, however, there was no license limitation system in effect. The number of charter operation grew from 194 in 1980 to 254 in 1987. Some of the increase may have been caused by vessels displaced from the Washington charter vessel fishery. In 1988 and 1989, the fee was reduced from between $25 and $100 to $10. Correlated with this reduction was a jump in the number of charter vessel permits to over 300 for 1988 and 1989. In 1990, the fee was increased to between $50 and $100 for residents. Correlated with this fee increase was an immediate reduction in the number of charter vessels to 170 in 1990. Since 1990, there has been a steady but gradual decline which reduced the number of vessels in the charter fleet to 122 vessels in 1997 (a decline of 28% since 1990).

In California, there have not been the definite trends in vessel counts observed in Washington and Oregon. There is also no license limitation program for salmon vessels in California. While there appears to be fewer charter operations fishing salmon in recent years than past years, the third greatest count in charter vessels targeting on salmon occurred in 1995. To some degree, declines in charter vessels targeting on salmon north of Point Arena have been offset by an increase in the number of vessels operating out of Monterey area ports (see Table D-19 of the annual review for port by port counts of numbers of charter vessels).

TABLE 5-11. Ocean salmon angler effort levels by state and mode (thousands of angler trips).

	Charter Vessel	Private Vessel	Total
	California		
1981-1988 average	80	100	180
Range	57-105	61-163	122-268
1993-1997 average	96	145	241
Range	66-153	109-226	175-379
	Oregon		
1981-1988 average	49	183	233
Range	24-65	129-246	153-311
1993-1997 average	6	38	44
Range	2-13	26-67	27-80
	Washington		
1981-1988	82	61	142
Range	30-162	37-90	70-237
1993-1997	17	27	45
Range	0-40	0-69	0-109
	West Coast Total		
1981-1988 average	211	344	555
Range	116-289	241-406	357-670
1993-1997 average	119	210	329
Range	74-175	143-287	217-462

TABLE 5-12. Numbers of recreational charter vessels by state.

	California (Charter Vessels Catching Salmon)				
Year	Active	Casual	Total	Oregon (All Charter Vessels)	Washington (Licensed Salmon Charter Vessels)
1980				194	510
1981				248	478
1982				253	415
1983				255	375
1984				218	334
1985				226	288
1986				247	308
1987	96	53	149	254	280
1988	95	71	166	313	281
1989	89	93	182	322	276
1990	93	67	160	170	273
1991	78	108	186	171	267
1992	49	91	140	157	269
1993	66	61	127	148	265
1994	60	42	102	145	260
1995	93	71	164	134	231
1996	75	51	126	127	210
1997	82	38	120	122	209

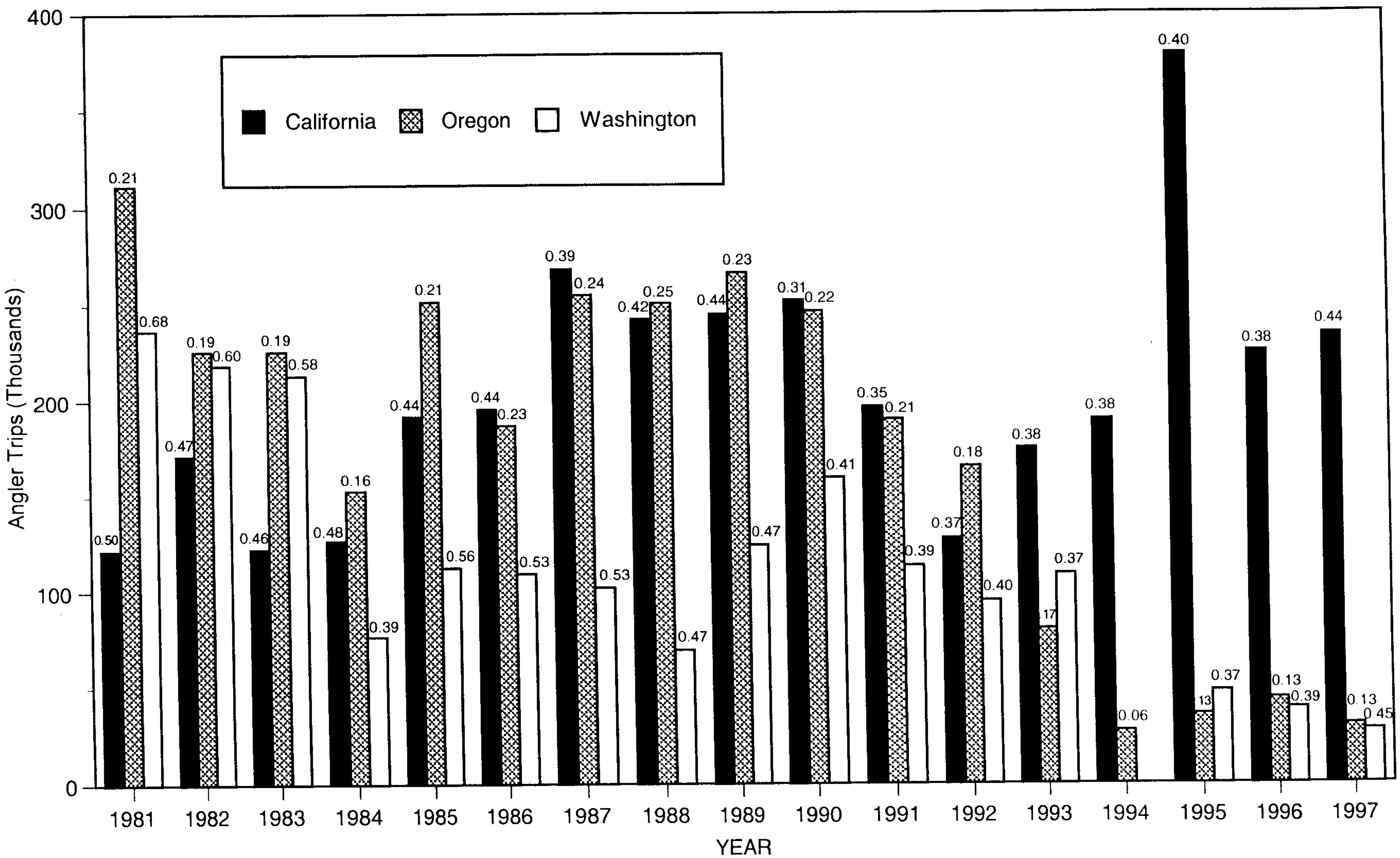


FIGURE 5-1. Angler effort by state with percent of trips on charter vessels.

5.3.3.8 Impacts on Coastal Communities

There are many different kinds of communities including communities based on location, occupation, and areas of interest. The Magnuson-Stevens Act focuses on fishing communities as geographic areas where residents are dependent on the fisheries or where fish harvesting or processing occurs.

For purpose of reviewing the effects of the salmon fisheries on communities, income impacts associated with fish landings for the port areas of the West Coast are estimated. Three different types of income are included in the estimate of income impacts (1) direct income, income paid directly to business owners and employees of fish harvesting and fish processing firms; (2) indirect income, income paid to business owners and employees of firms supplying the fish harvesting and processing firms (e.g., engine repair and bait businesses); and (3) induced income, income that is generated for owners and employees of other firms when recipients of direct and indirect income spend their money in the community (e.g., grocery stores and theaters). These effects should be thought of as those "associated with" the fishery rather than "generated by" the fishery, because in the absence of the fishing opportunity some of the income would still be generated in the community or elsewhere in the economy (e.g., tourists at the coast for primary reasons other than fishing might spend their time and money on other activities, fishers not traveling to the coast to salmon fish might spend their time and money on some alternative activity in another community, and the crew on vessels would seek an alternative source of income either within the community or elsewhere).

The income impact estimates provided here are very approximate. The estimates are generated on the basis of the simplifying assumption that all expenditures associated with the fish harvesting and processing activity occur in the community in which the fish are landed. In fact, many of the activities associated with a landing may occur elsewhere, for example crew member residences (and hence location of the preponderance of their income expenditures), vessel repair, or a vessels home port may be in a community different from where the fish were landed. Additionally, some fish landed in one community may be shipped to another for processing. To the degree that the assumption that all effects occur in the community is inaccurate, income effects may be more broad spread and the level of community dependence and effect on communities lower than indicated by the numbers provided here. For these reasons, the relative sizes of the values presented and relative magnitudes of the changes may be more important than the absolute values of the estimates.

Fisheries have impacts on communities other than the income impacts. For example, when members of families in the community must travel away from home for long periods of time in order to continue in their profession, social stresses occur both on the families and on those away from home. These social stresses will inevitably have some effects felt beyond the family, effects on the community. Similarly, decreased household income or changes in professions are also likely to result in social and economic effects on families which may spill outside the family unit, affecting others in the community.

In the following sections, income impact estimates for the troll fisheries include only those associated with chinook and coho landings, pink salmon landings are excluded. For a discussion of the volume and value of pink salmon landings see the start of Section 5.3.3.1.

North of Cape Falcon Communities

The major ocean port areas in the north of Cape Falcon area are Astoria in Oregon and Ilwaco, Westport, La Push and Neah Bay in Washington. Astoria also includes Warrenton, Gearhart/Seaside and Cannon Beach and all Oregon side Columbia River ports; Ilwaco also includes Long Beach, Nacotta, Naselle and all Washington Columbia River ports, Westport also includes Aberdeen, Bay City, Copalis Beach, Hoquiam, Moclips, Taholah, Bay Center, Grayland Beach, Raymond, South Bend and Tokeland; La Push also includes Kalaloch; and Neah Bay includes no other communities. These communities are estimated to have experienced drop of around 80% in the income associated with both the troll and recreational salmon fisheries.

County level income impacts associated with north of Cape Falcon fisheries ($ thousands, inflation adjusted).

	Neah Bay	La Push	Westport	Ilwaco	Astoria	Total
			Troll			
1981-1988 average	753	306	3,313	706	892	5,970
1993-1997 average	135	32	189	2	25	383
Percent change	-82%	-89%	-94%	-100%	-97%	-94%
			Recreational			
1981-1988 average	1,418	287	6,576	3,093	1,385	12,759
1993-1997 average	301	54	1,474	749	439	3,017
Percent change	-79%	-81%	-78%	-76%	-68%	-76%
			Combined			
1981-1988 average	2,171	594	9,889	3,799	2,277	18,730
1993-1997 average	436	86	1,662	752	464	3,400
Percent change	-80%	-86%	-83%	-80%	-80%	-82%

Income reductions for businesses and people dependent on the troll fisheries tend to be slightly less severe to the north than to the south. On the recreational side the interport distribution of allocation was fixed by the FMP for the first time in 1989, and affects the distribution of the decline in recreational fishery related income impacts between ports.

Cape Falcon to Cape Blanco Communities

The major ocean port areas between Cape Falcon and Cape Blanco are Tillamook, Newport, and Coos Bay, Oregon. Tillamook also includes Garibaldi, Netarts, Pacific City and Nehalem Bay; Newport also includes Depoe Bay, Siletz Bay, Salmon River and Waldport; and Coos Bay also includes Florence, Winchester Bay, Charleston and Bandon The communities along the central Oregon coast are estimated to have lost between about 70% and 90% of their salmon industry related income.

The greatest drop in both relative and absolute terms have been in Coos Bay for both the troll and recreational fisheries. Coos Bay port area fisheries are more under the influence of management restrictions related to the Klamath fall chinook than other areas along the coast. Income related to the Newport troll fleet has held up better than any other area of the coast with the exception of Monterey California and the combined recreational troll value even at -71% was a lower drop than for any other area except San Francisco and Monterey. The recreational fishery in central Oregon, strongly dependent on coho, has probably been harder hit by reduced effort related to the non-retention status on coho than by the reduction in season length for recent years.

County level income impacts associated with central Oregon coast fisheries ($ thousand, inflation adjusted).

	Tillamook	Newport	Coos Bay	Total
		Troll		
1981-1988 average	2,212	5,329	9,421	16,961
1993-1997 average	239	2,354	833	3,426
Percent change	-89%	-56%	-91%	-80%
		Recreational		
1981-1988 average	1,332	3,624	3,197	8,153
1993-1997 average	301	282	219	802
Percent change	-77%	-92%	-93%	-90%
		Combined		
1981-1988 average	3,544	8,952	12,617	25,114
1993-1997 average	540	2,636	1,053	4,229
Percent change	-85%	-71%	-92%	-83%

Cape Blanco to Horse Mountain

The Cape Blanco to Horse Mountain area includes all of what is traditionally referred to as the KMZ (Humbug Mountain to Horse Mountain) and a small area from Humbug Mountain to Horse Mountain that includes Port Orford. Port Orford is grouped here with the KMZ ports, because Port Orford is included with the Brookings port area which, for the most part, is within KMZ. The major ocean port areas between Cape Blanco, Oregon and Horse, Mountain California are Brookings in Oregon and Crescent City, and Eureka in California. Brookings also includes Port Orford and Gold Beach, Crescent City includes no other communities, Eureka also includes Trinidad and Humboldt Bay locations.

County level income impacts associated with central Oregon coast fisheries ($ thousands, inflation adjusted).

	Brookings	Crescent City	Eureka	Total
	Troll			
1981-1988 average	2,740	2,217	3,335	8,293
1993-1997 average	199	6	97	302
Percent change	-93%	-100%	-97%	-96%
	Recreational			
1981-1988 average	2,299	1,418	1,404	5,121
1993-1997 average	763	514	630	1,907
Percent change	-67%	-64%	-55%	-63%
	Combined			
1981-1988 average	5,039	3,635	4,739	13,413
1993-1997 average	962	521	727	2,209
Percent change	-81%	-86%	-85%	-84%

Even though the Brookings port area includes one port outside the area of severest restrictions associated with the Klamath fall chinook (the KMZ area), the decline in income impacts related to the recreational fishery is greater than for other port areas and reasonably close to the level of decline experienced in the Crescent City and Eureka areas in relation to the troll fishery. Overall, the combined decline in salmon fishery related income impacts for all three port areas are relatively comparable.

South of Horse Mountain Communities

The major port areas in the area south of Horse Mountain are Fort Bragg, San Francisco and Monterey. In some years Fort Bragg is strongly affected by restrictions for Klamath fall chinook and other years less so. To some extent it might be considered a borderline KMZ community. Fort Bragg also includes Shelter Cove, Noyo Harbor, Mendocino, and Pt. Arena; San Francisco also includes Bodega Bay, San Francisco Bay and Half Moon Bay; Monterey also includes Santa Cruz, Moss Landing, Monterey, Morro Bay and Santa Barbara.

County level income impacts associated with the area south of Horse Mountain ($ thousand, inflation adjusted).

	Fort Bragg	San Francisco	Monterey	Total
		Troll		
1981-1988 average	11,584	21,298	7,132	40,014
1993-1997 average	507	8,770	6,019	15,296
Percent change	-96%	-59%	-16%	-62%
		Recreational		
1981-1988 average	699	10,045	1,402	12,147
1993-1997 average	1,276	11,004	5,386	17,666
Percent change	82%	10%	284%	45%
		Combined		
1981-1988 average	12,284	31,344	8,534	52,161
1993-1997 average	1,783	19,775	11,405	32,962
Percent change	-85%	-37%	34%	-37%

On a proportional basis Fort Bragg appears to have seen some growth in its recreational fishery and related income impacts; however, the growth in this sector of the industry has not been nearly sufficient to overcome the effects of the dramatic drop in income impacts related to the troll fishery. San Francisco and Monterey have also seen growth in their recreational fisheries relative to the 1981 through 1988 base period and in Monterey the amount of growth may have been sufficient to offset the decline in troll industry related income.

5.3.4 Impacts of Continued Reductions in the Ocean Salmon Fisheries

If ocean harvest continues to be become more constrained due to certain weak stocks, including ESA listed stocks, ocean escapement of stronger stocks will increase. Increases in ocean escapement could provide opportunities for increased inside fisheries so long as those inside fisheries can be prosecuted without increasing impacts on weak stocks. In the absence of an ability to increase inside harvest, spawning escapement to natural spawning beds and hatcheries will increase with the potential for increasing future production (the question being whether or not there will be an opportunity to take advantage of this future production if certain weak stocks continue to constrain harvest). Thus, lost opportunity to harvest in the ocean does not necessarily mean the complete loss of benefits from fish forgone in the ocean harvest.

In the same way that fish not caught in the ocean move on to another use, money not expended on ocean fisheries moves on to another activity. The values provided in the previous section on amounts of exvessel revenue in the ocean fisheries, numbers of vessels participating, numbers of recreational trips taken, and community income impacts are indicators of the amount of dislocation and dislocational costs which may occur in the event of continued reductions or even a shut down of ocean fisheries, but are not indicators of the net loss to the nation from such reductions. Recreational anglers, workers, and vessel owners would be expected to adjust to reductions by moving on to other activities. The type and value of the alternative activity in comparison to the value of the fishing activity determines the net effect of reductions in ocean fisheries. For example, if a worker in the commercial ocean fisheries goes on government assistance as a result of lost ocean fishing opportunity and there is no new job or income created elsewhere in the economy, then the net loss to the economy with respect to the workers job would be the entire wages for that worker. However, if additional income is generated elsewhere either through the harvest of the salmon in an inside fishery or through the consumers redirection of food expenditures from salmon to another food source such as another fish species or chicken (with the consequent generation of additional income or jobs for some of those in the other fishery or chicken producing industry), then the net effect of the lost employment income would have to be reduced by some portion of the value of the increased economic activity elsewhere in the economy. For the consumer in the fish market or the recreational angler whose first choice would be to buy or catch an ocean chinook or coho, the forced move from that choice to another food product or another recreational experience reflects a reduction in value to the consumer. However, the net economic value of the reduction is not the entire expenditure on the purchase or experience, or even the difference between the expenditure and the value the angler or fish market consumer places on the fish (i.e., we often pay less than what we would have been willing to pay for a good or service). It is, rather, the difference between what the individual paid and would be willing to pay for the salmon as compared to the difference between what the individual paid and would have been willing to pay for the next best thing. This difference would in all likelihood indicate a net loss from the move from the first to second choice activity, but the size of the net loss is uncertain. The coastal community as a whole will experience reductions in economic activity to the degree that economic activity and expenditures are redirected to a different geographic region. As discussed in Sections 5.3.2.1 under "Time Area Restrictions" and at the start of Section 5.3.3.8, while some people may switch their recreational expenditures to another community in response to lost recreational salmon harvesting opportunities, others may switch to another activity within the same community. Similar explanations of net effects to those provided here for the crew member, consumer and community could be provided for the vessel owner, engine mechanic, processor employee, bait supplier, and others who might be affected by a reduction in the ocean salmon harvest.

Section 5.3.3 provided many indicators of value which are comparable to indicators often used to describe the value of activities in nonfishing sectors of the economy. As with these other sectors, the values are useful in characterizing impacts and potential dislocational effects of reductions in activity, however, in assessing the effects of reductions (or increases) on the net benefits provided to the nation, the changes in net benefits are likely less than indicated by these gross values and their estimation would require information and models not currently available.

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8 CONSULTATION AND COORDINATION

8.1 SCOPING

Formal scoping for this amendment was initiated in October 1996 in a special work session of the Council, its salmon advisors, and interested public. The purpose of the scoping was to review the entire salmon fishery management plan (FMP) with the intent of identifying any needed amendments in light of management and resource changes, passage of the Sustainable Fisheries Act (1996), and completion of an updated supplemental environmental impact statement (EIS) for the FMP. A summary of the results of this initial scoping session was circulated widely and additional refinement of the amendment issues continued at several Council meetings in 1997 and 1998. In the process, the Council separated the issue of Oregon coastal natural (OCN) coho management from the rest of the amendment issues and moved it ahead on a separate track so that it was completed and adopted in 1997 (Amendment 13). The remaining amendment issues became Amendment 14.

8.2 PUBLIC REVIEW AND COMMENTS

Draft Amendment 14 and a draft supplemental EIS for the salmon FMP were distributed in January 1999 to affected agencies and interested public. Agencies and organizations receiving copies of the drafts included:

Federal Entities

Bonneville Power Administration
CALFED Bay Delta Program
Canadian Consulate General
General Accounting Office
National Marine Fisheries Service
North Pacific Anadromous Fish Commission
Northwest Power Planning Council
Olympic Coast National Marine Sanctuary
U.S. Army Corps of Engineers
U.S. Coast Guard
U.S. Bureau of Land Management
U.S. Bureau of Reclamation
U.S. Department of Interior
U.S. Department of State
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Forest Service
U.S. National Park Service

State Entities

Alaska Department of Fish and Game
California Department of Fish and Game
California Department Of Water Resources
California Department of Transportation
Idaho Department of Fish and Game
Idaho Department of Lands
Independent Multidisciplinary Science Team
Oregon Department of Fish and Wildlife
Oregon Department of Forestry
Washington Department of Ecology
Washington Department of Fish and Wildlife

Tribal Entities

Columbia River Intertribal Fish Commission
Confederated Tribes of the Siletz Indians
Hoopa Valley Tribe
Makah Tribal Council
Northwest Indian Fisheries Commission
Puyallup Tribe
Quileute Tribe
Quinault Fisheries Division
Tulalip Tribes
Yurok Tribe

County and Local Governments

City and County of San Francisco
City of Bellevue, WA
City of Everett, WA
City of Forks, WA
East Bay Municipal Utility District
Idaho Assoc. of Counties
Illinois Valley Water Right Owners, Assoc.
Lincoln Soil and Water Conservation District
Metro Water District of Southern California
Monterey County Water Resources Agency
Northern California Water Assoc.
Oregon International Port of Coos Bay
Port of Coupeville
Port of Siuslaw
Port San Luis Harbor District
Santa Carbona Irrigation Dist.
Sonoma County Water Agency
Snohomish County
Tulare Lake Rain Water Storage District
Water District 65, Payette, ID

Organizations and Business

American Fisheries Soc.
American Oceans Campaign
Assoc. of California Water Agencies
Boeing Co.
California Building Industry Assoc.
California Farm Bureau Federation
California Forestry Assoc.
California Salmon Council
Central Coast Salmon Enhancement, Inc.
Central Valley Water Assoc.
CH2M Hill
Coastal Watershed Council
Coast Range Assoc.
Committee of Nine
Cutler and Stanfield, LLP
Deer Creek Watershed Conservancy
Downey, Brand, Seymour and Rohwer
Earth Justice legal Defense Fund
Fisherman's Alliance of California
Fisherman's Alliance of Monterey
Formation Capital Corp., U.S.
Grant County P.U.D.
Grays Harbor Gillnetters
Headwaters Environmental Center
Huck Finn Sportfishing
Humboldt Fishermen's marketing Assoc.
Idaho Farm Bureau Federation
Institute for Sustainable Forestry
Interactive Citizens United
Intermountain Forest Industry Assoc.
Jaws Sportfishing, Inc.
Jones and Stokes Associates
Josephine County Farm Bureau
Klamath Alliance
Lower Columbia Econ. Development Council
Mattole Restoration Council
National Assoc. of Home Builders
National Audubon Soc.
Native Fish Society
Natural Resource Consultants
Norm & Semanko
North Coast Resources
Northeast Environmental Center
Northwest Marine Trade Assoc.
Oregon Natural Resources Council
Oregon Trout, Inc.
Pacific Coast Federation of Fishermen's Assoc.
Pacific Coast Oyster Growers Assoc.
Pacific International Engineering
Pacific Ocean Conservation Network
Pacific Salmon Company
Pacific States Marine Fisheries Commission
Pacific Trollers Assoc.
People for Puget Sound
People for the USA - Happy Camp Chapter
Perkins Coie, LLP
Peter Black Real Estate
Puget Sound Water Quality Action Team
Quest Fisheries
Salmon Troller's Marketing Assoc., Fort Bragg
Save Our Wild Salmon
Save the Bay
Scott River Watershed Council
Siskiyou County Farm Bureau
Siskiyou Project
Skagit Fisheries Enhancement Group
Taylor Shellfish Co.
Tehama Fly Fishers
The Research Group
Thornton Dairy and Sheep Ranch
Tom's Sportfishing
Trinidad Bay Charters
Trout Unlimited
Umpqua Valley Audubon Soc.
Washington Trollers Association
Washington Trout
Westport Charterboat Assoc.

Libraries

Clark College Library
College of the Redwoods
Hatfield Marine Science Center
Humboldt State University
National Park Service
Northwestern School of Law
Oregon State University
Seattle Times Library
University of Alaska
University of California, Davis
University of California, Santa Barbara
University of Oregon
University of Washington
Utah State University
US DOC/NMFS/SWFSC LIBRARY
Washington Contract Loggers Assoc.

Media

Capitol Press
Curry County Reporter
Monterey County Herald
National Fisherman
Newport News Times
Pacific Fishing Magazine
Seattle Post Intelligencer
The Minato Shimbun Daily
The Oregonian
The Reel News
The Sun

Public hearings on Draft Amendment 14 and the Draft Supplemental EIS were held in February 1999 at four locations: Olympia, Washington; Boise, Idaho; Coos Bay, Oregon; and Sacramento, California. Additional public comments were taken in Portland, Oregon at the Council's March meeting during the adoption of the amendment. Fifty-six persons attended the public hearings and 24 provided testimony. An additional seven persons provided comments at the March Council meeting. In addition, a total of 58 written comments were received at the Council office. The written public comments and summaries of testimony received at the public hearings are contained in a separate Public Comment Appendix. A response to substantive comments is provided in Chapter 9.

9 RESPONSE TO COMMENTS

The Council office received 58 comment letters in addition to oral comments and questions at the public hearings for Draft Amendment 14 and the Draft SEIS (copies of the written comments and a summary of comments received at the public hearings is contained in a separate Public Comment Appendix). Responses to the comments included making appropriate changes in the final amendment and SEIS and/or the statements and explanations contained in the responses to substantive comments provided below which are arranged by topic. Similar comments in various letters have been combined and summarized. The numbers in parentheses provide an index to the letters in the Public Comment Appendix which are pertinent to each comment.

9.1 ACHIEVING OPTIMUM YIELD

Continued use of the theory of MSY is not scientifically justified (44).

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) requires the Council to use MSY as a basis for determining optimum yield and thereby provides little choice in this matter. MSY is a commonly accepted theoretical construct to guide management decisions for exploited fish populations. However, in actual practice it is very hard to specifically ascertain, difficult to determine when it may be changing, and can only be approximated over the long-term. When there is a high degree of uncertainty about the MSY of a stock, the Council may need to choose spawner escapement objectives that significantly reduce fishing impacts at low stock sizes while allowing variable spawner escapements at medium and high stock sizes. This approach provides a way to annually determine allowable harvest while preserving the long-term productivity of a stock and gathering information from which to better understand stock production dynamics.

9.2 CONSERVATION

A "precautionary approach" should be added to the conservation alert procedure and estimation of bycatch in selective fisheries (16, 21, 33, 40, 52).

The Magnuson-Stevens Act does not specifically use the term "precautionary approach". This term appears in the National Standard Guidelines (NSG) in reference to the specification of optimum yield. The amended FMP does explicitly include reference to uncertainty and imprecision in its definition of optimum yield in Section 2.1.

The NSG characterize a precautionary approach by three features: (1) target reference points, such as optimum yield, should be safely below limit reference points that indicate a stock is overfished; (2) a stock or stock complex below the size that would produce MSY should be harvested at a lower rate than one which is above that stock size; and (3) criteria used to set target catch levels should be explicitly risk averse (i.e., greater uncertainty regarding stock status corresponds to greater caution in setting target catch levels). The FMP does not specifically use the term "precautionary approach" with regard to the conservation alert and selective fisheries. However, both procedures incorporate features of such an approach as described below.

The Council-adopted conservation alert is triggered when the STT projects that a managed stock will not meet its MSY, MSP, or floor spawner objective in the coming season. This finding requires a cessation of fishing impacts on that stock or special impact reductions in the case of some specific stocks managed under court-ordered procedures. This procedure clearly meets the three features of the precautionary approach in that (1) the MSY, MSP and floor spawner objectives are well above a level that indicates overfishing, especially if they are missed in just one year, (2) harvest rates are completely or significantly reduced in Council-managed fisheries, and (3) in the case of stocks managed through court procedures, the available stock production data is generally more complete and maintained at a finer (less aggregated) level than for the other stocks which are subject to the conservation alert procedure.

With regard to selective fisheries, the requirement for the Council to use the best science and the guidelines in Section 6.5.3 provide a precautionary type of approach to their implementation. Among the requirements is that any selective fishery proposal be made in a timely manner to allow full analysis and public comment. An example of this precautionary approach is provided by a Council implemented selective coho fishery off central Oregon in 1999. The fishery was only approved based on estimated fishery impacts being significantly below the allowable level to meet the pertinent conservation objectives while using a hook-and-release mortality rate that was double the standard rate currently in use to account for both uncertainty in the status of the stock and in the hook-and-release mortality estimates.

The draft supplemental EIS does not evaluate the health and viability of all salmon stocks of the entire Pacific Coast population, nor whether hatcheries have been successful in compensating for past adverse impacts and maintained populations at predam levels (57).

The salmon FMP provides some general information as to the status of stocks which have conservation objectives (Table 3-1) and references sources of additional infomation. Evaluating the success of hatcheries to fulfill mitigation for losses due to dams is beyond the scope of this amendment and the Council's FMP.

9.2.1 Conservation Objectives

Modifying the floor conservation objective for Klamath River fall chinook should require an FMP amendment rather than being possible through a technical review.

This requirement has been included in the Council's final adoption.

The Strait of Juan de Fuca coho stock should not be a key salmon stock that drives Council management (29).

There is no new conservation objective for the Strait of Juan de Fuca coho stock. The amended FMP simply clarifies the objective agreed to by the State of Washington and the pertinent treaty tribes through U.S. District Court procedures.

Each stock that is impacted by Council fisheries should have a conservation objective (16, 40). Conservation objectives should be associated with ecological functions such as nutrient enrichment and gene conservation (16). A time line should be included for developing conservation objectives for stocks which currently have none (33, 52).

The Council has included conservation objectives for each stock for which information is sufficient to do so and hopes to add other stocks as appropriate data are developed. Even though a stock may not have a specific conservation objective it may still be protected by objectives for other stocks which have similar distributions or life histories and by limits for stocks listed under the ESA.

The Council's MSY and MSP objectives are associated with ecological functions such as nutrient enrichment and gene conservation as long as they are accurate reflections of the productive potential of each pertinent stream system. In cases where there is considerable uncertainty about the current MSY or MSP levels for a stock, such as for OCN coho and Klamath River fall chinook, the Council has established rebuilding goals which allow the spawner escapements to vary well above previously theorized estimates of MSY or MSP to test the results of such numbers on productivity.

Table 3-1 indicates if efforts are ongoing to provide more specific conservation objectives for individual stocks within a particular stock complex. In an ideal situation, the Council would have the staff and funds to establish an effort and time line to complete these tasks. However, the Council must rely on the states and tribes to take the primary role in developing these new objectives and is not in charge of the direct management of many of these stocks. Therefore, a specific time line for the development of new objectives is not possible.

More conservative standards than NMFS jeopardy standards should be used as conservation objectives in Table 3-1 to rebuild the stocks listed under the ESA and they should not be exempted from the overfishing concern (51).

The FMP considers the jeopardy standards and recovery plans developed by NMFS for listed populations as interim rebuilding plans and it is unlikely that they will recover listed populations to historical MSY levels within ten years. However, they should be sufficient to stabilize populations at currently depressed MSY levels until freshwater habitats can be restored and estimates of MSY developed consistent with recovered habitat conditions. As species are delisted, the Council will establish long-term conservation objectives with subsequent overfishing criteria and manage to maintain the stocks at or above MSY levels for the recovered habitat.

The conservation objective for OCN coho is not appropriate (e.g., the allowable harvest rate may be too high, criteria for initiating harvest is not well founded, and some data used in the habitat model is questionable) (30, 32, 40, 44).

Modifications to the conservation objective for OCN coho is beyond the scope of Amendment 14. However, the FMP calls for a comprehensive, adaptive review of the management measures for OCN coho in 2000 which could result in changes to the objective.

There are no objectives to deal with differentiating and enumerating central and northern Oregon fall and spring chinook.

While there are no objectives in the FMP at the current time, ODFW is developing specific objectives for fall and spring chinook that may be incorporated in the FMP when they are completed.

The Central Valley fall chinook conservation objective should not include hatchery fish to be consistent with NMFS requirements for ESA listed stocks and goals for certain habitat protection and restoration projects (24).

Identifying individual goals for each stock of fish would be ideal. However, these stocks are mixed in the ocean fisheries and it is not possible to manage them individually. It is possible to manage ocean fisheries to meet an overall spawner escapement to the river which is based on providing enough natural stock to meet enhancement and recovery needs. The current FMP conservation objective for Sacramento River fall chinook is based on a blend of data from the 1950s and 1970s. It recognizes that many naturally produced stocks have been at depressed levels due, in considerable part, to water diversion and other habitat problems. Combining hatchery and natural stocks in the objective has allowed for changes in the proportions of natural and hatchery production to account for losses and recoveries without constantly amending the FMP. In the future, as improvements occur in habitat, the Council may need to revisit the Central Valley objective to assure it is meeting the needs of the naturally produced stocks.

9.2.2 Overfishing Criteria

The conservation alert procedure must meet the "conservation necessity" standard when applied to ocean treaty troll fisheries (29).

The Council agrees with the comment and included such recognition in its final adoption as follows:

> In the case of Washington coastal and Puget Sound salmon stocks and fisheries managed under U.S. District Court orders, the Council may allow fisheries which meet annual spawner targets developed through relevant U.S. v. Washington, Hoh v. Baldrige, and subsequent U.S. District Court ordered processes and plans, which may vary from MSY or MSP conservation objectives.

The term "overfishing" should only apply if changes in the fishery management regime offer the primary opportunity to improve stock status and excepted stocks should be those in which Council fisheries have a 15% or less impact, rather than 5% (25, 53). The 5% exemption criteria should only apply to the stocks already identified in Table 3-1 of the FMP and not to small local stocks that are not currently in the table and would be adversely affected by such an action (e.g., lower Columbia River coho) (32).

The Magnuson-Stevens Act defines overfishing without respect to identifying the primary factor that has led to or can reverse the stock depression, be it fishing or habitat related. However, the Council action in reviewing a stock which meets its overfishing concern criteria includes identifying the primary factors which can prevent or end overfishing.

The choice of a minimal incidental impact level that prevents the Council from being able to take meaningful actions to rebuild a stock is somewhat arbitrary and may be more thoroughly reviewed and possibly recommended for change in the future. In view of the strong emphasis in the Magnuson-Stevens Act for avoiding overfishing and recovering an overfished stock in the shortest time possible, the Council chose to adopt 5% as the exemption cutoff. A very low rate, such as 5%, provides considerable certainty that the Council will not fail to adequately consider rebuilding a stock that may receive some benefit from the effort. This is especially true for small stock groups at low abundance which reside primarily within Council-managed waters as opposed to stocks which have distributions that are mostly outside Council fisheries and for which Council area fishery reductions would have little effect on their recovery.

The 5% impact cutoff would apply to stocks that are added to Table 3-1 in the future. The 5% is a total exploitation rate on the stock and is a very low level of impact that is well below the incidental levels currently allowed in the recovery of most stocks listed under the ESA. Also, the 5% applies to the base period for the Council models (generally 1979-1982) during which time the ocean fisheries had full seasons, few restrictions and much greater fishing effort. Under today's restricted fisheries, the impact on a stock that was 5% during the base period would likely be significantly reduced.

What would be the allowable incidental harvest impact rate for stocks that meet the criteria for a conservation alert or an overfishing concern (40)?

The Council's adopted amendment would allow no incidental impacts on a stock which triggered a conservation alert, unless the stock were managed by WDFW and tribes pursuant to U.S. District Court orders. In these cases a very low level of incidental impact could be allowed as agreed to by WDFW and the treaty tribes.

The allowable incidental harvest impact rate on a stock that meets the Council-adopted overfishing concern criteria would be dependent on the results and recommendations of an STT review for stock rebuilding in accordance with the requirements of the Magnuson-Stevens Act.

9.2.3 Bycatch

The definition of bycatch should be expanded to cover all fisheries, not just the salmon fishery (30, 40, 53).

The Council deals with bycatch in other fisheries through the FMPs for those fisheries (e.g., the Pacific Coast groundfish FMP and the Coastal Pelagic FMP).

In Option B-5, the Council should state that it will initiate an independent, comprehensive analysis of hooking mortality and encounter rates, as well as methodologies used in predicting impacts in nonretention fisheries (52).

Specifying this level of detail in the FMP is generally not useful and is quickly outdated. The Council's advisory groups, annual processes, and operating procedures have been established to ensure assessment of the technical issues the Council must face to meet the requirements of the Magnuson-Stevens Act. For example, in 1998, the Council established an ad-hoc committee to review nonretention mortality issues and data. At the November 1999 Council meeting, as a result of action by this ad-hoc committee, the STT (with guidance from the Scientific and Statistical Committee) provided a preliminary technical review of the rates reported in recent research for ocean sport fisheries. Prior to the March 2000 Council meeting, the STT will complete its analysis and provide recommendations for an interim nonretention mortality rate for the 2000 season.

9.3 HABITAT AND PRODUCTION

9.3.1 Essential Fish Habitat

9.3.1.1 Definition and Description

The Council's designation of essential fish habitat (EFH) is overly broad, should not extend beyond water and substrate (1, 2, 5, 7, 10, 11), and exceeds Congressional intent by ignoring the terms "necessary" and "essential". The definition should just describe those areas which are truly essential and focus only on weaker stocks. It should not include the entire historic habitat. (31, 46, 51, 55)

The Council's designation of EFH is broad rather than narrow because the Magnuson-Stevens Act [Section 301(a)(1) and (8)] is not about preserving remnant fish populations, but about being able to recover, maintain, and harvest the Nation's fishery resources at optimum levels which contribute to the social and economic well being of fishery dependent communities and the Nation as a whole. This is reflected in NMFS' 1997 Interim Final Rule on EFH which defines "necessary" as the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and defines "spawning, breeding, feeding, or growth to maturity" as covering a species' full life cycle. To maintain and harvest the Nation's fishery resources at optimum levels requires utilizing the habitat that has historically been available to salmon with certain exceptions for impassable dams and other current barriers which the Council has excluded.

The Council's designation does not extend beyond water and substrate. However, in accordance with NMFS' 1997 Interim Final Rule on EFH, the designation of "water" includes aquatic areas and their associated physical, chemical and biological properties that are used by fish and may include historic areas if appropriate. In the same rule, "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities. The properties of the designated "water and substrate" are certainly affected by the input to the aquatic environment from the surrounding dry land. To ignore this linkage would make the habitat provisions of the Magnuson-Steven Act ludicrous.

The designation of EFH overlaps with existing environmental laws (i.e., the ESA and NEPA) and will overwhelm NMFS, the Council staff, and federal action agencies to deal with it. Additionally it will unduly burden non-fishing stakeholders and homebuilders. (46, 55)

The consultation requirements of the EFH provisions of the Magnuson-Stevens Act do overlap with existing environmental laws and requirements and will add some additional workload to NMFS, federal action agencies, and the Council staff. To keep that additional workload at a minimum, the amendment proposes that the consultations be combined with existing interagency consultations and environmental review procedures that may be required under other statutes. The EFH provisions call for the Council and NMFS to provide recommendations for conservation and enhancement measures to protect and restore the Nation's fishery resources in the case of federal or state actions which may have adverse impacts on the EFH. It is possible that some of these recommendations may result in actions by non-fishing stakeholders and homebuilders that were not previously required. The Council does not agree that this constitutes an undue burden or is beyond the scope of Congressional intent in including EFH provisions in the Magnuson-Stevens Act.

The amendment has too much emphasis on habitat and not enough on actions to control overfishing and predators (1, 2, 5, 7, 11, 17, 46, 50, 51)

The Council disagrees and believes the coverage of EFH accurately reflects the very strong emphasis found in the Magnuson-Stevens Act. In terms of specifics, less than three pages of the main body of the proposed salmon FMP is devoted to EFH, while 27 pages are used to cover overfishing and the Council's salmon stock conservation objectives. An additional eight pages in the current FMP outline harvest control measures. The EFH Appendix is quite large due to the extensive area covered by the Council (four states plus the ocean area). The appendix provides background on the ecological needs and range of salmon, details the extent of EFH over four states and the Council's ocean management area, and provides conservation and enhancement recommendations that are advisory to federal and state action agencies.

In regard to adequately dealing with overfishing, the salmon FMP limits fishing to meet specific stock conservation objectives (see Chapter 3 of the FMP). Under the FMP, the Council and NMFS have the authority to develop and implement regulations that, when necessary, can completely close all salmon fishing within the Council's area of jurisdiction (i.e., ocean fisheries of California, Oregon, and Washington). In accord with Council recommendations for the 1994 season, all non-Indian fisheries north of Cape Falcon, Oregon were closed and fisheries south of that area greatly reduced. Fisheries north of Cape Falcon have been allowed only at very low levels since that time. The retention of coho salmon has been prohibited in all fisheries south of Cape Falcon from 1994 through 1998. Every year, large areas of the ocean fishery are restricted or closed to assure the Council's conservation objectives are achieved. In contrast, with regard to EFH, the Council and NMFS may only submit comments and recommendations for federal or state actions which may adversely affect the salmon EFH. The federal and state action agencies are not required to follow the recommendations. However, federal action agencies must respond to the recommendations in writing within 30 days and, if their actions are inconsistent with the proposed conservation measures, explain their reasons for not following them.

The Council recognizes that in certain cases mammalian, avian and fish predators can be a significant factor in the mortality of juvenile and adult salmon and has been supportive of research and actions to better document, understand and control these impacts where possible. Appendix A notes the implications and impacts of predation in several places in both Chapters 2 and 3. While there is voluminous information from many sources documenting thousands of lost miles of freshwater salmon habitat and loss of salmon production throughout the Council management area, significant region wide impacts from predation are much less well documented and scientific evidence does not support that predators are currently the limiting factor in West coast salmon production. Many of the cases in which significant predation is documented are in conjunction with habitat degradation that makes salmon more susceptible to predation such as low flows, reservoirs, dam passage, artificially created islands from dredge spoils, etc. (see pages 3-23, 3-28, 3-29 and 3-43 of the draft Appendix A). The Council has no management authority with regard to avian or mammalian predators of salmon, but must meet the requirements of other applicable federal law which provides protection to these species.

How can changes be made in the EHF definition in the future (33)?

From time to time and as necessary to meet legislative mandates, the Council considers amendments to its salmon FMP. Changes to the definition of EFH can be considered in the amendment process. NMFS guidelines call for reviewing the EFH provisions at least once every five years.

The following areas should not be included in EFH: several smaller Sacramento Valley stream reaches (Stone Corral Creek, Stony Creek, Thomes Creek, Elder Creek, and Bear River) and upstream of Englebright Dam (47); San Pablo Creek below San Pablo Dam (24); and the area above Hell's Canyon Dam should be permanently excluded (38, 51).

The identification of EFH has had to proceed quickly. Changes and updates may prove to be necessary in the future. Based on the information before it, the Council has included the areas in California which the commenter believes should be excluded.

The area above Hell's Canyon dam, which historically produced large numbers of salmon, is not included in the description of EFH. No function would be served by permanently excluding it in the FMP. If restoring runs above the dam again became feasible and valuable, the FMP could be amended to account for the change.

The definition should include: a forest riparian management area (26, 28); release of waters from areas above impassable dams in terms of quality and quantity of water (25, 48, 53); and habitat above Cougar Dam (South Fork Mckenzie River), Dexter Dam (Middle Fork Willamette River), and Soda Springs Dam (North Umpqua River) (28, 39, 40, 41).

The Magnuson-Stevens Act defines EFH as "waters and substrate" and does not include adjacent dry land. Therefore, a forest riparian management area cannot be included in the definition. However, the adverse effects on EFH from activities within riparian areas are addressed in Chapter 3 of the EFH Appendix.

In its final adopted definition, the Council included activities occurring above impassable barriers that are likely to adversely affect EFH below impassable barriers as requiring consultation under the terms of the Magnuson-Steven Act.

Based on the information before it, the Council chose not to include the areas above Cougar, Dexter, and Soda Springs dams in the identification of EFH. Should these areas warrant such designation in the future, they could be added through FMP amendment.

9.3.1.2 Consultation Process

Clarify, simplify, and streamline the consultation process (23, 46).

In the final adoption, the Council approved a simplified and less redundant consultation process in which there are four general scenarios rather than seven. The specifics of each consultation, including suggested EFH conservation and enhancement recommendations, will be tailored to meet the proposed program or project activity (see page A-62 of the final Appendix A).

Conduct EFH consultation at both programmatic and project levels (26, 28).

The Council agrees and adopted such an approach as it appeared in the draft amendment (also see page A-63 of the final Appendix A).

The Consultation process is duplicative and should be a partnership rather than adding more regulations (24).

The consultation is required by the Magnuson-Stevens Act, Section 305(b)(2). To prevent duplication, the FMP proposes that the consultations be combined with existing interagency consultations and environmental review procedures that may be required under other statutes such as the ESA, Clean Water Act, the National Environmental Policy Act, the Fish and Wildlife Coordination Act, the Federal Power Act, or the Rivers and Harbors Act. To the extent that EFH and ESA consultations are integrated, NMFS will apply the provisions of the 1997 Secretarial Order 3206.

The FMP should provide a clear process for how the Council will comment on habitat issues (33).

The specific process for the Council's comments on habitat issues is contained in Council Operating Procedure 6 rather than in the FMP. A review and updating of this procedure to specifically identify EFH may be beneficial.

9.3.1.3 Conservation and Enhancement Measures

Add or upgrade measures to: decommission roads (16, 21, 35, 40, 52); address cumulative watershed impacts (21, 35, 40, 52); strengthen properly functioning condition designations (26, 28, 40); prohibit wet season log hauling (28, 39); improve all area plans for spill prevention and better protection of sensitive areas from spills (40); and hold shellfish production in estuaries at present levels until effects on salmon can be determined (40).

These recommended changes may include some valid measures, but would take further review and consideration before incorporation into the FMP at some later date. The Council will need to regularly review its proposed measures to ensure they reflect the best science.

Appendix A identifies overly general and restrictive prescriptions to apply to nonfishing activities and does not take into account best management practices (BMP) (31, 55).

Early on in the process, the Council considered the option of providing specific or more general conservation and enhancement measures in Appendix A and opted to be more general. The specificity belongs in the actual regulations that govern the actions while the Council's advisory recommendations generally deal more with intent and broader guidance which give flexibility to the action agencies in achieving the end result of protecting or restoring EFH. In addition, the more specific the measure the higher the probability that it may become outdated or otherwise need to be modified. Updating the measures in the salmon FMP is generally not a quick procedure.

The Council does not agree that the measures are overly restrictive and do not take BMPs into account. The measures in the amendment are those necessary to support a long-term sustainable fishery capable of producing optimum yield and healthy ecosystems. BMP's can be helpful in protecting EFH, but are not an end in themselves (i.e., habitat losses still occur despite meeting BMPs). These losses need to be addressed through more risk averse considerations that are geared at achieving the bottom line of no loss of EFH.

9.3.1.4 Miscellaneous

The FMP should indicate a higher priority for protecting existing EFH rather than to develop mitigation plans to replace it (16, 21, 40, 52).

The tenor of the amended FMP is in agreement with this statement, though it may not be quite as specifically stated. The introduction to chapter four (Habitat and Production) states:

> The Council will be guided by the principle that there should be no net loss of the productive capacity of marine, estuarine, and freshwater habitats which sustain commercial, recreational, and tribal salmon fisheries beneficial to the nation. Within this policy, the Council will assume an aggressive role in the protection and enhancement of anadromous fish habitat, especially essential fish habitat.

In addition, the amended FMP guidelines for mitigation are premised on the fish population losses being unavoidable.

9.3.2 Artificial Production

Maximizing hatchery production, as stated in the Council's objectives, will have serious adverse effects on long-term natural production (26, 27).

Taken as a whole, the four objectives for artificial production in the adopted FMP recognize the need to minimize adverse ecological and genetic impacts on natural stocks, but do not propose there will be no impacts at all. The objective to maximize present ongoing artificial production is aimed primarily at efficiency and is only within the constraint of achieving the conservation objectives for natural stocks which are meant to ensure their long-term health.

9.4 HARVEST

9.4.1 Allocation

Will the change in allocation for the La Push and Neah Bay areas increase fishing pressure and impacts on natural stocks of concern (57)?

The change in allocation for La Push and Neah Bay does not increase harvest and is likely to change fishing effort distribution rather than to increase fishing pressure. The allocation change does not change the allowable impact rates on the various stocks which is set by the conservation objectives.

9.4.2 Selective Fisheries

The final supplemental EIS should provide convincing evidence that targeting additional hatchery stocks with selective fisheries will not adversely affect natural stocks (57).

The use of selective fisheries does not change the Council's management constraints with regard to meeting conservation objectives for natural stocks. It does add importance to the accurate, or risk averse, determination of the impacts of such fisheries on natural stocks. However, if the stocks fail to meet expected conservation objectives, action will have to be taken to reduce fishery impacts and assure stock rebuilding.

How will fish be uniquely marked and regulations enforced to assure selective fisheries operate as modeled (57)?

Hatchery fish are uniquely marked by removal of the adipose fin prior to their release as juveniles. Regulations require that only salmon with a healed adipose fin clip may be retained by anglers. Enforcement and monitoring occurs by patrols on the water, participation in charter boat trips, and checks dockside. Such monitoring of the selective fisheries in 1998 and 1999 showed a high rate of angler compliance (overall, more than 98% of the harvest was finclipped). In addition, public education to solicit angler support for preserving natural stocks enhances compliance with the regulations. Estimates of noncompliance are included in preseason fishery impact projections.

The FMP should ensure that the production and mass-marking of hatchery fish poses minimal risk to salmon management tools and, in particular, not compromise the integrity of the coded-wire tag data base maintained by the U.S. and Canada (56).

The state, tribal, and federal fishery management entities that are members of the Council and have the primary fishery management responsibility in this regard have coordinated with Canada in developing a marking program that they believe will not compromise the coded-wire tag data base or prevent the collection of other management data, such as hatchery smolt survival, etc. The FMP specifically requires selective fisheries to be in accordance with U.S. v. Washington stipulation and order concerning co-management and mass marking (Case No. 9213, Subproceeding No. 96-3) and any subsequent stipulations or orders of the U.S. District Court and consistent with international objectives under the Pacific Salmon Treaty (see the final FMP at section 6.5.3.1).

9.5 SOCIO-ECONOMICS

The amendment does not adequately cover the economic effect on Neah Bay and the Makah Tribe (29).

Appendix B is intended to provide a baseline description of the fishery. Section 5.3.3.8 of the main text of the EIS provides additional information on some of the effects of ocean fishing on coastal communities such as Neah Bay and how those effects have changed over time. The Council has not generally had access to the type of information needed to provide a more thorough assessment of the impacts on specific tribes. If the tribes wish to provide more detailed information it may be possible in the future to provide a more adequate description of the economic effects.

The cost-benefit analysis fails to acknowledge the economic investments being made throughout the region which are focused on wild fish recovery, including employment in coastal communities (40, 53).

The focus of the EIS and the cost benefit analysis is the ocean harvest of salmon. Interactions are recognized between ocean harvest and inside fishing opportunities. However, the document is not an analysis of the entire system that sustains the salmon resource. Such an analysis may be part of a comprehensive EIS being developed by NMFS.

Section 2.0 of Appendix B discusses increasing world salmon supply and the effects on prices. Section 4.3.1.3 of Appendix B discusses changes in participation as a function of increasingly restrictive regulations. A general description of the effects of the rationale for and effects of fishery management measures is provided in Section 5.3.2.1. Stock condition factors that shape the ocean fisheries change from year to year and are discussed only in generalities with some specific examples. The general economic data collected by the government is inadequate to provide a basis for a thorough discussion of the interaction between fisheries and local community employment. Fishery specific harvester and processor information needs to be collected. NMFS is beginning to make an effort to collect the needed information.

9.6 NATIONAL ENVIRONMENTAL POLICY ACT ISSUES

The EIS fails to provide an adequate range of alternatives for identifying EFH and fails to properly consider the potentially huge socio-economic impacts on nonfishing activities and communities (46, 55).

The Council disagrees that the range of alternatives is inadequate. The Magnuson-Stevens Act [Section 303(a)(7)] requires FMPs to describe and identify essential fish habitat for the fishery based on the guidelines established by the Secretary of Commerce. A key phrase in this section is "for the fishery", which, under the Magnuson-Stevens Act, the Council must manage for optimum yield. On this basis, simply identifying the limited amount of habitat currently available for maintaining weak or depressed stocks, or for the purpose of preventing the extinction of any species is therefore not a viable alternative. While public comments stated that the EFH identification was too broad or too narrow or should or should not include certain areas, in the view of the Council, no other significantly different and viable alternatives were offered. The Council considered more limited areas within the marine environment and some variations in essential freshwater habitat in its early preliminary amendment drafts, but chose to include the whole EEZ and most of the historically available freshwater habitat in its final adoption (see Chapter 2 of Appendix A). Therefore, the amendment and EIS considered a limited, but pertinent range of alternatives to implement the relatively specific provisions of the Magnuson-Stevens Act for optimum yield and EFH, as well as to follow the guidance of the NSG with regard to EFH.

The Council does not agree that the potential impacts on non-fishing activities and communities were not properly considered. The identification of EFH does not have a direct socio-economic impact on nonfishing activities and communities. Indirect effects are identified in Section 2.6.3.2 of the EIS. These affects deal mainly with potential administrative responsibilities and delays. The identification of EFH imposes no new standards for evaluation of land use action but rather increases the probability that currently existing standards will be considered more carefully when there are potential impacts on fisher stocks. While some impacts may occur to non-fishing entities, to characterize nonbinding recommendations as having a "huge socio-economic impact" is purely speculative and not supported by fact.

The EFH portion of the amendment and EIS fails to incorporate any analysis of impacts on small entities pursuant to the RFA and applicable Executive Orders (31, 55)

Section 3.1 of the draft amendment contains the analysis of impacts on small entities pursuant to the RFA and applicable Executive Orders. The EFH portion of the amendment requires no new regulations for its implementation by the Council.

A federalism assessment should be prepared for the amendment (51).

The Council disagrees. The proposed amendment does not result in policies or regulations that preempt state law. The EFH recommendations provide advisory information with no requirements for state agencies. Council representatives of the affected states have been closely involved in reviewing the options considered in the amendment and have not expressed federalism related opposition to the options. The proposed action does not have sufficient federalism implications to require the preparation of a federalism assessment.

9.7 MISCELLANEOUS OR GENERAL COMMENTS

There is nothing in the FMP to indicate the Council's role in promoting and accomplishing research (33).

The comment is correct. Chapter 10 of the FMP (which was not amended) covers data needs, but does not speak specifically to research. While not covered in the FMP, the Council has an operating procedure for the development and communication of research and data needs. In the future, this policy could be referenced in the FMP so as to be more visible to the public.

The amendment should provide an evaluation of the effects of the salmon aquaculture industry and pending use of genetically altered salmon on the fisheries (57).

This issue was not part of the scoping for Amendment 14. However, Appendix B to the FMP provides some quantitative perspectives on the aquaculture industry and its economic impacts on the Pacific Coast salmon fishery. The Council does not have regulatory authority with regard to aquaculture or the use of genetically altered salmon which is handled by the various states. This issue has not yet been elevated to the Council for consideration.

APPENDIX A

IDENTIFICATION AND DESCRIPTION OF ESSENTIAL FISH HABITAT, ADVERSE IMPACTS, AND RECOMMENDED CONSERVATION MEASURES FOR SALMON

AMENDMENT 14 TO THE PACIFIC COAST SALMON PLAN

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TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

TABLE OF CONTENTS
(Continued)

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

ADFG	Alaska Department of Fish and Game
BLM	U.S. Bureau of Land Management
BPA	Bonneville Power Administration
CARA	California Rivers Assessment
CCAP	Coastal Change Analysis Program
CDFFP	California Department of Forestry and Fire Protection
CDFG	California Deptartment of Fish and Game
CWT	coded-wire tag
DO	dissolved oxygen
EEZ	U.S. Exclusive Economic Zone (3-200 miles offshore)
EFH	essential fish habitat
ELMR	estuarine living marine resources
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESU	evolutionarly significant units
FERC	Federal Energy Regulatory Commission
FMP	fishery management plan
FRI	Fisheries Research Institute
FSOS	For the Sake of the Salmon
GIS	Geographic Information System
IDFG	Idaho Department of Fish and Game
KRBFTF	Klamath River Basin Fisheries Task Force
NED	Northwest Environmental Database
NEP	National Estuary Program
NMFS	National Marine Fisheries Service
NMFS NWR	National Marine Fisheries Service - Northwest Regional Office
NMFS NWFSC	National Marine Fisheries Service - Northwest Fisheries Science Center
NMFS SWR	National Marine Fisheries Service - Southwest Regional Office
NOAA	National Oceanic and Atmospheric Administration
NOAA CSC	National Oceanic and Atmospheric Administration - Coastal Services Center
NOAA NOS	National Oceanic and Atmospheric Administration - National Ocean Service
NOAA ORCA	National Oceanic and Atmospheric Administration - Ocean Resources Conservation and Assessment Division
NPFMC	North Pacific Fishery Management Council
NPPC	Northwest Power Planning Council
NRC	National Research Council
NWIFC	Northwest Indian Fisheries Commission
OCSRI	Oregon Coastal Salmon Restoration Initiative
ODFW	Oregon Deptartment of Fish and Wildlife
ORIS	Oregon River Information System
OTSMS	Oregon Territorial Sea Management Study
OWRRI	Oregon Water Resources Research Institute
PFMC	Pacific Fishery Management Council
PSMFC	Pacific States Marine Fisheries Commission
PSWQAT	Puget Sound Water Quality Action Team
RAC	The Resources Agency of California
RACE	Resource Assessment and Conservation Engineering - NOAA/NMFS
SASSI	Salmon and Steelhead Stock Inventory
SSHIAP	Salmon and Steelhead Habitat Inventory and Assessment
USACOE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UW	University of Washington

WARIS	Washington Rivers Information System
WDF	Washington Department of Fisheries
WDFW	Washington Department of Fish and Wildlife
WDOE	Washington Department of Ecology
WFWC	Washington Fish and Wildlife Commission
WWPI	Western Wood Preservers Institute
WWWSD	Western Washington Watershed Screening Database

INTRODUCTION

Public Law 104-297, the Sustainable Fisheries Act of 1996, amended the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) to establish new requirements for "Essential Fish Habitat" (EFH) descriptions in federal fishery management plans (FMPs) and to require federal agencies to consult with National Marine Fisheries Service (NMFS) on activities that may adversely affect EFH. The Magnuson-Stevens Act requires all fishery management councils to amend their FMPs to describe and identify EFH for each managed fishery.

The Magnuson-Stevens Act requires consultation for all federal agency actions that may adversely affect EFH, and it does not distinguish between actions in EFH and actions outside EFH. Any reasonable attempt to encourage the conservation of EFH must take into account actions that occur outside of EFH, such as upstream and upslope activities that may have an adverse effect on EFH. Therefore, EFH consultation with NMFS is required by federal agencies undertaking, permitting, or funding activities that may adversely affect EFH, regardless of its location.

Under section 305(b)(4) of the Magnuson-Stevens Act, NMFS is required to provide EFH conservation and enhancement recommendations to federal and state agencies for actions that adversely affect EFH. However, state agencies and private parties are not required to consult with NMFS unless state or private actions require a federal permit or receive federal funding.

While there is no formal requirement for state and private collaboration in the consultation process on adverse effects to salmon EFH, there is common interest in the reduction of threats to species listed under the Endangered Species Act, prevention of future listings, and productive and sustainable coastal fisheries in the context of the Magnuson-Stevens Act. Conservation of anadromous fish resources through voluntary coordination is a goal without geographical or jurisdictional boundaries.

This appendix has five chapters. Chapter 1 identifies EFH for the Pacific salmon fishery. U.S. Geological Survey (USGS) hydrologic units (Table A-1) are used as the descriptors for EFH and a coastwide map showing EFH also is included (Figure A-1). Chapter 2 describes the life history and habitat requirements for each of the three species managed under the FMP (chinook salmon, coho salmon, and Puget Sound pink salmon) and provides a general context for these Pacific salmon. Chapter 3 describes potential adverse effects to salmon EFH as well as conservation and enhancement measures to avoid or minimize these effects. Chapter 4 describes additional information and research needs for marine and estuarine distributions, life history, and cited in Appendix A.

1.0 IDENTIFICATION OF ESSENTIAL FISH HABITAT FOR THE PACIFIC SALMON FISHERY

"Essential fish habitat means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity."

Magnuson-Stevens Act § 3

EFH for the Pacific coast salmon fishery means those waters and substrate necessary for salmon production needed to support a long-term sustainable salmon fishery and salmon contributions to a healthy ecosystem. To achieve that level of production, EFH must include all those streams, lakes, ponds, wetlands, and other currently viable water bodies and most of the habitat historically accessible to salmon in Washington, Oregon, Idaho, and California. In the estuarine and marine areas, salmon EFH extends from the nearshore and tidal submerged environments within state territorial waters out to the full extent of the exclusive economic zone (370.4 km) offshore of Washington, Oregon, and California north of Point Conception. Foreign waters off Canada, while still salmon habitat, are not included in salmon EFH, because they are outside United States jurisdiction. The Pacific coast salmon fishery EFH also includes the marine areas off Alaska designated as salmon EFH by the North Pacific Fishery Management Council (NPFMC). The geographic range of the salmon fishery EFH is shown in Figure A-1. This identification of EFH is based on the descriptions of habitat utilized by coho, chinook, and pink salmon provided in Chapter 2 of this appendix.

The geographic extent of freshwater EFH is specifically defined as all currently viable waters and most of the habitat historically accessible to salmon within the USGS hydrologic units identified in Table A-1. Salmon EFH excludes areas upstream of longstanding naturally impassible barriers (i.e., natural waterfalls in existence for several hundred years). Salmon EFH includes aquatic areas above all artificial barriers except the impassible barriers (dams) listed in Table A-2. However, activities occurring above impassable barriers that are likely to adversely affect EFH below impassable barriers are subject to the consultation provisions of the Magnuson-Stevens Act. In the future, should subsequent analyses determine the habitat above any of the dams listed in Table A-2 is necessary for salmon conservation, the Council will modify the identification of EFH.[1/]

1.1 COMPREHENSIVE APPROACH TO IDENTIFICATION

The Council chose a comprehensive rather than a limiting approach to the identification of salmon EFH for several reasons. In the marine environment, Pacific salmon distribution can only be defined generally throughout the exclusive economic zone (EEZ), because it is extensive, varies seasonally and interannually, and has not been extensively sampled in many ocean areas. In estuaries and freshwater, delimiting habitat to that which is essential is difficult, because of the diversity of habitats utilized by Pacific salmon coupled with (1) natural variability in habitat quality and use (e.g., some streams may have fish present only in years with plentiful rainfall; also, habitat of intermediate and low value may be important depending upon the health of the fish population and the ecosystem), (2) the current low abundance of Pacific salmon, and (3) lack of data on specific stream-by-stream historical distribution. Many of the current databases on salmon distribution were developed during recent periods of low salmon abundance and may not accurately reflect the complete distribution and habitats utilized by salmon. Furthermore, the current information on salmon freshwater distribution is useful at the regional level for determining which watersheds salmon inhabit, but not necessarily for identifying EFH down to specific stream reaches and habitats utilized by salmon.

Adopting an inclusive, watershed-based description of EFH using USGS hydrologic units is appropriate, because it (1) recognizes the species' use of diverse habitats and underscores the need to account for all of the habitat types supporting the species' freshwater and estuarine life stages, from small headwater streams to migration corridors and estuarine rearing areas; (2) considers the variability of freshwater habitat as affected

1/ Table A-6 (Chapter 2) provides documentation for the current and historic distribution, including areas above dams. Table A-1 is a subset of Table A-6.

by environmental conditions (droughts, floods, etc.) that make precise mapping difficult; and (3) reinforces important linkages between aquatic and adjacent upslope areas. Habitat available and utilized by salmon changes frequently in response to floods, landslides, woody debris inputs, sediment delivery, and other natural events. To expect the distribution of salmon within a stream, watershed, province, or region to remain static over time is unrealistic. Furthermore, this watershed-based approach is consistent with other Pacific salmon habitat conservation and recovery efforts such as those implemented under the Endangered Species Act (ESA). Additional details on Pacific salmon freshwater essential habitat is provided in Chapter 2 of this appendix.

As new and better information becomes available, the Council will consider potential modifications to the identification and description of EFH during the process of scoping changes to the FMP.

1.2 CONSIDERATION OF ARTIFICIAL BARRIERS

In identifying EFH, the Council considered artificial barriers (dams) that affect salmon habitat. Numerous hydropower, water storage, and flood control projects have been built that either block access to areas used historically by salmonids or alter the hydrography of downstream river reaches. While available information is not sufficient to conclude that currently accessible habitat is sufficient for supporting sustainable salmon fisheries and a healthy ecosystem, subsequent analyses (e.g., in recovery planning, ESA consultations, or hydropower proceedings) may conclude that currently inaccessible habitat should be made available to the species. The Council, therefore, considered whether more than 50 large dams in Washington, Idaho, Oregon, and California should be designated as the upstream extent of EFH. The four criteria used to evaluate EFH and the dams were:

1. *Is the dam federally owned or operated, licensed by the Federal Energy Regulatory Commission (FERC), state licensed, or subject to state dam safety supervision?* This criterion assures the dam is of sufficient size, permanence, impassibility, and legal identity to warrant consideration for inclusion in this list.

2. *Is the dam upstream of any other impassable dam*? This criterion provides for a continuous boundary of designated habitat.

3. *Is fish passage to upstream areas under consideration, or are fish passage facilities in the design or construction phase*? There is no currently, or soon to be, accessible freshwater salmon habitat that is expendable. All such habitat is key to the conservation of these species and needs the special considerations for protection and restoration incumbent with designation.

4. *Has NMFS determined the dam does not block access to habitat that is key for the conservation of the species?* This criterion provides for designation of habitat upstream of, and exclusion of, otherwise listed dams when NMFS is able to determine restoration of passage and conservation of such habitat is necessary for long-term survival of the species and sustainability of the fishery.

Based on these considerations, the Council excluded certain dams from the list of those representing the upstream extent of EFH including Elwha Dam, Merwin Dam, Landsburg Dam, Howard Hanson Dam, Condit Dam, Cushman Dam, Mayfield Dam, Foster Dam, Pelton Dam, and Englebright Dam. Several large, impassable dams, (e.g., Grand Coulee and Shasta dams), were removed from the list, since they are above other impassible dams. Subsequent analyses may indicate other dams should be removed from Table A-2.

Throughout the range of Pacific salmon, numerous hydropower dams are undergoing or are scheduled for relicensing by FERC. Information developed during the process of relicensing requires evaluation to determine whether fish passage facilities will be required at such dams to restore access to historically accessible habitat. Even though habitat above such barriers may not currently be designated as EFH, this conclusion does not diminish the potential importance of restoring access to these areas. Therefore, a determination on a case-by-case basis during FERC relicensing proceedings whether fish passage facilities will be required to provide access to habitat above currently impassible barriers will be necessary. Should salmon access or reintroduction above any of the dams listed in Table A-2 become feasible, the Council will remove them from the list, and the areas above the barriers would be designated as salmon EFH.

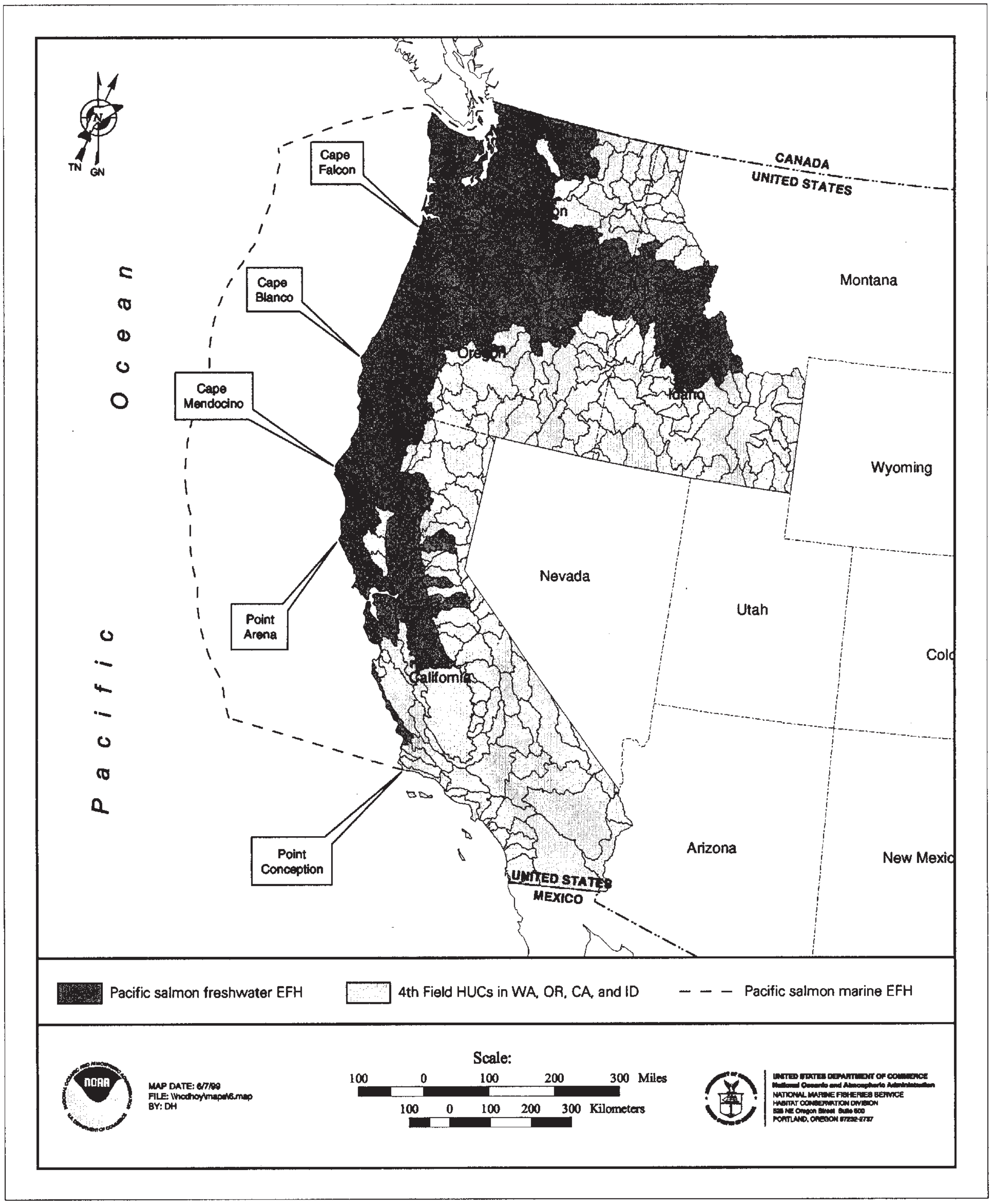

FIGURE A-1. Pacific salmon freshwater and marine EFH. Freshwater EFH includes currently viable aquatic habitat and most of the habitat historically accessible to Pacific salmon within the shaded hydrologic units (watersheds).

TABLE A-1. Pacific salmon freshwater EFH identified by USGS hydrologic unit number. (Page 1 of 5)

USGS Hydr. Unit	State(s)	Hydrologic Unit Name	Salmon Species
17110001	WA	Fraser (Whatcom)	coho salmon
17110002	WA	Strait of Georgia	chinook and coho salmon Puget Sound pink salmon
17110003	WA	San Juan Islands	chinook and coho salmon
17110004	WA	Nooksack River	chinook and coho salmon Puget Sound pink salmon
17110005	WA	Upper Skagit	chinook and coho salmon Puget Sound pink salmon Puget Sound sockeye salmon
17110006	WA	Sauk River	chinook and coho salmon Puget Sound pink salmon
17110007	WA	Lower Skagit River	chinook and coho salmon Puget Sound pink salmon Puget Sound sockeye salmon
17110008	WA	Stillaguamish River	chinook and coho salmon Puget Sound pink salmon
17110009	WA	Skykomish River	chinook and coho salmon Puget Sound pink salmon
17110010	WA	Snoqualmie River	chinook and coho salmon Puget Sound pink salmon
17110011	WA	Snohomish River	chinook and coho salmon Puget Sound pink salmon
17110012	WA	Lake Washington	chinook and coho salmon Puget Sound sockeye salmon
17110013	WA	Duwamish River	chinook and coho salmon
17110014	WA	Puyallup River	chinook and coho salmon Puget Sound pink salmon
17110015	WA	Nisqually River	chinook and coho salmon Puget Sound pink salmon
17110016	WA	Deschutes River	chinook and coho salmon
17110017	WA	Skokomish River	chinook and coho salmon
17110018	WA	Hood Canal	chinook and coho salmon Puget Sound pink salmon
17110019	WA	Puget Sound	chinook and coho salmon
17110020	WA	Dungeness - Elwha	chinook and coho salmon Puget Sound pink salmon
17110021	WA	Hoko - Crescent	chinook and coho salmon
17100101	WA	Hoh - Quillayute	chinook and coho salmon
17100102	WA	Queets - Quinault	chinook and coho salmon
17100103	WA	Upper Chehalis River	chinook and coho salmon
17100104	WA	Lower Chehalis River	chinook and coho salmon
17100105	WA	Grays Harbor	chinook and coho salmon
17100106	WA	Willapa Bay	chinook and coho salmon
17080001	OR/WA	Lower Columbia-Sandy River	chinook and coho salmon
17080002	WA	Lewis River	chinook and coho salmon
17080003	OR/WA	Lower Columbia - Clatskanie River	chinook and coho salmon
17080004	WA	Upper Cowlitz River	chinook and coho salmon
17080005	WA	Lower Cowlitz River	chinook and coho salmon

TABLE A-1. Pacific salmon freshwater EFH identified by USGS hydrologic unit number. (Page 2 of 5)

USGS Hydr. Unit	State(s)	Hydrologic Unit Name	Salmon Species
17080006	OR/WA	Lower Columbia	chinook and coho salmon
17090001	OR	Middle Fork Willamette River	chinook salmon
17090002	OR	Coast Fork Willamette River	chinook salmon
17090003	OR	Upper Willamette River	chinook and coho salmon
17090004	OR	McKenzie River	chinook and coho salmon
17090005	OR	N. Santiam River	chinook and coho salmon
17090006	OR	S. Santiam River	chinook and coho salmon
17090007	OR	Mid. Willamette River	chinook and coho salmon
17090008	OR	Yamhill River	chinook and coho salmon
17090009	OR	Molalla - Pudding River	chinook and coho salmon
17090010	OR	Tualatin River	chinook and coho salmon
17090011	OR	Clackamas River	chinook and coho salmon
17090012	OR	Lower Willamette River	chinook and coho salmon
17070101	OR/WA	Mid. Columbia - Lake Wallula	chinook salmon
17070102	OR/WA	Walla Walla River	chinook salmon
17070103	OR	Umatilla River	chinook salmon
17071004	OR	Willow	chinook salmon
17070105	OR/WA	Mid. Columbia - Hood	chinook and coho salmon
17070106	WA	Klickitat River	chinook salmon
17070301	OR	Upper Deschutes River	chinook salmon
17070305	OR	Lower Crooked River	chinook salmon
17070306	OR	Lower Deschutes River	chinook and coho salmon
17070307	OR	Trout Creek	chinook and coho salmon
17070201	OR	Upper John Day River	chinook salmon
17070202	OR	North Fork John Day River	chinook salmon
17070203	OR	Middle Fork John Day River	chinook salmon
17070204	OR	Lower John Day River	chinook salmon
17030001	WA	Upper Yakima River	chinook and coho salmon
17030002	WA	Naches River	chinook and coho salmon
17030003	WA	Lower Yakima River	chinook and coho salmon
17020005	WA	Chief Joseph River	chinook and coho salmon
17020006	WA/BC	Okanogan River	chinook salmon
17020007	WA/BC	Similkameen	chinook salmon
17020008	WA	Methow River	chinook and coho salmon
17020010	WA	Upper Columbia - Entiat River	chinook and coho salmon
17020011	WA	Wenatchee River	chinook and coho salmon
17020016	WA	Upper Columbia - Priest Rapids	chinook salmon
17060101	OR/ID	Hells Canyon	chinook salmon
17060102	OR	Imnaha River	chinook salmon
17060103	OR/WA/ID	Lower Snake - Asotin Creek	chinook and coho salmon
17060104	OR	Upper Grande Ronde	chinook and coho salmon

TABLE A-1. Pacific salmon freshwater EFH identified by USGS hydrologic unit number. (Page 3 of 5)

USGS Hydr. Unit	State(s)	Hydrologic Unit Name	Salmon Species
17060105	OR	Wallowa River	chinook and coho salmon
17060106	OR/WA	Lower Grande Ronde	chinook and coho salmon
17060107	WA	Lower Snake - Tucannon River	chinook and coho salmon
17060110	WA	Lower Snake River	chinook salmon
17060201	ID	Upper Salmon River	chinook salmon
17060202	ID	Pahsimeroi River	chinook salmon
17060203	ID	Mid. Salmon - Panther River	chinook salmon
17060204	ID	Lemhi River	chinook salmon
17060205	ID	Upper Middle Fork Salmon River	chinook salmon
17060206	ID	Lower Middle Fork Salmon River	chinook salmon
17060207	ID	Mid. Salmon - Chamberlain	chinook salmon
17060208	ID	S.F. Salmon River	chinook salmon
17060209	ID	Lower Salmon River	chinook salmon
17060210	ID	Little Salmon River	chinook salmon
17060301	ID	Upper Selway River	chinook salmon
17060302	ID	Lower Selway River	chinook salmon
17060303	ID	Lochsa River	chinook salmon
17060304	ID	M.F. Clearwater River	chinook salmon
17060305	ID	S.F. Clearwater River	chinook salmon
17060306	WA/ID	Clearwater River	chinook and coho salmon
17100201	OR	Necanicum River	chinook and coho salmon
17100202	OR	Nehalem River	chinook and coho salmon
17100203	OR	Wilson - Trask - Nestucca	chinook and coho salmon
17100204	OR	Siletz-Yaquina River	chinook and coho salmon
17100205	OR	Alsea River	chinook and coho salmon
17100206	OR	Siuslaw River	chinook and coho salmon
17100207	OR	Siltcoos River	chinook and coho salmon
17100301	OR	N. Umpqua River	chinook and coho salmon
17100302	OR	S. Umpqua River	chinook and coho salmon
17100303	OR	Umpqua River	chinook and coho salmon
17100304	OR	Coos River	chinook and coho salmon
17100305	OR	Coquille River	chinook and coho salmon
17100306	OR	Sixes River	chinook and coho salmon
17100307	OR	Upper Rogue River	chinook and coho salmon
17100308	OR	Middle Rogue River	chinook and coho salmon
17100309	CA/OR	Applegate River	chinook and coho salmon
17100310	OR	Lower Rogue River	chinook and coho salmon
17100311	CA/OR	Illinois River	chinook and coho salmon
17100312	CA/OR	Chetco River	chinook and coho salmon
18010101	CA/OR	Smith River	chinook and coho salmon
18010206	CA/OR	Upper Klamath River	chinook and coho salmon

TABLE A-1. Pacific salmon freshwater EFH identified by USGS hydrologic unit number. (Page 4 of 5)

USGS Hydr. Unit	State(s)	Hydrologic Unit Name	Salmon Species
18010207	CA	Shasta River	chinook and coho salmon
18010208	CA	Scott River	chinook and coho salmon
18010209	CA/OR	Lower Klamath River	chinook and coho salmon
18010210	CA	Salmon River	chinook and coho salmon
18010211	CA	Trinity River	chinook and coho salmon
18010212	CA	S.F. Trinity River	chinook and coho salmon
18010102	CA	Mad-Redwood	chinook and coho salmon
18010103	CA	Upper Eel River	chinook and coho salmon
18010104	CA	Middle Fork Eel River	chinook and coho salmon
18010105	CA	Lower Eel River	chinook and coho salmon
18010106	CA	South Fork Eel River	chinook and coho salmon
18010107	CA	Mattole River	chinook and coho salmon
18010108	CA	Big - Navarro - Garcia	chinook and coho salmon
18010109	CA	Gualala - Salmon Creek	chinook and coho salmon
18010110	CA	Russian River	chinook and coho salmon
18010111	CA	Bodega Bay	chinook and coho salmon
18060001	CA	San Lorenzo-Soquel	coho salmon
18060006	CA	Central Coastal	coho salmon
18050001	CA	Suisun Bay	chinook
18050002	CA	San Pablo Bay	chinook
18050003	CA	Coyote Creek	chinook
18050004	CA	San Francisco Bay	chinook and coho salmon
18050005	CA	Tomales-Drakes Bay	coho salmon
18050006	CA	San Francisco-Coastal South	coho salmon
18020101	CA	Sac.-Lower Cow-Lower Clear	chinook salmon
18020102	CA	Lower Cottonwood Creek	chinook salmon
18020103	CA	Sacramento - Lower Thomes	chinook salmon
18020104	CA	Sacramento - Stone Corral	chinook salmon
18020105	CA	Lower Butte Creek	chinook salmon
18020106	CA	Lower Feather River	chinook salmon
18020107	CA	Lower Yuba River	chinook salmon
18020108	CA	Lower Bear River	chinook salmon
18020109	CA	Lower Sacramento River	chinook salmon
18020110	CA	Lower Cache	chinook salmon
18020111	CA	Lower American River	chinook salmon
18020112	CA	Sacramento-Upper Clear	chinook salmon
18020113	CA	Cottonwood Headwaters	chinook salmon
18020114	CA	Elder Creek	chinook salmon
18020118	CA	Upper Cow - Battle Creek	chinook salmon
18020119	CA	Mill - Big Chico	chinook salmon
18020120	CA	Upper Butte Creek	chinook salmon

TABLE A-1. Pacific salmon freshwater EFH identified by USGS hydrologic unit number. (Page 5 of 5)

USGS Hydr. Unit	State(s)	Hydrologic Unit Name	Salmon Species
18020125	CA	Upper Yuba	chinook salmon
18040001	CA	Mid. San Joaquin- L. Cowchilla	chinook salmon
18040002	CA	Mid. San Joaquin- L. Merced- L. Stanislaus	chinook salmon
18040003	CA	San Joaquin Delta	chinook salmon
18040004	CA	L. Calaveras - Mormon Slough	chinook salmon
18040005	CA	L. Consumnes- L. Mokelumne	chinook salmon
18040010	CA	Upper Stanislaus	chinook salmon
18040011	CA	Upper Calveras	chinook salmon
18040013	CA	Upper Cosumnes	chinook salmon

TABLE A-2. List of man-made barriers (dams) that represent the upstream extent of Pacific salmon EFH. (Page 1 of 2)

Name of Barrier	State	USGS Hydrologic Unit	Tributary/Basin
Gorge Lake Dam	WA	17110005	Skagit River
Cedar Falls Dam	WA	17110012	Cedar River
Tolt Dam	WA	17110010	Snoqualmie River
Keechelus Dam	WA	17030001	Yakima River
Kachess Dam	WA	17030001	Yakima River
Cle Elum Dam	WA	17030001	Yakima River, Cle Elum River
Rimrock Dam	WA	17030002	Naches River
Chief Joseph Dam	WA	17020005	Upper Columbia River
Dworshak Dam	ID	17060308	Clearwater River
Hells Canyon Complex (Hells Canyon, Oxbow, and Brownlee Dams)	ID	17050201	Snake River
Opel Springs Dam	OR	17070306	Deschutes River
Big Cliff Dam	OR	17090005	N. Santiam River
Cougar Dam	OR	17090004	McKenzie River
Dexter Dam	OR	17090001	Middle Fork Willamette River
Dorena Dam	OR	17090002	Coast Fork Willamette River
Soda Springs Dam	OR	17100301	N. Umpqua River
Lost Creek Dam	OR	17100307	Rogue River
Applegate Dam	OR	17100309	Applegate River
Bull Run Dam	OR	17080001	Bull Run River/Sandy River
Oak Grove Dam	OR	17090011	Clackamas River
Iron Gate Dam	CA	18010206	Klamath River
Lewiston Dam	CA	18010211	Trinity River
Dwinnell Dam or Shasta River Dam	CA	18010207	Shasta
Robert W. Matthews Dam	CA	18010102	Mad River
Coyote Valley Dam	CA	18010110	E. Fork Russian River
Warm Springs Dam	CA	18010110	Dry Creek
Scott Dam	CA	18010103	Eel River
Keswick Dam	CA	18020112	Sacramento River
Oroville Dam	CA	18020121 & 18020123	Feather River
Black Butte Dam	CA	18020115	Stoney Creek
Whiskeytown Dam	CA	18020112	Clear Creek
Camp Far West Dam	CA	18020126	Bear River
Nimbus Dam	CA	18020111	American River
Friant Dam	CA	18040006	San Joaquin River
Camanche Dam	CA	18040005	Mokelumne River

TABLE A-2. List of man-made barriers (dams) that represent the upstream extent of Pacific salmon EFH. (Page 2 of 2)

Name of Barrier	State	USGS Hydrologic Unit	Tributary/Basin
New Hogan Dam	CA	18040011	Calaveras River
Crocker Diversion Dam	CA	18040008	Merced River
Goodwin Dam	CA	18040010	Stanislaus River
La Grange Dam	CA	18040002	Tuolumne River
Nicasio Dam	CA	18050005	Nicasio Creek
Peters Dam	CA	18050005	Lagunitas Creek
San Pablo Dam	CA	18050002	San Pablo Bay
LeRoy Anderson Dam	CA	18050003	Coyote Creek
Newell Dam	CA	18060001	Newell Creek

2.0 ESSENTIAL FISH HABITAT DESCRIPTIONS

The following essential habitat and life history descriptions were developed for the three Pacific salmon species actively managed under the *Pacific Coast Salmon Plan*. This includes chinook and coho salmon stocks from Washington, Oregon, Idaho, and California as well as pink salmon stocks originating from watersheds within Puget Sound (PFMC 1997b). Descriptions for pink or sockeye salmon originating from outside of Puget Sound, and for chum salmon (*Oncorhynchus keta*), steelhead (*Oncorhynchus mykiss*), and cutthroat trout (*Oncorhynchus mykiss*) are not included, because incidental catches of these species in Council-managed ocean fisheries are rare.

2.1 ESSENTIAL HABITAT DESCRIPTION FOR CHINOOK SALMON (*Oncorhynchus tshawytscha*)

2.1.1 General Distribution and Life History

The following is an overview of chinook salmon (*Oncorhynchus tshawytscha*) life history and habitat use as a basis for identifying EFH for chinook salmon. More comprehensive reviews of chinook salmon life history can be found in Allen and Hassler (1986), Nicholas and Hankin (1988), Healey (1991), Myers *et al.* (1998), and others. This description serves as a general description of chinook salmon life history for Washington, Oregon, Idaho, and California and is not specific to any region, stock, or population.

Chinook salmon, also called king, spring, or tyee salmon, is the least abundant and largest of the Pacific salmon (Netboy 1958). They are distinguished from other species of Pacific salmon by their large size, the small black spots on both lobes of the caudal fin, black pigment at the base of the teeth, and a large number of pyloric caeca (McPhail and Lindsey 1970). Chinook salmon follow a generalized life history, which includes the incubation and hatching of embryos; emergence and initial rearing of juveniles in freshwater; migration to oceanic habitats for extended periods of feeding and growth; and return to natal waters for completion of maturation, spawning, and death. Within this general life-history strategy, however, chinook salmon display diverse and complex life history patterns and tactics. Their spawning environments range from just above tidewater to over 3,200 km from the ocean, from coastal rainforest streams to arid mountain tributaries at elevations over 1,500 m (Major *et al.* 1978). At least 16 age categories of mature chinook salmon have been documented, involving 3 possible freshwater ages and total ages of 2-8 years, reflecting the high variability within and among populations in freshwater, estuarine, and oceanic residency (Healey 1986). Chinook salmon also demonstrate variable ocean migration patterns and timing of spawning migrations (Ricker 1972, Healey 1991).

This variation in life history has been partially explained by separating chinook salmon into two distinct races: stream-type and ocean-type fish (Gilbert 1912, Healey 1983). Stream-type fish have long freshwater residence as juveniles (1-2 years), migrate rapidly to oceanic habitats, and adults often enter freshwater in spring and summer, spawning far upriver in late summer or early fall. Ocean-type fish have short, highly variable freshwater residency (from a few days to several months), extensive estuarine residency, and adults show considerable geographic variation in month of freshwater entry. Within these two types, there is also substantial variability most likely due to a combination of phenotypic plasticity and genetic selection to local conditions (Myers *et al.* 1998).

The natural freshwater range of the species includes large portions of the Pacific rim of North America and Asia. In North America, chinook salmon historically ranged from the Ventura River in California (~34° N latitude) to Kotzebue Sound in Alaska (~66° N latitude); in addition, the species has been identified in North America in the Mackenzie River, which drains into the Arctic Ocean (McPhail and Lindsey 1970, Major *et al.* 1978). At present, the southern-most populations occur in the San Joaquin River, although chinook salmon are occasionally observed in Rivers south of San Francisco Bay, such as the San Luis Obispo and Carmel rivers. In Asia, natural populations of chinook salmon have been documented from Hokkaido Island, Japan (~42° N latitude), to the Andyr River in Russia (~64° N latitude). In marine environments, chinook salmon from Washington, Oregon, and California range widely throughout the north Pacific Ocean and the Bering Sea, as far south as the U.S./Mexico border.

The largest rivers tend to support the largest aggregate runs of chinook salmon and have the largest individual spawning populations (Healey 1991). Major rivers near the southern and northern extremes of the range support populations of chinook salmon comparable to those near the middle of the range. For example, in North America, the Yukon River near the north edge of the range and the Sacramento-San Joaquin River system near the south edge of the range have historically supported chinook salmon runs comparable to those of the Columbia and Fraser rivers, which are near the center of the species range in North America (Healey 1991).

Declines in the abundance of chinook salmon have been well documented throughout the southern portion of the range. Concern over coast-wide declines from southeastern Alaska to California was a major factor leading to the signing of the Pacific Salmon Treaty between the United States and Canada in 1985. Wild chinook salmon populations have been extirpated from large portions of their historic range in a number of watersheds in California, Oregon, Washington, Idaho, and southern British Columbia (Nehlsen *et al.* 1991), and a number of Evolutionarily Significant Units (ESUs) have been listed or proposed for listing by NMFS as at risk of extinction under the ESA (NMFS 1998, 1999). For example, the Columbia River formerly supported the world's largest chinook salmon run, but currently five Columbia Basin ESUs are listed as "threatened" under the ESA - Snake River spring/summer, Snake River fall, upper Columbia River spring, lower Columbia River and upper Willamette River chinook salmons (NMFS 1992, 1999).

Habitat degradation is the major cause for extinction of populations; many extinctions are related to dam construction and operation (NMFS 1996, Myers *et al.* 1998). Urbanization, agricultural land use, water diversion, and logging are also factors contributing to habitat degradation and the decline of chinook salmon (Nehlson *et al.* 1991, Spence *et al.* 1996). The development of large-scale hatchery programs have, to some degree, mitigated the decline in abundance of chinook in some areas. However, genetic and ecological interactions of hatchery and wild fish have also been identified as risk factors for wild populations, and the high harvest rates directed at hatchery fish may cause over-exploitation of co-mingled wild populations (Reisenbichler 1997, Mundy 1997). Recent increases in pinniped populations also raise concerns over the impacts of pinniped predation on the recovery of salmonids in certain situations (NMFS 1997c).

2.1.2 Fisheries

Chinook salmon are highly prized by commercial, sport, and subsistence fishers, because of their large size and excellent palatability. Because of their migrations through coastal waters, however, chinook salmon returning to Washington, Oregon, and California waters are harvested in fisheries over a wide geographic area. Considerable management and regulatory efforts focus on chinook salmon fisheries primarily due to the value of the fish, the numerous states and agencies involved in regulating these fisheries, and concerns about declining abundance.

Ocean fisheries targeting chinook salmon use hook-and-line gear, but gill nets are used in commercial and tribal freshwater fisheries in the Columbia and Klamath Rivers, and other rivers. Chinook salmon fisheries have some bycatch associated with them, most often other salmonids and undersized chinook salmon. While the majority of these fish survive the hooking encounter, substantial (> 25%) mortality may occur (Wertheimer 1988, Wertheimer *et al.* 1989, Gjernes *et al.* 1993). A complete and current description of ocean fisheries, harvest levels, and management framework can be found in the most recent versions of the annual PFMC documents *Review of Ocean Salmon Fisheries* and *Preseason Report I* (PFMC 1999a, 1999b).

2.1.3 Relevant Trophic Information

Chinook salmon eggs, alevins, and juveniles in freshwater streams provide an important nutrient input and food source for aquatic invertebrates, other fishes, birds, and small mammals. The carcasses of chinook adults can also be an important nutrient input in their natal watersheds, as well as providing food sources for terrestrial mammals such as bears, otters, minks, and birds such as gulls, eagles, and ravens (Cederholm *et al.* 1989, Bilby *et al.* 1996, Ben-David *et al.* 1997). Because of their relatively low abundance in coastal and oceanic waters, chinook salmon in the marine environment are typically only an incidental food item in the diet of other fishes, marine mammals, and coastal sea birds (Botkin *et al.* 1995). However, pinniped predation on migrating salmonids, both adult spawners and downstream migrating smolts, can be substantial especially at sites of restricted passage and small salmonid populations (NMFS 1997c).

2.1.4 Habitat and Biological Associations

Table A-3 summarizes chinook salmon habitat use by life history stage.

2.1.4.1 Eggs and Spawning

Chinook salmon spawning generally occurs from July to March depending primarily upon the geographic location and the specific race or population. In general, northern populations tend to spawn from July to October and southern populations from October to February. The Sacramento River supports a unique winter run chinook that spawn from March through July with peak spawning occurring in June (Myers *et al.* 1998). There is a general tendency for stream-type fish to spawn earlier than ocean-type fish in the central and southern parts of the species range, but the difference is generally less than one to two months in most streams. However, spawn timing may vary several months among some chinook salmon populations in larger river systems such as the Columbia or the Sacramento (Healey 1991).

Chinook salmon fecundity and size of eggs, like that of other salmon species, is related to female size, and exhibits considerable small-scale geographic and temporal variability. Fecundity in chinook salmon increases with latitude and ranges from 2,000-17,000 eggs per female, with females in most populations having 4,000-7,000 eggs (Healey and Heard 1984, Beacham and Murray 1993). Stream-type fish also tend to have higher fecundity than ocean-type fish, and northern populations are dominated by stream-type fish (Healey and Heard 1984).

Chinook salmon spawn in a broad range of habitats. They have been known to spawn in water depths ranging from a few centimeters to several meters deep, and in small tributaries 2-3 m wide to large rivers such as the Columbia and the Sacramento (Chapman 1943, Burner 1951, Vronskiy 1972, Healey 1991). Chinook salmon redds (nests) range in size from 2 to 40 m^2, occur at depths of 10-700 cm and at water velocities of 10-150 cm/s (Healey 1991). Typically, chinook salmon redds are 5-15 m^2 and located in areas with water velocities of 40-60 cm/s. The depth of the redd is inversely related to water velocity, and the female buries her eggs in clean gravel or cobble 10-80 cm in depth (Healey 1991). Because of their large size, chinook salmon are able to spawn in higher water velocities and utilize coarser substrates than other salmon species. Female chinook salmon select areas of the spawning stream with high subgravel flow such as pool tailouts, runs, and riffles (Vronskiy 1972, Burger *et al.* 1985, Healey 1991). Because their eggs are the largest of the Pacific salmon, ranging from 6 to 9 mm in diameter (Rounsefell 1957, Nicholas and Hankin 1988), with a correspondingly small surface-to-volume ratio, they may be more sensitive to reduced oxygen levels and require a higher rate of irrigation than other salmonids. Fertilization of the eggs occurs simultaneous with deposition. Males compete for the right to breed with spawning females. Chinook salmon females have been reported to remain on their redds from six to 25 days after spawning (Neilson and Geen 1981, Neilson and Banford 1983), defending the area from superimposition of eggs from another female. This period of redd protection roughly coincides with the period the eggs are most sensitive to physical shock.

2.1.4.2 Larvae/Alevins

Fertilized eggs begin their two to eight month (typically three to four month) period of embryonic development and growth in intragravel interstices. The length of the incubation period is primarily determined by water temperature, dissolved oxygen concentrations, and egg size. To survive successfully, the eggs, alevins, and pre-emergent fry must first be protected from freezing, desiccation, stream bed scouring or shifting, and predators. Water surrounding them must be non-toxic, and of sufficient quality and quantity to provide basic requirements of suitable temperatures, adequate supply of oxygen, and removal of waste materials. Rates of egg development, survival, size of hatched alevins and percentage of deformed fry are related to temperature and oxygen levels during incubation. Under natural conditions, 30% or less of the eggs survive to emerge from the gravel as fry (Healey 1991).

TABLE A-3. Chinook salmon habitat use by life history stage. (See key to abbreviations and EFH data levels on the next page.)

Stage - EFH Data Level	Duration or Age	Diet/Prey	Season/Time	Location	Water Column	Bottom Type	Oceanographic Features	Other
Eggs EFH Data Level 0-4; not all habitats have been sampled	50-130 d	Non-feeding stage; eggs consumed by birds, fish, and mammals.	Late summer, fall, and winter	Intragravel in stream beds	20-80 cm gravel depth; 15-700 cm water depth	Medium to course gravel	NA	**DO** < 2 mg/l lethal, optimum > 8 mg/l; **Temperature** 0-17°C, optimum 5-14°C; **Water velocity** 15-190 cm/s
Larvae (alevins) EFH Data Level 0-4; not all habitats have been sampled	50-125 d until fry emerge from gravel	Non-feeding stage; Alevins consumed by birds, fish and mammals	Fall, winter, and early spring	Intragravel until fry emergence	20-80 cm gravel depth; 15-700 cm water depth	Medium to course gravel	NA	**DO** < 2 mg/l lethal, optimum > 8 mg/l; **Temperature** 0-17°C, optimum 5-14°C; **Water velocity** 15-190 cm/s
Juveniles (freshwater) EFH Data level 0-4; not all habitats have been sampled	days-yrs	Insect larvae, adults, plankton	Year-round, depending on race	Streams, lakes, sloughs, rivers	0-120 cm	Varied	NA	**DO** lethal at <2 mg/l, optimum at saturation; **Temperature** 0-26°C, optimum 12-14°C; **Salinity** < 29 ppt
Juveniles (Estuary and oceanic) EFH Data Level 0-3; not all habitats have been sampled	6-months to 2 yrs	Estuary: copepods, euphausiids, amphipods. Ocean: fish, squid, euphausiids	Estuary: spring, summer, fall. Ocean: year-round	BCH BAY, IP, ICS, OCS	P, N, SD/SP 30-80 m preferred depth	All bottom types	Estuarine, littoral then more open water, UP, F, CL, G	**DO** lethal at <2 mg/l, optimum at saturation; **Temperature** 0-26°C, optimum 12-14°C; **Salinity** sea water
Adults EFH Data Level 0-2; not all habitats have been sampled	2-8 yrs of age from egg to mature adult	Fish, squid, euphausiids, amphipods, and copepods	Spawning: July-Feb. Non-spawning: Year round	Oceanic to nearshore migrations, spawn in freshwater	P, N, SD/SP	NA	Different stock groups have specific oceanic migratory patterns	**DO** Preferred >5 mg/l, optimum at saturation; **Temperature** 0-26°C; optimum <14°C

Major sources: Healey 1991, Bjorrn and Reiser 1991, Myers *et al.* 1998, NOAA 1990, Fisher and Pearcy 1995, Spence *et al.* 1996.

KEY FOR TABLES A-3, A-4, AND A-5.

EFH Data Level

0 No systematic sampling has been conducted for this species and life stage; may have been caught opportunistically in small numbers during other surveys.

1 Presence/absence distribution data are available for some or all portions of the geographic range.

2 Habitat-related densities are available. Density data should reflect habitat utilization, and the degree that a habitat is utilized is assumed to be indicative of habitat value.

3 Habitat-related growth, reproduction, or survival rates are available. The habitats contributing the most to productivity should be those that support the highest growth, reproduction, and survival of the species (or life history stage).

4 Habitat-related production rates are available. Essential habitats are those necessary to maintain fish production consistent with a sustainable fishery and a healthy ecosystem.

Location where found (in waters of these depths)

BAY - nearshore bays, give depth if appropriate (e.g., fjords)
BCH - beach (intertidal)
BSN - basin (>3,000 m)
IP - island passes (areas of high current), give depth if appropriate
ICS - inner continental shelf (1-50 m)
LSP - lower slope (1,000-3,000 m)
MCS - middle continental shelf (50-100 m)
OCS - outer continental shelf (100-200 m)
USP - upper slope (200-1,000 m)

Where found in water column

D - demersal (found on bottom)
N - neustonic (found near surface)
P - pelagic (found off bottom, not necessarily associated with a particular bottom type)
SD/SP - semi-demersal or semi-pelagic if slightly greater or less than 50% on or off bottom

Bottom Types

M - mud	S - sand	R - rock
SM - sandy mud	CB - cobble	C - coral
MS - muddy sand	G - gravel	K - kelp

SAV - subaquatic vegetation other than kelp (e.g., eelgrass).

Oceanographic Features

UP - upwelling	G - gyres	F - fronts
CL - thermo-or pycnocline	E - edges	

Other

U=Unknown
NA=not applicable

2.1.4.3 Juveniles (Freshwater)

Chinook salmon fry are typically 33-36 mm in length when they emerge, though there is considerable variation among populations and size at emergence is determined in part by egg size. Juvenile residence in freshwater and size and timing of seawater migration are highly variable. Ocean-type fish can migrate seaward immediately after yolk absorption, but most migrate 30-90 days after emergence. However, some move seaward as fingerlings in the late summer of their first year, while others, particularly in less-productive or cold water systems, overwinter and migrate as yearling fish (Taylor 1990a, 1990b). The proportion of fingerling and yearling migrants within a population may vary significantly among years (Roni 1992, Myers *et al.* 1998).

In contrast, stream-type fish generally spend at least one year in freshwater before emigrating to sea. Alaskan fish are predominantly stream-type, while chinook salmon from northern British Columbia are approximately half stream-type and half ocean-type (Taylor 1990a, Healey 1991). Ocean-type life histories are most common in central and southern British Columbia, Washington, Oregon, and California, with the exception of populations inhabiting the upper reaches of large river basins such as the Fraser, Columbia, Snake, and to a lesser extent the Klamath and Sacramento.

Water and habitat quality and quantity determine the productivity of a watershed for chinook salmon. Both stream and ocean-type fish utilize a wide variety of habitats during their freshwater residency, and are dependent on the quality of the entire watershed, from headwater to the estuary. Juvenile chinook inhabit primarily pools and stream margins, particularly undercut banks, behind woody debris accumulations, and other areas cover and reduced water velocity (Lister and Genoe 1970, Bjornn and Reiser 1991). While chinook salmon habitat preferences are similar to coho salmon, chinook salmon inhabit slightly deeper (15-120 cm) and higher velocity (0-38 cm/s) areas than coho salmon (Bjornn and Reiser 1991, Healey 1991). The stream or river must provide adequate summer and winter rearing habitat, and migration corridors from spawning and rearing areas to the sea. Stream-type juveniles are more dependent on freshwater ecosystems, because of their extended residence in these areas. The length of freshwater residence and growth is determined partially by water temperature and food resources. The principal foods in freshwater are larval and adult insects, while those in estuarine areas include epibenthic organisms, insects, and zooplankton.

Growth rates during the period of initial freshwater residency depend on the quality of habitats occupied by the fish. Growth rates between 0.21 mm/d and 0.62 mm/d have been reported for ocean-type fish and between 0.09 mm/d and 0.33 mm/d for stream-type fish (Kjelson *et al.* 1982, Healey 1991, Rich 1920, Mains and Smith 1964, Meeh and Siniff 1962, Loftus and Lenon 1977). For ocean-type fish, growth rates in estuarine habitats are generally much higher than they are in riverine or stream habitats, most likely due to a higher abundance of prey.

2.1.4.4 Juvenile (Estuarine)

Although both stream and ocean-type chinook salmon may reside in estuaries, stream-type chinook salmon generally spend a very brief period in the lower estuary before moving into coastal waters and the open ocean (Healey 1980, 1982, 1983; Levy and Northcote 1981). In contrast, ocean-type chinook salmon typically reside in estuaries for several months before entering coastal waters of higher salinity (Healey 1980, 1982; Congleton *et al.* 1981, Levy and Northcote 1981, Kjelson *et al.* 1982).

Ocean-type chinook salmon typically begin their estuarine residence as fry immediately after emergence or as fingerling after spending several months in freshwater. Fry generally enter the upper reaches of estuaries in late winter or early spring, beginning in January at the southern end of their range in the Sacramento-San Joaquin Delta, to April farther north, such as in the Fraser River Delta (Sasaki 1966; Dunford 1975; Levy *et al.* 1979; Healey 1980, 1982; Gordon and Levings 1984). In contrast, chinook salmon fingerling typically enter estuarine habitats in June and July (April through June in the Sacramento), or approximately as the earlier timed fry are emigrating to higher salinity marine waters. Regardless of time of entrance juvenile ocean-type chinook salmon spend from one to three months in estuarine habitats (Rich 1920; Reimers 1973; Myers 1980; Kjelson *et al.* 1982; Levy and Northcote 1981; Healey 1980, 1982; Levings 1982).

Chinook salmon fry prefer protected estuarine habitats with lower salinity, moving from the edges of marshes during high tide to protected tidal channels and creeks during low tide, although they venture into less-protected areas at night (Healey 1980, 1982; Levy and Northcote 1981, 1982; Kjelson *et al.* 1982; Levings 1982). As the fish grow larger, they are increasingly found in higher-salinity waters and increasingly utilize less-protected habitats, including the use of delta fronts or the edge of the estuary before finally dispersing into strictly marine habitats. In contrast to fry, chinook fingerling, with their larger size, immediately take up residence in deeper-water estuarine habitats (Everest and Chapman 1972, Healey 1991).

The chinook salmon diet during estuarine residence is highly variable and is dependent upon the particular estuary, year, season, and prey abundance. In general, chinook are opportunistic feeders, consuming larval and adult insects and amphipods when they first enter estuaries, with increasing dependance on larval and juvenile fish (including other salmonids) as they grow larger. Preferred diet items for chinook salmon include aquatic and terrestrial insects such as chironomid larvae, dipterans, cladoceans such as *Daphnia*, amphipods including *Eogammarus* and *Corophium*, and other crustacea such as *Neomysis*, crab larvae, and cumaceans (Sasaki 1966, Dunford 1975, Birtwell 1978, Levy *et al.* 1979, Northcote *et al.* 1979, Healey 1980, 1982; Kjelson *et al.* 1982, Levy and Northcote 1981, Levings 1982, Gordon and Levings 1984, Myers 1980; Reimers 1973). Larger juvenile chinook consume juvenile fishes such as anchovy *(Engraulidae)*, smelt *(Osmeridae)*, herring *(Clupeidae)*, and stickleback *(Gasterosteidae)*.

Growth in estuaries is quite rapid and chinook may enter the upper reaches of estuarine environments as 35-40 mm fry, and leave as 70-110 mm smolts (Rich 1920, Levy and Northcote 1981, 1982; Reimers 1973, Healey 1980). Growth rates during this period are difficult to estimate because small individuals are continually entering the estuary from upstream, while larger individuals depart for marine waters. Reported growth for populations range from .22 mm/d to .86 mm/d, and is as high as 1.32 mm/d for groups of marked fish (Rich 1920; Levy and Northcote 1981, 1982; Reimers 1973; Healey 1980; Kjelson *et al.* 1982; Healey 1991; Levings *et al.* 1986).

2.1.4.5 Juveniles (Marine)

After leaving the freshwater and estuarine environment, juvenile chinook disperse to marine feeding areas. Ocean-type fish which have a longer estuarine residence, tend to be coastal oriented, preferring protected waters and waters along the continental shelf (Healey 1983). In contrast, stream-type fish pass quickly through estuaries, are highly migratory, and may migrate great distances into the open ocean.

Chinook salmon typically remain at sea for one to six years. They have been found in oceanic waters at temperatures ranging from 1-15°C, although few chinook salmon are found in waters below 5°C (Major *et al.* 1978). They do not concentrate at the surface as do other Pacific salmon, but are most abundant at depths of 30-70 m and often associated with bottom topography (Taylor 1969, Argue 1970). However, during their first several months at sea, juvenile chinook salmon < 130 mm are predominantly found at depths less than 37 m (Fisher and Pearcy 1995). Because of their distribution in the water column, the majority of chinook salmon harvested in commercial troll fisheries are caught at depths of 30 m or greater.

Chinook salmon range widely throughout the north Pacific Ocean and the Bering Sea, as far south as the U.S./Mexico border (Godfrey 1968, Major *et al.* 1978). Chinook salmon from California, Oregon, Washington, and Idaho have been recovered in coastal areas throughout the Strait of Georgia and Inland Passage, along the Alaskan coast into Cook Inlet and waters surrounding Kodiak Island, extending out into the Aleutian/Rat Island chains to 180° W longitude, and northward in the Bering Sea to the Pribilof Islands (Hart and Dell 1986, Myers *et al.* 1996).

Chinook salmon may stay in coastal waters or may migrate into offshore oceanic habitats. Migration from coastal to more oceanic waters may begin off the coast of Vancouver Island, or may be delayed until reaching as far as Kodiak Island (Hartt and Dell 1986). Limited tag release and recovery data have found Washington origin chinook salmon in the Emperor Sea Mounts area, at ~44° N latitude and 175° W longitude (Myers *et al.* 1996). Based on high seas tagging data presented in Myers *et al.* (1996) and Hartt and Dell (1986), the oceanic distribution of Pacific Northwest chinook salmon appears to include the Pacific Ocean and Gulf of Alaska north of ~44° N latitude and east of 180° W longitude, including some areas of the Bering Sea.

The coastal distribution of chinook salmon is similar to coho salmon (Hartt and Dell 1986), with high concentrations in areas of pronounced coastal upwelling. Juvenile chinook are generally found within 55 km of the Washington, Oregon, and California coast, with the vast majority of fish found less than 28 km offshore (Pearcy and Fisher 1990, Fisher and Pearcy 1995). Historically, juvenile chinook salmon have been reported in coastal streams as far south as San Luis Obispo (Jordan 1895) and the Ventura River (Jordan and Gilbert 1881), so it can be presumed that their historical ocean distribution occasionally included coastal upwelling areas off southern California. Point Conception (34°30' N latitude), California, is considered the faunal break for marine fishes, with salmon and other temperate water fishes found north and subtropical fishes found south of this point (Allen and Smith 1988). Therefore, the historic southern edge of the marine distribution appears to be near Point Conception, California, and expands and contracts seasonally and between years depending on ocean temperature patterns and upwelling.

Ocean migration patterns have been shown to be influenced by both genetics and environmental factors (Healey 1991). Migratory patterns in the ocean may have evolved as a balance between the benefits of accessing specific feeding grounds and the energy expenditure and dispersion risks necessary to reach them. Along the eastern Pacific Rim, chinook salmon originating north of Cape Blanco on the Oregon coast tend to migrate north towards and into the Gulf of Alaska, while those originating south of Cape Blanco migrate south and west into waters off Oregon and California (Godfrey 1968, Major *et al.* 1978, Cleaver 1969, Wahle and Vreeland 1977, Wahle *et al.* 1981, Healey and Groot 1987).

While the marine distribution of chinook salmon can be highly variable within and among populations, migration and ocean distribution patterns show similarities among some geographic areas. For example, chinook salmon that spawn in rivers south of the Rogue River in Oregon disperse and rear in marine waters off the Oregon and California coast, while those spawning north of the Rogue River migrate north and west along the Pacific coast (Godfrey 1968, Major *et al.* 1978, Cleaver 1969, Wahle and Vreeland 1977, Wahle *et al.* 1981, Healey and Groot 1987). These migration patterns result in the harvest of fish from Oregon, Washington, and British Columbia within the EEZ off the Alaskan coast.

Chinook salmon are the most piscivorous of the Pacific salmon. Accordingly, fishes make up the largest component of their diet at sea, although squids, pelagic amphipods, copepods, and euphausiids are also important at times (Merkel 1957, Prakash 1962, Ito 1964, Hart 1973, Healey 1991).

2.1.4.6 Adults

Throughout their range, adult chinook salmon enter freshwater during almost any month of the year, although there are generally one to three peaks of migratory activity in most areas. In northern areas, chinook salmon river entry peaks in June, while in rivers such as the Fraser and Columbia, chinook salmon enter freshwater between March and November, with peaks in spring (March through May), summer (May through July), and fall (August through September). The Sacramento River has a winter-run population that enters freshwater between December and July.

Chinook salmon become sexually mature at a wide range of ages from two to eight years, with "jacks" or precocious males maturing after one to two years. Overall, the most common age of ocean- and stream-type maturing adults is three to five years, with males tending to be slightly younger than females. In general, stream-type fish have a longer generation time than do ocean-type fish, presumably owning to their longer freshwater residence, and chinook salmon from Alaska and more northern latitudes typically mature a year or more later than their southern counterparts (Roni and Quinn 1995, Myers *et al.* 1998). This phenomenon may also be an artifact of fishing pressure.

The size and age of adults varies considerably among populations and years and is influenced by genetic and environmental factors as well as by fishing pressure. Adult chinook salmon size is thought to represent adaptation to local spawning environment (Ricker 1980, Healey 1991, Roni and Quinn 1995). Most adult chinook salmon females are 65-85 cm in length, while the slightly younger males are 50-85 cm. However, male and female fish larger than 100 cm in length are not uncommon in many populations.

Prior to sexual maturation and spawning, adult chinook salmon often hold in large, deep, low velocity pools, with abundant large woody debris or other cover features. These areas may serve as a refuge from high river temperatures, predators, or a refuge to reduce metabolic demands and reserve energy until spawning commences (Berman and Quinn 1991). The spawning densities of chinook and coho salmon have been correlated with a number of factors including large woody debris and pool frequency (Montgomery *et al.* In prep.).

The survival of chinook salmon is affected by factors including run type (i.e., spring, summer, fall), freshwater migration length, and year. Hatchery spring and summer chinook salmon have smolt-to-adult survival rates that average 1%, although survival of many upper Columbia and Snake river basin hatchery stocks is typically less than 0.2% (Coronado-Hernandez 1995). Wild stocks from these areas are thought to have ocean survival rates two to ten times greater than hatchery fish (Coronado-Hernandez 1995). Fall chinook hatchery stocks also survive from smolt to adult at approximately 1%, although fish from some areas, such as the Oregon coast, are consistently higher, but typically less than 5% (Coronado-Hernandez 1995).

2.1.4.7 Databases on Chinook Salmon Distribution

To determine the geographic extent of chinook salmon freshwater and estuarine distribution, we examined the available information and selected databases on chinook salmon distribution and habitat use (see tables in Sections 2.4 and 2.5). The databases fell into three general categories, (1) regional, small scale (1:100,000 or 1:250,000) regional Geographic Information System (GIS) databases on salmon distribution (StreamNet, Washington Rivers Information System [WARIS], Oregon River Information System [ORIS], etc.), (2) local, large scale GIS database of limited coverage (county, tribal datasets, etc.), and (3) databases on habitat quality (U.S. Forest Service [USFS] stream survey data, state agency stream survey data, etc.). Unfortunately, databases in category 2 and 3 are of limited utility in specifically determining chinook salmon freshwater distribution, because they are composed of numerous, incompatible, small databases with incomplete geographic coverage. These datasets may, however, be useful during the EFH consultation process.

Small scale, regional databases such as StreamNet (1998) are suitable for portraying the overall distribution of chinook salmon and have utility for determining presence on the majority of specific stream reaches. Various life stages (migration, spawning and rearing, and rearing only) are delimited in the database distribution data as well. The hydrography used by StreamNet to spatially reference fish distribution is predominantly composed of 1:100,000 scale data, but both 1:63,500 and 1:24,000 linework has been added where appropriate to reference all the distribution data available to the project.

The formation and modification of stream channels and habitats is a dynamic process. Habitat available and utilized by chinook salmon changes frequently in response to floods, landslides, woody debris inputs, sediment delivery, and other natural events (Sullivan *et al.* 1987, Naiman *et al.* 1992, Reeves *et al.* 1995). To expect the distribution of chinook salmon within a stream, watershed, province, or region to remain static over time is unrealistic. Therefore, current information on chinook salmon distribution is useful for determining which watersheds chinook salmon inhabit, but not necessarily for identifying specific stream reaches and habitats utilized by the species.

2.1.4.8 Habitat Areas of Particular Concern

Information exists on the type of stream reaches preferred by chinook salmon for spawning and rearing. It is generally accepted that salmon spawn and rear primarily in stream reaches with a slope less than 4-5% (Lunetta *et al.* 1997), while they migrate through much steeper stream reaches. Furthermore, recent research has indicated that chinook and other fall-spawning anadromous salmonids are found primarily in plane-bed, pool-riffle, and forced-pool riffle stream channels[1/], which are channel types less than 4% slope (Montgomery and Buffington 1997, Montgomery *et al.* In prep.). Stream reaches greater than 4% slope are not frequently utilized by chinook salmon for spawning and rearing, because of their high bed load transport rate, deep scour, and coarse substrate (Montgomery *et al.* In prep.). Stream reaches less than 4-5% slope that potentially display plane-bed, pool-riffle, forced-pool-riffle morphology can be determined using GIS technology. Gradient and channel type as identified by GIS technology can differ from those actually present in the field (Lunetta *et al.* 1997, Montgomery and Buffington 1997). Therefore, it is important that a 1:24,000

1/ See Montgomery and Buffington (1997) for a description of this channel classification system.

or larger (finer) scale maps are used to determine potential channel type and a fine scale (10 m or less) digital elevation model is used to calculate slopes and channel types. Furthermore, slope and channel type should be confirmed in a representative number of reaches by site visits or existing habitat surveys. While the technology exists to develop this information, data at this scale and resolution have only been developed for specific provinces, not for the entire region; and, therefore, could not be used in the current EFH identification process. However, the existing information should be useful in the consultation process.

The delineation of channel types allows identification of potentially important and vulnerable habitats in the absence of accurate salmon distribution or habitat data. Moreover, degraded stream reaches, those lacking key roughness elements (e.g., large woody debris), and stream reaches with a high potential for restoration will still be identified as potential habitat. Therefore, the protection and restoration of chinook salmon habitat should focus on pool-riffle, plane bed, and forced-pool-riffle channels. Furthermore, any activity adjacent to or upstream of activity that could influence the quality of these important reaches or channels should be evaluated. Other vulnerable habitats that are in need of protection and restoration are off-channel rearing areas (e.g., wetlands, oxbows, side channels, sloughs) and estuarine and other near-shore marine areas. Submarine canyons and other regions of pronounced upwelling are also thought to be particularly important during El Niño events (N. Bingham, Pacific Coast Federation of Fishermen's Associations, P.O. Box 783, Mendocino, CA 95460, pers. comm.) and may need additional consideration for protection.

2.1.4.9 Freshwater Essential Fish Habitat

Freshwater EFH for chinook salmon consists of four major components, (1) spawning and incubation; (2) juvenile rearing; (3) juvenile migration corridors; and (4) adult migration corridors and adult holding habitat. Important features of essential habitat for spawning, rearing, and migration include adequate (1) substrate composition; (2) water quality (e.g., dissolved oxygen, nutrients, temperature, etc.); (3) water quantity, depth, and velocity; (4) channel gradient and stability; (5) food; (6) cover and habitat complexity (e.g., large woody debris, pools, channel complexity, aquatic vegetation, etc.); (7) space; (8) access and passage; and (9) flood plain and habitat connectivity. This incorporates, but is not limited to, life-stage specific habitat criteria summarized in Table 2-1.

Chinook salmon essential freshwater habitat includes all those streams, lakes, ponds, wetlands, tributaries, and other water bodies currently viable and most of the habitat historically accessible to chinook salmon within Washington, Oregon, Idaho, and California. Figure A-2 illustrates the watersheds currently utilized by chinook salmon from Washington, Oregon, Idaho and California within the hydologic units identified at the end of the chapter for all Council-managed salmon (Table A-6). Current chinook EFH does not include the aquatic habitat in watersheds above Dworshak Dam and the Hells Canyon Dam complex (Table A-2). Figure A-3 depicts the approximate historical freshwater distribution and the currently identified range of common marine occurrence of chinook salmon from Washington, Oregon, Idaho, and California. The geographic extent of the historic freshwater distribution of chinook salmon is based on data from Table A-5. Data on the marine range of chinook salmon are from National Oceanic and Atmospheric Administration (NOAA) (1990).

The diversity of habitats utilized by chinook salmon coupled with the inadequacy of existing species distribution maps makes it extremely difficult to identify all specific stream reaches, wetlands, and water bodies essential for the species at this time. Defining specific river reaches is also complicated, because of the current low abundance of the species and our imperfect understanding of the species' freshwater distribution, both current and historic. Adopting a more inclusive, watershed-based description of EFH is appropriate, because it (1) recognizes the species' use of diverse habitats and underscores the need to account for all of the habitat types supporting the species' freshwater and estuarine life stages, from small headwater streams to migration corridors and estuarine rearing areas; (2) takes into account the natural variability in habitat quality and use (e.g., some streams may have fish present only in years with plentiful rainfall) that makes precise mapping difficult; and (3) reinforces the important linkage between aquatic areas and adjacent upslope areas. Furthermore, this watershed-based approach is consistent with other Pacific salmon habitat protection and recovery efforts such as the ESA, Northwest Forest Plan, and the Oregon Coastal Salmon Restoration Initiative (OCSRI). Therefore, the geographic extent of chinook salmon essential habitat was delineated using USGS cataloging unit boundaries.

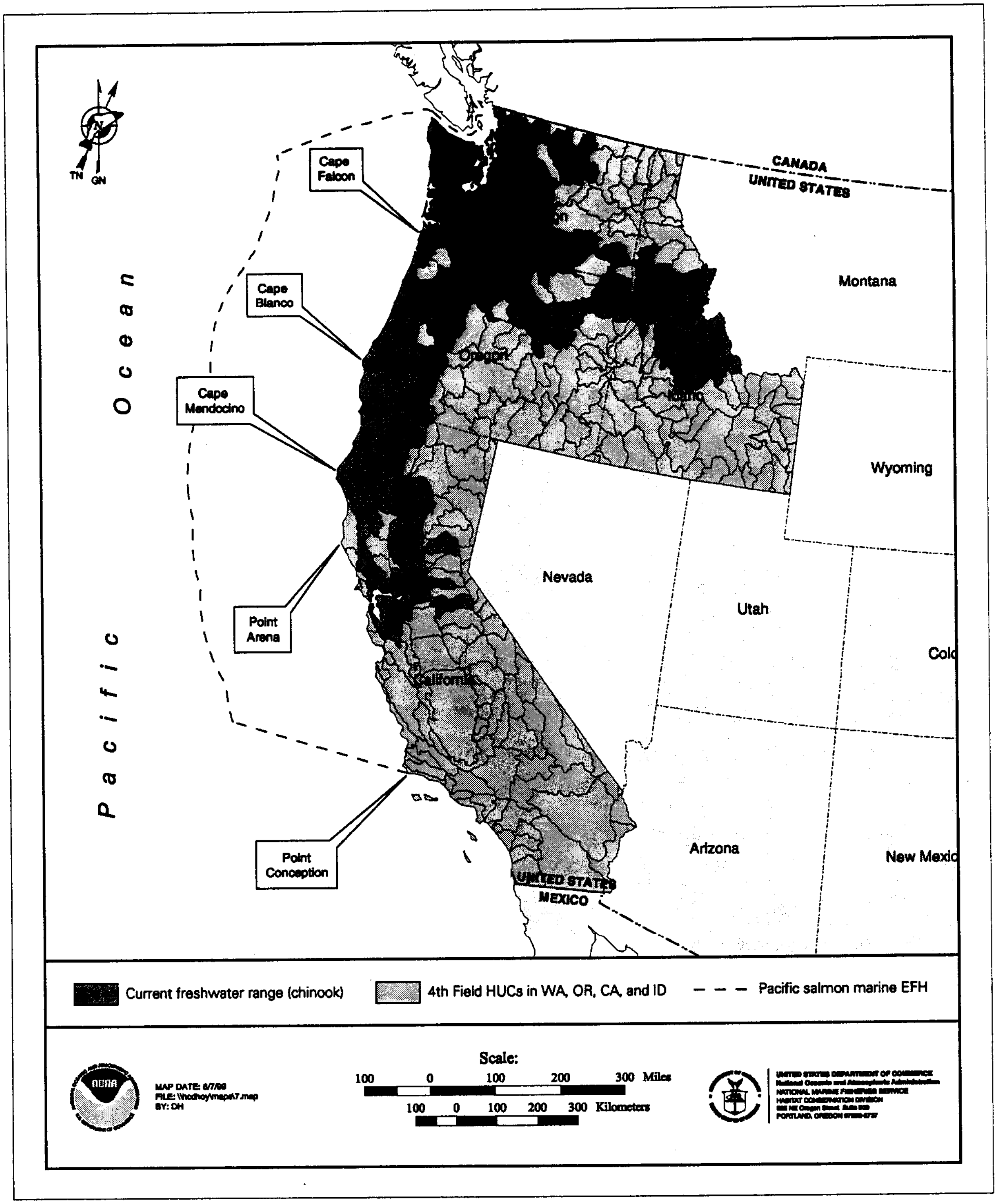

FIGURE A-2. Watersheds currently utilized by chinook salmon from Washington, Oregon, Idaho, and California.

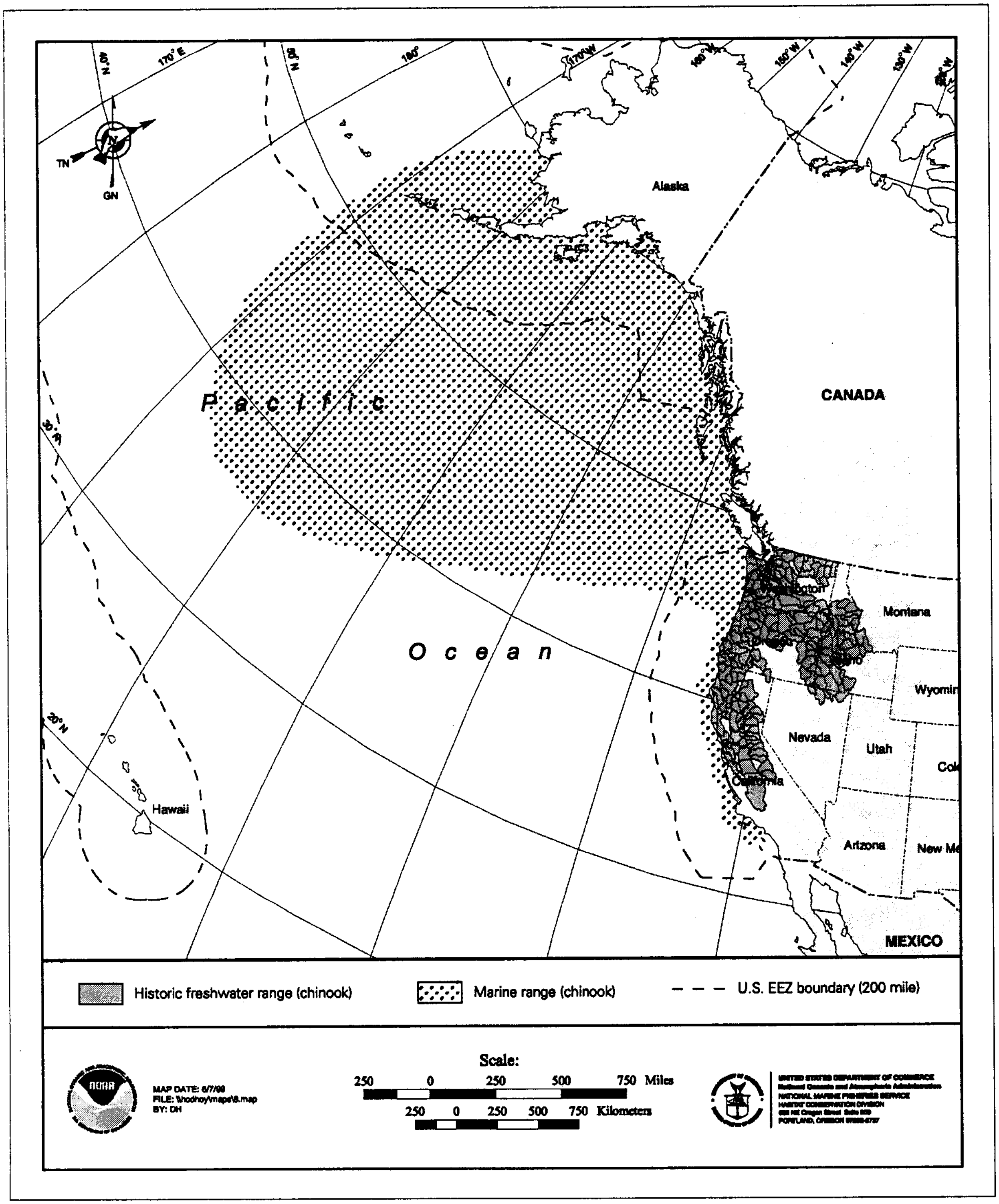

FIGURE A-3. Approximate historically accessible freshwater distribution and currently identified range of common marine occurrence of chinook salmon originating from Washington, Oregon, Idaho, and California.

2.1.4.10 Marine Essential Fish Habitat

The important elements of chinook salmon marine EFH are (1) estuarine rearing; (2) ocean rearing; and (3) juvenile and adult migration. Important features of this estuarine and marine habitat are (1) adequate water quality; (2) adequate temperature; (3) adequate prey species and forage base (food); and (4) adequate depth, cover, marine vegetation, and algae in estuarine and near-shore habitats. The available information for each life-history stage is summarized in Table A-3. Overall chinook salmon marine distribution is extensive, varies seasonally, interannually, and can only be defined generally (Figure A-3).

Limited information exists on chinook salmon habitat use in marine waters. Chinook are found throughout the North Pacific and have been encountered in waters far offshore. Available research (Pearcy and Fisher 1990, Fisher and Pearcy 1995), suggests that ocean-type juvenile chinook salmon are found in highest concentrations over the continental shelf. However, Fisher *et al.* (1983, 1984) found no clear evidence that young chinook were more abundant close to the coast. Ocean-type juvenile chinook appear to utilize different marine areas for rearing than stream-type juvenile chinook that are believed to migrate to ocean waters further offshore early in their ocean residence (Healey 1991). Coded-wire-tag recoveries of chinook salmon from high-seas fisheries and tagging programs (Myers *et al.* 1996; Healey 1991, Fig.18) provide evidence that chinook salmon utilize areas outside the continental shelf. Catch data and interviews with commercial fishermen indicate that maturing chinook salmon are found in highest concentrations along the continental shelf within 60 km of the Washington, Oregon, and California coast lines. Many stream-type chinook populations do not appear to be as heavily exploited as ocean-type chinook, indicating that stream-type fish may be vulnerable to coastal fisheries for only a short time during their spawning migrations (Healey 1991). Determination of a specific or uniform westward boundary within the EEZ which covers the distribution of essential marine habitat is difficult and would contain considerable uncertainty. Therefore, the geographic extent of essential marine habitat for chinook salmon includes all marine waters within the EEZ north of Point Conception, California (Figure A-3) and the marine areas off Alaska designated as salmon EFH by the North Pacific Fishery Management Council (NPFMC).

2.2 ESSENTIAL HABITAT DESCRIPTION FOR COHO SALMON *(Oncorhynchus kisutch)*

2.2.1 General Distribution and Life History

The following is an overview of coho salmon life history and habitat use as a basis for identifying EFH for coho salmon. Comprehensive reviews of coho salmon life history and habitat requirements can be found in Shapovalov and Taft (1954), Sandercock (1991), Weitkamp *et al.* (1995), and others. This description serves as a general description of coho salmon life history for Washington, Oregon, and California, and is not specific to any region, stock, or population.

Coho or "silver" salmon are a commercially and recreationally important species found in small streams and rivers throughout much of the Pacific Rim, from central California to Korea and northern Hokkaido, Japan (Godfrey 1965, Scott and Crossman 1973). They are distinguished from other Pacific salmon by the presence of irregular black spots confined to the back and the upper lobe of the caudal fin, and bright red sides and a bright green back and head when sexually mature (Godfrey 1965, Scott and Crossman 1973). Coho salmon spawn in freshwater streams, juveniles rear for at least one year in fresh water and spend about 18 months at sea before reaching maturity as adults. Precocious male coho salmon or "jacks" become sexually mature after only 6 months at sea, one year earlier than typical adult fish. Because coho salmon have relatively fixed residence times in both fresh and salt water, the species exhibits fewer age classes than all other Pacific salmon, with the exception of pink salmon. Most coho salmon populations south of central British Columbia consist of two-year-old jacks and three-year-old adults, while populations north of central British Columbia have two or three-year-old jacks and three or four-year-old adults (Gilbert 1912, Pritchard 1940, Shapovalov and Taft 1954, Wright 1970, Godfrey *et al.* 1975, Crone and Bond 1976). The older age at maturity of more northern populations is a product of the juveniles spending two years in freshwater as opposed to one year residence of more southern populations.

Unlike other Pacific salmon species, where the majority of production comes from large spawning populations in a few river basins, coho salmon production results from spawners using numerous small streams (Sandercock 1991). North American coho salmon populations are widely distributed along the

Pacific coast and spawn in tributaries to most major river basins from the San Lorenzo River in Monterey Bay, California, to Point Hope, Alaska, and through the Aleutian Islands (Godfrey 1965, Sandercock 1991). The species is most abundant in coastal areas from central Oregon through southeast Alaska and widely distributed throughout the North Pacific (Manzer *et al.* 1965, French *et al.* 1975, Godfrey *et al.* 1975).

In Alaska, coho salmon catches are at historically high levels, and trends in abundance of most stocks are stable (Baker *et al.* 1996, Slaney *et al.* 1996, Northcote and Atagi 1997, Wertheimer 1997). However, many coho salmon populations in southern British Columbia, Washington, Oregon, and California are depressed from historical levels with stocks at the southern-most end of the range generally at greatest risk of extinction (Nehlsen *et al.* 1991; Nelson 1993, 1994; Brown *et al.* 1994; Bryant 1994). Some stocks, particularly those in the Columbia River Basin above Bonneville Dam (*e.g.*, Idaho coho stocks), are thought to be extinct (Nehlsen *et al.* 1991). Coastal stocks of coho salmon from the Columbia River to the southern extent of their range in Monterey Bay were recently listed as a "threatened" species under the ESA, while coho salmon in the Columbia River Basin, southwest Washington, Puget Sound, and the Strait of Georgia are candidates for listing (NMFS 1995, 1997a, 1997b, 1999a).

Hatchery production of coho salmon is extensive in southern British Columbia, Washington, Oregon, and California, and is used to provide sport and commercial harvest opportunities (Bledsoe *et al.* 1989). The Columbia River is the world's largest producer of hatchery coho salmon, with over 50 million fry and smolts released annually in recent years, followed closely by Puget Sound (Flagg *et al.* 1995, Weitkamp *et al.* 1995). In contrast, most production of coho salmon from northern British Columbia and Alaska is natural, with minimal hatchery influence (Baker *et al.* 1996, Slaney *et al.* 1996). Coho are also used in net-pen cultures in Washington and British Columbia, and attempts to establish coho runs in other areas of the world have met with limited success (Sandercock 1991).

2.2.2 Fisheries

Commercial, tribal, sport, and subsistence fisheries for coho historically and currently occur from the eastern Pacific through the Bering Sea and along the West Coast of North America as far south as central California (Godfrey 1965). Trolling (hook-and-line) is the primary gear type used in ocean fisheries; however, gill nets and purse seines are used in near-shore or in-river commercial fisheries. Sport catches of coho are typically taken by hook-and-line.

Most coho salmon from Washington, Oregon, and California recruit to fisheries after one year in fresh water and about 16 months at sea. These fisheries take place in coastal adult migration corridors, near the mouths of river and in freshwater and marine migration areas (Williams *et al.* 1975) and largely target fish returning to hatcheries.

Bycatch in coho salmon fisheries is usually limited to other salmon species, primarily chinook and chum salmon, and occasionally pink salmon. Species such as steelhead, Dolly Varden, pollock, pacific cod, halibut, salmon sharks, and coastal rockfish make up a small part of the catch. Coho salmon are also taken incidentally in other salmon fisheries. When regulations prohibit the retention of coho, the majority of released fish survive the hooking encounter, however, large numbers can be hooked and substantial mortality incurred. Substantial coho salmon bycatch can lead to restrictions on these fisheries (Pacific Fishery Management Council [PFMC] 1998). A complete and current description of ocean fisheries, harvest levels, and management framework can be found in the most recent versions of the annual PFMC *Review of Ocean Salmon Fisheries* and *Preseason Report I* (PFMC 1999a, 1999b).

2.2.3 Relevant Trophic Information

Coho salmon (both live and carcasses) provide important food for bald eagles and other avian scavengers, numerous terrestrial mammal species (e.g., bear, river otter, racoon, weasels), aquatic invertebrates, marine mammals (e.g., California and Steller sea lion, harbor seal, and orca), and salmon sharks (Scott and Crossman 1973, Cederholm *et al.* 1989). Pinniped predation on migrating salmonids, both adult spawners and downstream migrating smolts, can be substantial especially at sites of restricted passage and small salmonid populations (NMFS 1997c). Carcasses also transfer essential nutrients from marine to freshwater environments (Bilby *et al.* 1996). Eggs, larvae, and alevins are consumed by various fishes, including juvenile steelhead, coho salmon, and cutthroat. Juveniles are eaten by a variety of birds (e.g., gulls, terns, kingfishers, cormorants, mergansers, herons), fish (e.g., Dolly Varden, steelhead, cutthroat trout, sculpins, and arctic char), and mammals (e.g., mink and water shrew) (Shapovalov and Taft 1954, Chapman 1965, Godfrey 1965, Scott and Crossman 1973). Juvenile coho are also predators of pink, sockeye, and chinook salmon fry and may be cannibalistic on the succeeding year's eggs and alevins (Gribanov 1948, Shapovalov and Taft 1954, Scott and Crossman 1973, Beacham 1986, Bilby *et al.* 1996).

2.2.4 Habitat and Biological Associations

Table A-4 summarizes coho salmon habitat use by life history stage.

Coho salmon are highly migratory at each stage of their life and are dependent on high-quality spawning, rearing, and migration habitat. Water depth, water velocity, water quality, cover, and lack of physical obstruction are important elements in all migration habitats. Soon after emergence in spring, fry move from spawning areas to rearing areas. In fall, juveniles may migrate from summer rearing areas to areas with winter habitat (Sumner 1953, Skeesick 1970, Swales *et al.* 1988). Such juvenile migrations may be extensive within the natal stream basin, or, less frequently, fish may migrate between basins through salt water or connecting estuaries (Greg Bryant, NMFS, 1330 Bayshore Way, Eureka, California 98501, pers. comm.). Seaward migration of coho smolts in Washington, Oregon, and California occurs predominantly after one year in fresh water, but may not occur until two or more years in more northern or less productive environments. This migration is primarily triggered by photoperiod and usually coincides with spring freshet (Shapovalov and Taft 1954, Chapman 1962, Crone and Bond 1976). During this transition, coho undergo major physiological changes to enable them to osmoregulate in salt water and are especially sensitive to environmental stress at that time. While migration patterns at sea differ considerably by province and stock, juvenile coho generally migrate north or south in coastal waters and may move north and offshore into the North Pacific Ocean (Loeffel and Forster 1970, Hartt 1980, Miller *et al.* 1983, Pearcy and Fisher 1988). After 12 to 14 months at sea they migrate along the coast to their natal streams.

2.2.4.1 Eggs and spawning

Most coho salmon spawn between November and January, with some populations spawning as late as March (Godfrey *et al.* 1965, Sandercock 1991, Weitkamp *et al.* 1995). Populations spawning in the northern portion of the species range or at higher elevations generally spawn earlier than those at lower elevations or in the southern portion of the range (Godfrey *et al.* 1965, Sandercock 1991, Weitkamp *et al.* 1995). Spawn timing also exhibits considerable small-scale geographical and interannual variability.

In general, coho salmon select sites in coarse gravel where the gradient increases and the currents are moderate, such as pool tailouts and riffles. In these areas, intergravel flow must be sufficient for adequate dissolved oxygen delivery to eggs and alevins. Coho salmon typically spawn in small streams where flows are 0.3.-0.5 m^3/s, although they also spawn in large rivers and lakes (Burner 1951, Bjornn and Reiser 1991). Coho salmon spawning habitat consist primarily of coarse gravel with a few large cobbles, a mixture of sand, and a small amount of silt. High quality spawning grounds of coho salmon can best be summarized as clean, coarse gravel. Typically, redd (nest) size is 1.5 m^2, constructed in relatively silt-free gravels ranging from 0.2 to 10 cm in diameter, with well-oxygenated intragravel flow and nearby cover (Burner 1951, Willis 1954, Bjornn and Reiser 1991, van den Berghe and Gross 1984).

Coho salmon eggs are typically 4.5-6 mm in diameter, smaller than most other Pacific salmon (Beacham and Murray 1987, Fleming and Gross 1990). The fecundity of female coho salmon is dependent on body size, population, and year, and is generally between 2,500 and 3,500 eggs (Shapovalov and Taft 1954, Beacham 1982, Fleming and Gross 1990). Several males may compete for each female, but larger males usually dominate by driving off smaller males (Holtby and Healey 1986, van den Berghe and Gross 1989). After spawning, coho females remain on their redds one to three weeks before dying, defending the area from superimposition of eggs from other females (Briggs 1953, Willis 1954, Crone and Bond 1976, Fleming and Gross 1990).

TABLE A-4. Coho salmon habitat use by life history stage. (See key to abbreviations and EFH data levels on page A-16.)

Stage - EFH Data Level	Duration or Age	Diet/Prey	Season/Time	Location	Water Column	Oceanographic Features	Other
Eggs EFH Data Level 0-4; not all habitats have been sampled	50 days at optimum temperatures	Non-feeding stage; eggs consumed by birds, fish and mammals	Fall/winter	Streambeds	Intragravel; water depth 4-35 cm	NA	**DO** < 2 mg/l lethal, optimum > 8 mg/l; **Temperature** 0-17°C; optimum 4.4-13.3°C; **Substrate** 2-10 cm with < 12% fines (<3.3 mm), optimum <5% fines; **Water velocity** 25-90 cm/s
Larvae (alevins). EFH Data Level 0-4; not all habitats have been sampled	100 days at optimum temperatures	Non-feeding stage; Alevins consumed by birds, fish and mammals	Winter/spring	Streambeds	Intragravel; water depth 4-35 cm	NA	**DO** < 3 mg/l lethal, optimum > 8 mg/l; **Temperature** 0-17°C; optimum 4.4-13.3°C; **Substrate** 2-10 cm with < 12% fines (<3.3 mm), optimum <5% fines; **Water velocity** 25-90 cm/s
Juveniles (freshwater) EFH Data Level 0-4; not all habitats have been sampled	1-2 yrs, most (>90%) 1 yrs	Aquatic, terrestrial, and estuarine invertebrates, fish; predators include birds, fish, mammals	Rearing - all year Migration - spring and fall	Streams, lakes, BAY (estuaries)	Water depth 0-122 cm in streams	NA	**DO** lethal at <2 mg/l, optimum at saturation; **Temperature** 0-26°C; optimum 12-14°C; **Salinity** < 29 ppt; **Water velocity** 5-30 cm/s
Juveniles (marine) EFH Data Level 0-3; not all habitats have been sampled	16 months (except precocious males)	Epipelagic fish (herring, sand lance) and marine invertebrates (copepods, euphausiids, amphipods, crab larvae)	Rearing - all year Migration - all year	BCH, ICS, MCS, OCS, USP, BAY, IP	Pelagic	UP, CL, F; migration influenced by currents, salinity, and temperature	**Temperature** <15°C; **Depth** <10 m
Adults (freshwater) EFH Data Level 1-2; not all habitats have been sampled	up to 2 months	Little or none	Migration - fall Spawning - fall, winter	Rivers, streams, lakes			

Primary Sources: Shapovalov and Taft 1954, Sandercock 1991, Bjorrn and Reiser 1991, Weitkamp *et al.* 1995, Spence *et al.* 1996.

2.2.4.2 Larvae/Alevins

Egg incubation time is influenced largely by water temperature and lasts from approximately 38 days at 10.7°C to 137 days at 2.2°C (Shapovalov and Taft 1954, Koski 1965, McPhail and Lindsey 1970, Fraser *et al.* 1983, Murray *et al.* 1990). Eggs, alevins, and pre-emergent fry must be protected from freezing, desiccation, stream bed scouring or shifting, and predators to survive to emergence. Water surrounding them must be non-toxic and of sufficient quality and quantity to provide basic requirements of suitable temperatures, adequate supply of oxygen, and removal of waste materials. Under natural "average" conditions, 15-27% of the eggs survive to emerge from the gravel as fry, although values of 85% survival have been reported under "optimal" conditions, and survival in degraded habitats or under harsh conditions may be essentially zero (Briggs 1953, Shapovalov and Taft 1954, Koski 1965, Crone and Bond 1976).

As the yolk sac is absorbed, the larvae become photopositive and emerge from the substrate (Shapovalov and Taft 1954, Koski 1965). Fry emerge between March and July, with most emergence occurring between March and May, depending on when the eggs were fertilized and the water temperature during development (Briggs 1953, Shapovalov and Taft 1954, Koski 1965, Crone and Bond 1976). These 30 mm-long newly-emerged fry initially congregate in schools in protected, low-velocity areas such as quiet backwaters, side channels, and small creeks before venturing into protected areas with stronger currents (Shapovalov and Taft 1954, Godfrey 1965, Scrivener and Anderson 1984).

2.2.4.3 Juveniles (Freshwater)

The vast majority of juvenile coho salmon from California to central British Columbia spend one year in fresh water before migrating to sea as 85-115 mm-long smolts (Pritchard 1940; Sumner 1953; Drucker 1972; Blankenship and Tivel 1980; Seiler *et al.* 1981, 1984; Blankenship *et al.* 1983; Lenzi 1983, 1985, 1987; Irvine and Ward 1989; Lestelle and Weller 1994). Because growth rates are lower in colder water, juveniles from northerly areas require two years in fresh water to attain this size, and some populations may need as many as four to five years to reach this size (Gribanov 1948, Drucker 1972, Crone and Bond 1976).

Coho smolt production is most often limited by the availability of summer and winter freshwater rearing habitats (Williams *et al.* 1975, Reeves *et al.* 1989, Nickelson *et al.* 1992). Inadequate winter rearing habitats, such as backwater pools, beaver ponds, wetlands, and other off-channel rearing areas, are considered the primary factor limiting coho salmon production in many coastal streams (Cederholm and Scarlett 1981, Swales *et al.* 1988, Nickelson *et al.* 1992). If spawning escapement is adequate, sufficient fry are usually produced to exceed the carrying capacity of rearing habitat. In such cases, carrying capacity of summer habitats set a density-dependent limit on the juvenile population, which then may suffer density-independent mortality during winter depending on the severity of conditions, fish size, and quality of winter habitat.

Coastal streams, wetlands, lakes, sloughs, tributaries, estuaries, and tributaries to large rivers can all provide coho rearing habitat. The most productive habitats exist in smaller streams less than fourth order having low-gradient alluvial channels with abundant pools formed by large woody debris (Foerster and Ricker 1953, Chapman 1965). Beaver ponds and large slackwater areas can provide some of the best rearing areas for juvenile coho (Bustard and Narver 1975, Nickelson *et al.* 1992). Coho juveniles may also use brackish-water estuarine areas in summer and migrate upstream to fresh water to overwinter (Crone and Bond 1976).

During summer rearing, the highest juvenile coho densities tend to occur in areas with abundant prey (e.g., drifting aquatic invertebrates and terrestrial insects that fall into the water) and structural habitat elements (e.g., large woody debris and associated pools). Preferred habitats include a mixture of different types of pools, glides, and riffles with large woody debris, undercut banks, and overhanging vegetation which provide advantageous positions for feeding (Foerster and Ricker 1953, Chapman 1965, Reeves *et al.* 1989, Bjornn and Reiser 1991). Coho grow best where water temperature is between 10 and 15°C, and dissolved oxygen (DO) is near saturation. Juvenile coho can tolerate temperatures between 0° and 26°C if changes are not abrupt (Brett 1952, Konecki *et al.* 1995). Their growth and stamina decline significantly when DO levels drop below 4 mg/l, and a sustained concentration less that 2 mg/l is lethal (Reeves *et al.* 1989). Summer populations are usually constrained by density-dependant effects mediated through territorial behavior. In flowing water, juvenile coho usually establish individual feeding territories, whereas in lakes, large pools, and estuaries they are less likely to establish territories and may aggregate where food is abundant (Chapman 1962, McMahon 1983). Because growth in summer is often density-dependent, the size of juveniles in late summer is often inversely related to population density.

In winter, territorial behavior is diminished, and juveniles aggregate in freshwater habitats that provide cover with relatively stable depth, velocity, and water quality. Winter mortality factors include hazardous conditions during winter peak stream flow (e.g., scour, high velocities), stranding of fish during floods or by ice damming, physiological stress from low temperature, and progressive starvation (Hartman *et al.* 1984). In winter, juveniles prefer a narrower range of habitats than in summer, especially large mainstream pools, backwaters, beaver ponds, off-channel ponds, sloughs, and secondary channel pools with abundant large woody debris, and undercut banks and debris along riffle margins (Skeesick 1970, Nickelson *et al.* 1992). Survival in winter, in contrast to summer, is generally density-independent, and varies directly with fish size and amount of cover and ponded water, and inversely with the magnitude of the peak stream flow. Survival from eggs to smolts is usually less than 2% (Neave and Wickett 1953).

Habitat requirements during seaward migration are similar to those of rearing juveniles. High streamflow aids their migration by flushing them downstream and reducing their vulnerability to predators. Migrating smolts are particularly vulnerable to predation, because they are concentrated and moving through areas of reduced cover. Mortality during seaward migration can be quite high (Tytler *et al.* 1978, Dawley *et al.* 1986, Seiler 1989). The seaward migration of smolts in native stocks is thought to be timed so that the smolts arrive in the estuary and nearshore ocean when food is plentiful (Foerster and Ricker 1953, Shapovalov and Taft 1954, Drucker 1972). In California the seaward migration is also timed to occur prior to closing of some estuaries and tidal reaches by the formation of impassible sand bars (Bryant 1994). Rapid growth during the early period in the estuary and nearshore ocean is critical to survival, because of mortality from predation which may be size dependent (Myers and Horton 1982, Dawley *et al.* 1986, Pearcy and Fisher 1988, Holtby *et al.* 1990, Pearcy 1992).

2.2.4.4 Juveniles (Estuarine)

The amount of time juvenile coho salmon rear in estuaries appears to be highly variable, with more northern populations generally dwelling longer in estuaries than more southern populations (Pearce *et al.* 1982, Simenstad *et al.* 1982, Tschaplinksi 1982). For example, Oregon coast, Columbia River, and Puget Sound coho salmon are thought to remain in estuarine areas for several days to several weeks, while many British Columbian, and Alaskan populations remain in estuaries for several months (Myers and Horton 1982, Pearce *et al.* 1982, Simenstad *et al.* 1982, Tschaplinksi 1982, Levings *et al.* 1995). Similar to the stream environment, large woody debris is also an important element of juvenile coho salmon habitat in estuaries (McMahon and Holtby 1992). In estuarine environments, coho salmon consume large planktonic or small nektonic animals, such as amphipods (*Corophium* spp., *Eogammarus* spp.), insects, mysids, decapod larvae, and larval and juvenile fishes (Myers and Horton 1982, Simenstad *et al.* 1982, Dawley *et al.* 1986). They are in turn preyed upon by marine fishes, birds, and mammals. In estuaries, smolts occur in intertidal and pelagic habitats, with deep, marine-influenced habitats often preferred (Pearce *et al.* 1982, Dawley *et al.* 1986).

2.2.4.5 Juveniles (Marine)

Two primary dispersal patterns have been observed in coho salmon after emigrating from freshwater. Some juveniles spend several weeks in coastal waters before migrating northwards into offshore waters of the Pacific Ocean (Hartt 1980, Hartt and Dell 1986, Pearcy and Fisher 1988, Pearcy 1992), while others remain in coastal waters near their natal stream for at least the first summer before migrating north. The later dispersal pattern is commonly seen in coho salmon from California, Oregon, and Washington (Shapovalov and Taft 1954, Godfrey 1965, Miller *et al.* 1983). It is not clear whether these less-migratory fish, particularly those from coastal areas, make extensive migrations after the first summer. However, it is known that some Puget Sound/Strait of Georgia-origin coho salmon spend their entire ocean residence in the Sound and Strait, while others migrate to the open ocean in late summer (Healey 1980, Godfrey *et al.* 1975, Hartt and Dell 1986). The spatial distribution of suitable habitat conditions is affected by annual and seasonal changes in oceanographic conditions and may affect the tendency for fish to migrate from, or reside in, coastal areas after ocean entry.

Juvenile coho salmon generally stay in nearshore coastal and inland waters well into October (Hartt and Dell 1986). Juvenile coho from Oregon and presumably other areas will initially be found south of their natal streams, moved by strong southerly currents (Pearcy 1992). When these currents weaken in the winter months, juvenile coho migrate northward. In strong upwelling years, where the band of favorable temperatures and available prey is more extensive, coho salmon appear to be more dispersed off shore. In weak upwelling years, coho salmon concentrate in upwelling zones closer to the shore (Pearcy 1992), and often near submarine canyons and other areas of consistent upwelling (N. Bingham, Pacific Coast Federation of Fishermen's Associations, P.O. Box 783, Mendocino, California, 95460, pers. comm., February 1998). Generally, juvenile coho are found in highest concentrations within 60 km of the California, Oregon, and Washington coast, with the majority found within 37 km of the coast (Pearcy and Fisher 1990, Pearcy 1992). Puget Sound origin coho salmon are typically found in the Strait of Juan de Fuca and coastal waters of Vancouver Island throughout summer months (Hartt and Dell 1986).

Coho leaving Puget Sound and other inland waters are found to migrate north along the east or West Coast of Vancouver Island and out into the Pacific Ocean (Williams *et al.* 1975, Hartt and Dell 1986). Tag, release, and recovery studies suggest that immature coho salmon from Washington and Oregon are found as far north as 60° N latitude along the Pacific Coast, and California-origin coho salmon as far north as 58° N latitude in Southeast Alaska (Myers *et al.* 1996). Coho salmon from Oregon streams have been taken in offshore waters near Kodiak Island in the northern Gulf of Alaska (Hart and Dell 1986, Myers *et al.* 1996). Westward migration of coho salmon into offshore oceanic waters appears to extend beyond the EEZ beginning around 45° N latitude off the Oregon coast (Myers *et al.* 1996). Coded-wire and high-seas tag data for Washington and Oregon suggest that oceanic migration for these coho stocks can extend as far south and west as 43° N latitude and 175° E longitude around the Emperor Sea Mounts (Myers *et al.* 1996), believed to be an area of high prey abundance. Thus it appears that coho salmon stocks from Washington, Oregon, and California are found at least occasionally in the Pacific Ocean and Gulf of Alaska north of 44° N latitude to 57° N latitude, extending westward and southward along the Aleutian chain to the Emperor Sea Mounts area near 43° N latitude and 175° E longitude.

While juvenile and maturing coho are found in the open north Pacific, the highest concentrations appear to be found in more productive waters of the continental shelf within 60 km of the coast. Coho salmon have been occasionally reported off the coast of southern California near the Mexican border (Bryant 1994). However, Point Conception (34°30' N latitude), California, is considered the faunal break for marine fishes, with salmon and other temperate water fishes primarily found north and subtropical fishes to the south (Allen and Smith 1988), although the southern limit expands and contracts seasonally and between years depending on ocean temperature patterns and upwelling.

Coho salmon in coastal and oceanic waters are comprised of stocks from a wide variety of streams from Washington, Oregon, and California (Godfrey *et al.* 1975, French *et al.* 1975, Burgner 1980, Hartt 1980, Hartt and Dell 1986, Weitkamp *et al.* 1995). Analysis of coded-wire tag (CWT) data indicates distinct migration patterns for various basins, provinces, and states. For example, coho salmon from the Columbia River make up a high proportion of fish captured in Oregon waters, whereas coho from the Washington coast are rarely recovered in Oregon waters, but frequently recovered in British Columbia (Weitkamp *et al.* 1995). The vast majority of CWT coho salmon are recovered in coastal waters where coho salmon fisheries occur.

Marine invertebrates, such as copepods, euphausiids, amphipods, and crab larvae, are the primary food when coho first enter salt water. Fish represent an increasing proportion of the diet as coho salmon grow and mature (Shapovalov and Taft 1954, Healey 1978, Myers and Horton 1982, Pearcy 1992). Growth is controlled mainly by food quantity, food quality, and temperature. Growth is best in pelagic habitats where forage is abundant and sea surface temperature is between 12 and 15°C (Godfrey *et al.* 1975, Hartt 1980, Healey 1980). Coho salmon rarely use areas where sea surface temperature exceeds 15°C and are generally found in the uppermost 10 m of the water column. Coho salmon do not aggregate in offshore oceanic waters and prefer slightly warmer ocean temperatures than do other Pacific salmon (Godfrey 1965, Manzer *et al.* 1965, Welch 1995). Before entering fresh water, most coho slow their feeding and begin to lose weight as they develop secondary sexual characteristics and large gonads. Precocious males return to spawn after approximately six months at sea, but most coho remain at sea for about 16 months before returning to coastal areas and entering fresh water to spawn (Godfrey 1965; Wright 1968, 1970; Sandercock 1991).

2.2.4.6 Adults

Adult coho enter fresh water from early July through December, often after the onset of fall freshets, with peak river entry occurring as early as September in Alaska, in October and November in British Columbia, Washington, and Oregon, and in December and even January in California (Briggs 1953, Godfrey 1965, Ricker 1972, Fraser *et al.* 1983, Bryant 1994). Some populations, often referred to as the "summer-run" coho salmon, are exceptionally early, entering rivers in late spring and early summer (Aro and Shepard 1967, Houston 1983, Washington Department of Fisheries [WDF] *et al.* 1993). In general, larger river basins have a wider range of river entry times than do smaller systems, and river entry occurs later the farther south a river is situated (Godfrey 1965, Sandercock 1991). The fish feed little and migrate upstream to their natal stream using olfactory cues imprinted in early development (Harden Jones 1968, Quinn and Tolson 1986, Sandercock 1991). Fidelity of mature fish to natal streams is high, and straying rates are generally less than 5% (Shapovalov and Taft 1954, Lister *et al.* 1981, Labelle 1992). Adult coho may travel for a short time and distance upstream to spawn in small streams or may enter large river systems and travel for weeks to reach spawning areas more than 2,000 km upstream (Godfrey 1965, Aro and Shepard 1967, McPhail and Lindsay 1970, Sandercock 1991, WDF *et al.* 1993).

Most coho salmon spawn at approximately the same time regardless of when they entered fresh water (Foerster and Ricker 1953, Shapovalov and Taft 1954, Sandercock 1991). Consequently, populations that enter fresh water in late summer and early fall may reside in fresh water three to four months before spawning, while fish entering fresh water in late fall may spawn within weeks of fresh water entry. At the extreme southern end of their range in central California, most coho salmon enter fresh water in late December or January and spawn shortly thereafter (Briggs 1953, Shapovalov and Taft 1954, Bryant 1994).

The survival of coho salmon is generally affected by numerous factors in both salt and fresh water, including ocean conditions, location of natal stream, freshwater migration length, stream flow, and other environmental factors. Hatchery coho salmon have smolt-to-adult survival rates that average between 3-5%, but can be much higher in areas such as Puget Sound, or lower during unfavorable years (Coronado-Hernandez 1995). Wild stocks typically show marine survival rates two to three times greater than hatchery fish (Seiler 1989, Pearcy 1992, Coronado-Hernandez 1995).

2.2.4.7 Databases on Distribution

To determine the geographic extent of coho salmon freshwater and estuarine distribution, we examined the available information and databases on coho salmon distribution and habitat use (see tables in Sections 2.4 and 2.5). The databases fell into three general categories, (1) regional, small-scale (e.g., 1:100,000 or 1:250,000) regional GIS databases on coho salmon distribution (e.g., StreamNet, WARIS, ORIS, etc.); (2) local, large scale GIS database of limited scope (e.g., county, tribal datasets, etc.); and (3) databases on habitat surveys and habitat quality (e.g., USFS stream survey data, state, and tribal stream survey data, etc.). Unfortunately, databases in categories 2 and 3 are of limited utility in determining coho salmon freshwater distribution, because they are comprised of many small, disparate, incompatible databases with incomplete geographic coverage. These datasets may, however, be useful during EFH consultations.

Small-scale, regional databases such as StreamNet (1998) are suitable for portraying the overall distribution of chinook salmon and have utility for determining presence on the majority of specific stream reaches. Various life stages (migration, spawning and rearing, and rearing only) are delimited in the database distribution data as well. The hydrography used by StreamNet to spatially reference fish distribution is predominantly composed of 1:100,000 scale data, but both 1:63,500 and 1:24,000 linework has been added where appropriate to reference all the distribution data available to the project.

The formation and modification of stream channels and habitats is a dynamic process. Habitat available and utilized by coho and other salmonids also changes frequently in response to floods, landslides, woody debris inputs, sediment delivery, and other natural events (Sullivan *et al.* 1987, Naiman *et al.* 1992, Reeves *et al.* 1995). It is unrealistic to expect coho salmon distribution within a stream, watershed, province, or region to remain static over time. Therefore, coarse scale regional GIS databases are useful only for determining which watersheds coho salmon inhabit, but not for identifying specific stream reaches and habitats utilized by the species.

2.2.4.8 Habitat Areas of Particular Concern

Information exists on the type of stream reaches preferred by coho salmon for spawning and rearing. It is generally accepted that they spawn and rear in stream reaches and channels less than 4-5% gradient (Lunetta *et al.* 1997). Furthermore, coho and other fall spawning anadromous salmonids are found primarily in plane-bed, pool-riffle, and forced-pool-riffle stream channels[2/], which are channel types less than 4% (Montgomery and Buffington 1997, Montgomery *et al.* In press). Stream reaches greater than 4% slope (gradient) are generally not utilized by coho salmon for spawning, because of their high bed load transport rate, deep scour, and coarse substrate (Montgomery *et al.* In press). Stream reaches less than 4% that potentially display plane-bed, pool-riffle, and forced-pool-riffle morphology can be identified using GIS technology. However, channel types identified with GIS technology can differ from those actually present in the field (Lunetta *et al.* 1997, Montgomery and Buffington 1997). Therefore, it is important that 1:24,000 or larger scale maps be used to determine potential channel type and a fine scale (10 m or less) digital elevation model to calculate slopes. Furthermore, slope and channel type should be confirmed in a representative number of reaches by site visits or existing habitat surveys. While the technology exists to develop this information, data at this scale and resolution have only been developed for provinces, not the entire region; and, therefore, could not be used in the current EFH identification process. However, the existing information will be useful in the consultation process.

The delineation of channel types allows identification of potentially important and vulnerable habitats in the absence of accurate salmon distribution or habitat data. Moreover, degraded stream reaches, those lacking key roughness elements (e.g., large woody debris), and stream reaches with a high potential for restoration will still be identified as potential habitat. Therefore, the protection and restoration of coho salmon habitat should focus on pool-riffle, plane bed, and forced-pool-riffle channels. Furthermore, any activity adjacent to or upstream of activity that could influence the quality of these important habitats should be evaluated. Other vulnerable habitats that are in need of protection and restoration are off-channel rearing areas (e.g., wetlands, oxbows, side channels, sloughs), estuaries, and other near-shore marine areas. Submarine canyons and other regions of pronounced upwelling are also thought to be particularly important during El Niño events (N. Bingham, Pacific Coast Federation of Fishermen's Associations, P.O. Box 783, Mendocino, California 95460, pers. comm.) and may need additional consideration for protection. Finally, off-channel areas are particularly important winter habitats for juvenile coho salmon (Cederholm and Scarlett 1981), and one of the primary factors limiting coho salmon smolt production in many areas (Nicholson *et al.* 1992).

2.2.4.9 Freshwater Essential Fish Habitat

Freshwater EFH for coho salmon consists of four major components, (1) spawning and incubation; (2) juvenile rearing; (3) juvenile migration corridors; and (4) adult migration corridors. Important features of essential habitat for spawning, rearing, and migration include adequate (1) substrate composition; (2) water quality (e.g., dissolved oxygen, nutrients, temperature, etc.); (3) water quantity, depth and velocity; (4) channel gradient and stability; (5) food; (6) cover and habitat complexity (e.g., large woody debris, channel complexity, aquatic vegetation, etc.); (7) space; (8) access and passage; and (9) habitat and flood plain connectivity. This incorporates, but is not limited to, life-stage specific habitat criteria summarized in Table A-4.

Coho salmon essential freshwater habitat includes all those streams, lakes, ponds, wetlands, and other water bodies currently viable and most of the habitat historically accessible to coho within Washington, Oregon, and California. Figure A-4 illustrates the watersheds currently utilized by coho from Washington, Oregon, and California within the USGS hydrologic units identified at the end of the chapter for all Council-managed salmon (Table A-6). Figure A-5 depicts the approximate historical freshwater distribution and the currently identified range of common marine occurrence of coho salmon. The geographic extent of the historic freshwater distribution of coho salmon is based on data from Table A-6. Data on the marine range of coho salmon are from NOAA (1990).

2/ See Montgomery and Buffington (1997) for a description of this channel classification system.

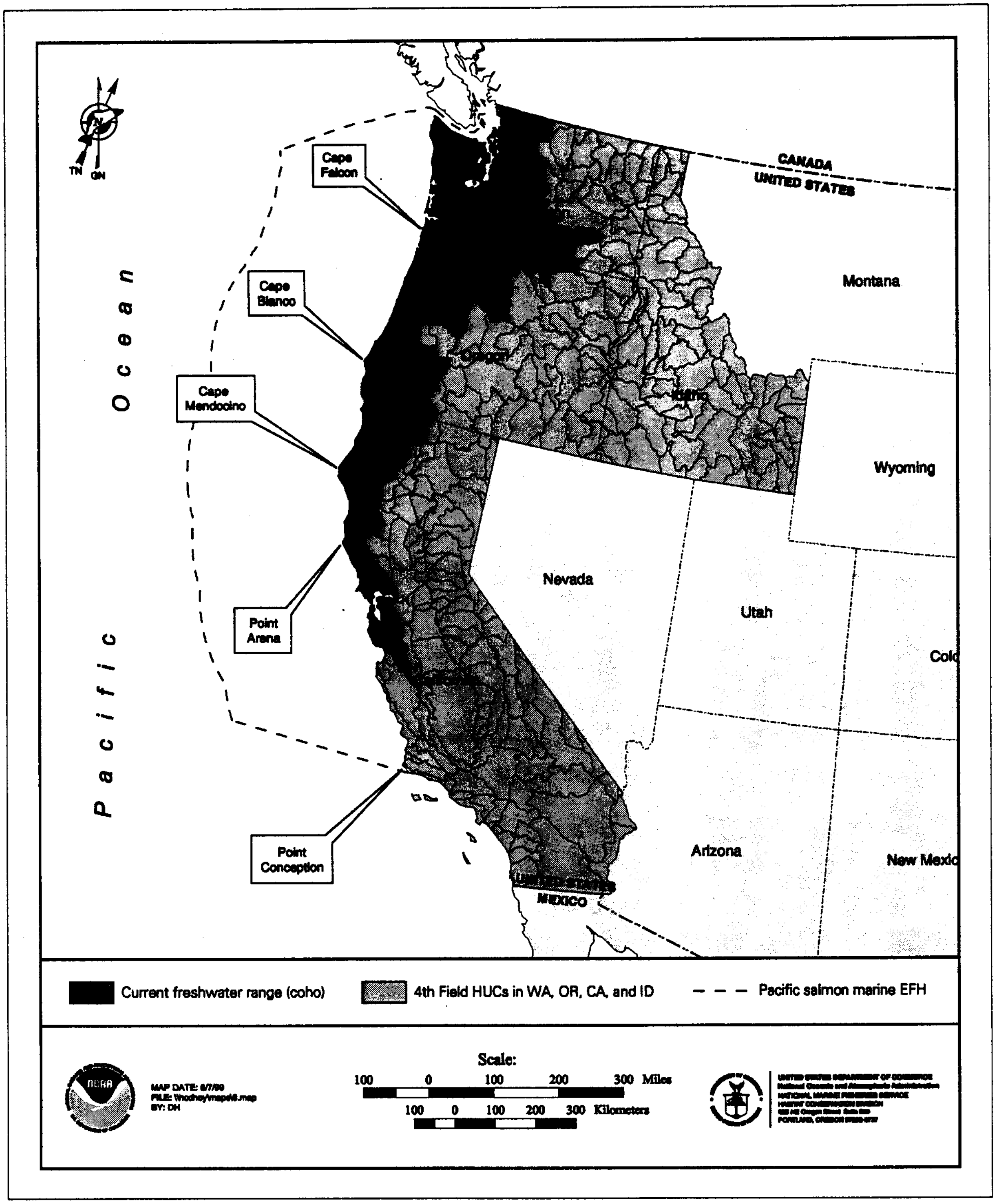

FIGURE A-4. Watersheds currently utilized by coho salmon from Washington, Oregon, and California.

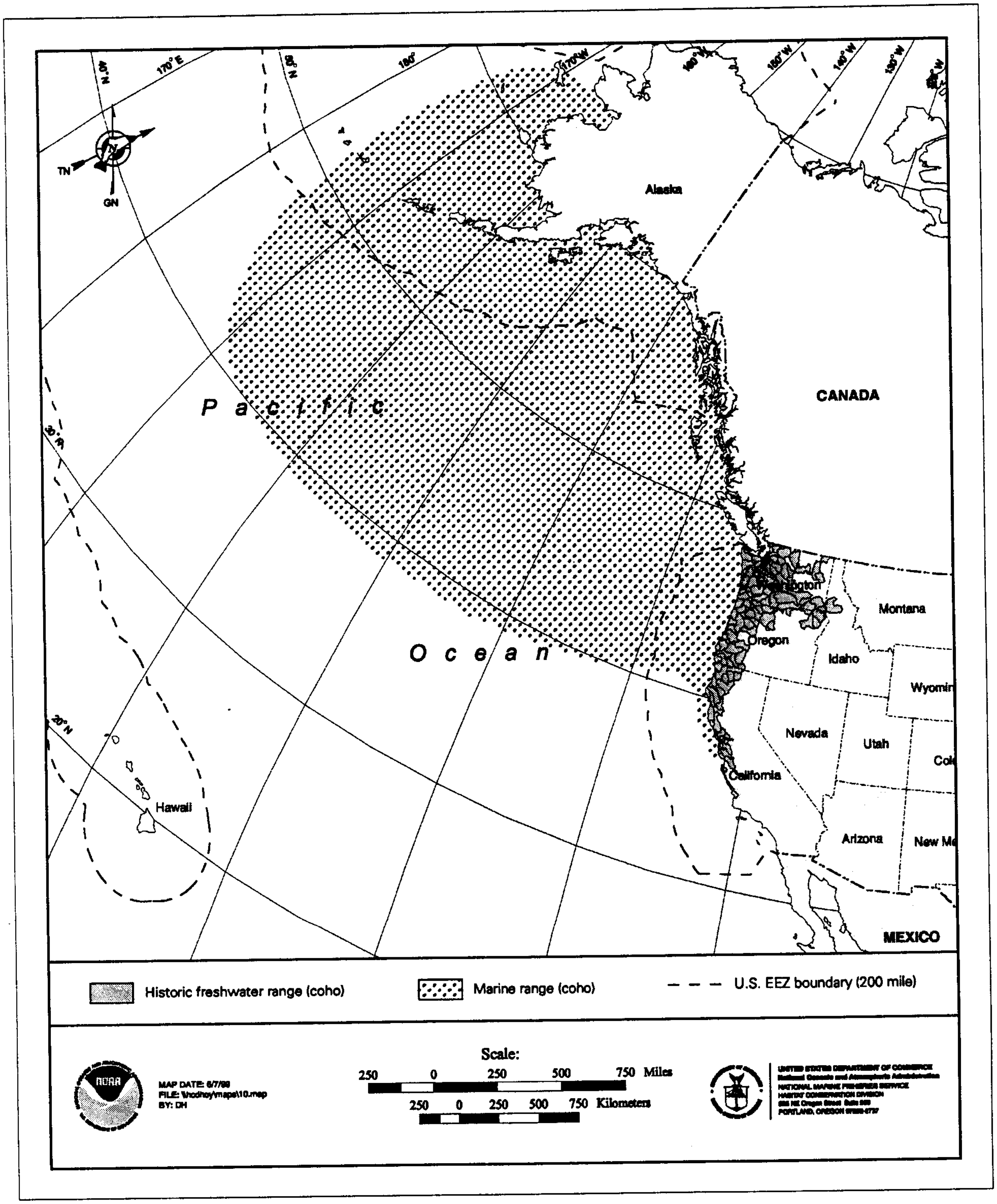

FIGURE A-5. Approximate historically accessible freshwater distribution and currently identified range of common marine occurrence of coho salmon from Washington, Oregon, and California.

The diversity of habitats utilized by coho salmon coupled with the inadequacy of existing species distribution maps makes it extremely difficult to identify all specific stream reaches, wetlands, and water bodies essential for the species at this time. Designating each specific river reach would invariably exclude small important tributaries from designation as EFH. Defining specific river reaches is also complicated, because of the current low abundance of the species and of our imperfect understanding of the species' freshwater distribution, both current and historical. Adopting a more inclusive, watershed-based description of EFH is appropriate because, it (1) recognizes the species' use of diverse habitats and underscores the need to account for all of the habitat types supporting the species' freshwater and estuarine life stages, from small headwater streams to migration corridors and estuarine rearing areas; (2) takes into account the natural variability in habitat quality and use (e.g., some streams may have fish present only in years with plentiful rainfall) that makes precise mapping difficult; and (3) reinforces the important linkage between aquatic areas and adjacent upslope areas. Moreover, this watershed-based approach is consistent with other Pacific salmon habitat protection and recovery efforts such as the ESA, Northwest Forest Plan, and the OCSRI. Therefore, the geographic extent of coho salmon essential habitat was delineated using USGS cataloging units.

2.2.4.10 Marine Essential Fish Habitat

The important elements of coho salmon marine EFH are (1) estuarine rearing; (2) ocean-rearing; and (3) juvenile and adult migration. Important features of this estuarine and marine habitat are (1) adequate water quality; (2) adequate temperature; (3) adequate prey species and forage base (food); and (4) adequate depth, cover, and marine vegetation in estuarine and nearshore habitats. Overall, coho salmon marine distribution is extensive, varies seasonally, interannually, and can only be defined generally (Figure A-5).

Limited information exists on coho salmon habitat use in marine waters. While juvenile and maturing coho are found in the open north Pacific, the highest concentrations appear to be found in more productive waters of the continental shelf, coho have also been encountered in an extensive offshore area as far west as 44° N latitude, 175° W longitude (Sandercock 1991). CWT recoveries of coho salmon from high seas fisheries and tagging programs (Myers *et al.*, 1996; Healey 1991, fig.18) provide evidence that coho salmon utilize offshore areas. Shapalov and Taft (1954) reported coho within 150 km offshore in their study of Waddell Creek coho. Catch data and interviews with commercial fishermen indicate that maturing coho salmon are found in highest concentrations along the continental shelf within 60 km of the Washington, Oregon, and California coast lines. However, determination of a specific or uniform westward boundary within the EEZ which covers the distribution of essential marine habitat is difficult and would contain considerable uncertainty. Therefore, the geographic extent of essential marine habitat for coho salmon includes all marine waters within the EEZ north of Point Conception, California (Figure A-5) and the marine areas off Alaska designated as salmon EFH by the NPFMC.

2.3 ESSENTIAL HABITAT DESCRIPTION FOR PUGET SOUND PINK SALMON (*Oncorhynchus gorbuscha*)

2.3.1 General Distribution and Life History

The following is an overview of pink salmon life history and habitat use as a basis for identifying EFH for pink salmon. Comprehensive reviews of pink salmon life history and habitat requirements can be found in Aro and Shepard (1967), Neave (1966), Heard (1991), Hard *et al.* (1996), and others. This description serves as a general description of pink salmon life history with an emphasis on populations from Puget Sound and the Fraser River.

Pink (or "humpback") salmon are the smallest of the Pacific salmon, averaging just 1.0-2.5 kg at maturity (Scott and Crossman 1973). Adult pink salmon are distinguished from other Pacific salmon by the presence of large dark oval spots on the back and entire caudal fin, and their general coloration and morphology (Scott and Crossman 1973). Maturing males develop a marked hump on their back, which is responsible for their vernacular name "humpback" salmon. Pink salmon are unique among Pacific salmon by exhibiting a nearly invariant two-year life span within their natural range (Gilbert 1912, Davidson 1934, Pritchard 1939, Bilton and Ricker 1965, Turner and Bilton 1968). Upon emergence, pink salmon fry migrate quickly to sea and grow rapidly as they make extensive feeding migrations. After 18 months in the ocean the maturing fish return to freshwater to spawn and die. Pink salmon spawn closer to tidewater than most other Pacific salmon species, generally within 50 km of a river mouth, although some populations may migrate up to 500 km upstream to spawn, and a substantial fraction of other populations may spawn intertidally (Hanavan and Skud 1954, Hunter 1959, Atkinson *et al.* 1967, Aro and Shepard 1967, Helle 1970, WDF *et al.* 1993). Pink salmon often have extremely large spawning populations throughout much of their range, exceeding hundreds of thousands of adult fish in many populations (Takagi *et al.* 1981, Heard 1991, WDF *et al.* 1993).

The natural range of pink salmon includes the Pacific rim of Asia and North America north of approximately 40° N latitude. However, the spawning distribution is more restricted, ranging from 48°N latitude (Puget Sound) to 64°N latitude (Norton Sound, Alaska) in North America and 44° N latitude (North Korea) to 65° N latitude (Anadyr Gulf, Russia) in Asia (Neave *et al.* 1967, Takagi *et al.* 1981). Within this vast area, spawning pink salmon are widely distributed in streams of both continents as far north as the Bering Strait. North, east, and west of the Bering Strait, spawning populations become more irregular and occasional. In marine environments along both the Asian and North American coastlines, pink salmon occupy waters south of the limits of spawning streams. In North America, pink salmon regularly spawn as far south as Puget Sound and the Olympic Peninsula. However, most Washington state spawning occurs in northern Puget Sound (Williams *et al.* 1975, WDF *et al.* 1993). On rare occasions, pink salmon are observed in rivers along the Washington, Oregon, and California coasts, but it is unlikely spawning populations regularly occur south of northwestern Washington (Hubbs 1946, Ayers 1955, Herrmann 1959, Hallock and Fry 1967, Williams *et al.* 1975, Moyle *et al.* 1995, Hard *et al.* 1996).

Because of its fixed two-year life cycle, pink salmon spawning in a particular river system in odd- and even-numbered years are reproductively isolated from each other and exist as genetically distinct lines (Neave 1952; Beacham *et al.* 1988; Gharret *et al.* 1988; Shaklee *et al.* 1991, 1995; Hard *et al.* 1996). In some river systems, such as the Fraser River in British Columbia, the odd-year line dominates; returns to the same systems in even-numbered years are negligible (Vernon 1962, Aro and Shepard 1967). In Bristol Bay, Alaska, the major runs occur in even-numbered years, whereas the coastal area between these two river systems is characterized by runs in both even- and odd-numbered years. In Washington state and southern British Columbia, odd-numbered-year pink salmon are the most abundant (Ellis and Noble 1959, Aro and Shepard 1967, Ricker and Manzer 1974, WDF *et al.* 1993). However, small even-numbered-year populations exist in the Snohomish River in Puget Sound and in several Vancouver Island rivers (Aro and Shepard 1967, Ricker and Manzer 1974, WDF *et al.* 1993).

Pink salmon populations in Alaska are abundant, with historic record catches over the past decade, exceeding 100 million fish statewide in several years (Wertheimer 1997). Farther south, pink salmon populations may not be at record levels, but are generally healthy. For example, recent reviews of the status of pink salmon from Washington and southern British Columbia indicated that, with a few exceptions, odd-year populations in those areas were generally healthy and near historic levels, while even-year populations were small, but stable or increasing (Ricker 1989, Nehlsen *et al.* 1991, Lichatowich 1993, Hard *et al.* 1996). For example, the 1995 run-size estimate of Fraser River odd-year pink salmon was approximately 12 million fish, and that of Puget Sound was 3.4 million fish (PFMC 1998).

2.3.2 Fisheries

Pink salmon are the most abundant Pacific salmon, contributing about 40% by weight and 60% in numbers of all salmon caught commercially in the north Pacific Ocean and adjacent waters (Neave *et al.* 1967). Coastal fisheries for pink salmon presently occur in Asia (Japan and Russia) and North America (Canada and the United States), with major fisheries in Russia, Canada, and the U.S. Historically, some pink salmon were caught in high seas fisheries by Japan and Russia. Most pink salmon in the U.S. are caught in Alaska where major fisheries occur in the Southeast, Prince William Sound, and Kodiak regions; with lesser fisheries in the Cook Inlet, Alaska Peninsula, and Bristol Bay regions (Heard 1991). Catches of pink salmon decrease south of Alaska, with about 10 million fish caught annually in British Columbia, 2-3 million in Washington, and a negligible number in Oregon and California (Heard 1991, PFMC 1999a). Most pink salmon are harvested in the marine environment by purse seines with smaller commercial catches made by set and drift gill net and troll fisheries. Marine recreational fisheries primarily use troll gear. Washington marine pink salmon harvests are predominantly composed of Fraser River-origin fish (Hard *et al.*1996, PFMC 1984). The Pacific Salmon Commission (PSC) manages fisheries for pink salmon in U.S. Convention waters north of 48° N latitude to meet Fraser River natural spawning escapement and U.S./Canada allocation requirements. Fisheries for pink salmon have some bycatch associated with them, primarily other

Pacific salmon species. A complete and current description of ocean fisheries, harvest levels, and management framework can be found in the most recent versions of the annual PFMC *Review of Ocean Salmon Fisheries* and *Preseason Report I* (PFMC 1999a, 1999b).

2.3.3 Relevant Trophic Information

Pink salmon eggs, alevins, and fry in freshwater streams provide an important nutrient input and food source for aquatic invertebrates, other fishes, especially sculpins, birds, and small mammals (Pritchard 1934, Hoar 1958, Hunter 1959, Tagmazyan 1971, Khorevin *et al.* 1981). In the marine environment, pink salmon fry and juveniles are food for a host of other fishes, including other Pacific salmon, and coastal sea birds (Thorsteinson 1962, Parker 1971, Bakshtansky 1980, Karpenko 1982).

Subadult and adult pink salmon are known to be eaten by 15 different marine mammal species, sharks, other fishes such as Pacific halibut, and humpback whales (Fiscus 1980). Because pink salmon are the most abundant salmon in the North Pacific, it is likely they comprise a significant portion of the salmonids eaten by marine mammals.

Pink salmon spawning populations often number in the hundreds of thousands of fish, consequently, their carcasses provide significant nutrient input into many coastal watersheds. Adult pink salmon in streams are major food sources for gulls, eagles, and other birds, along with bear, otter, mink and other mammals, fishes, and aquatic invertebrates (Cederholm *et al.* 1989, Michael 1995, Bilby *et al.* 1996).

2.3.4 Habitat and Biological Associations

Table A-5 summarizes pink salmon habitat use by life history stage.

2.3.4.1 Eggs and Spawning

Pink salmon choose a fairly uniform spawning bed in both small and large streams in Asia and North America. Generally, these spawning beds are situated on riffles with clean gravel, or along the borders between pools and riffles in shallow water with moderate to fast currents (Semko 1954, Heard 1991, Mathisen 1994). In large rivers, they may spawn in discrete sections of main channels or in tributary channels. Pink salmon avoid spawning in deep, quiet water, in pools, in areas with slow current, or over heavily silted or mud-covered streambeds. Places selected for egg deposition is determined primarily by the optimal combination of water depth and velocity. Although intertidal spawning is extensive in some areas of the north Pacific such as Prince William Sound (Hanavan and Skud 1954, Helle 1970), it is not in Washington, Oregon, and California (Williams *et al.* 1975, WDF *et al.* 1993, Hard *et al.* 1996).

On both the Asian and North American sides of the Pacific Ocean, pink salmon generally spawn at depths of 30-100 cm (Dvinin 1952, Hourston and MacKinnon 1956, Graybill 1979, Goloranov 1982). High densities of spawning pink salmon are usually found at depths of 20-25 cm, but occasionally to depths of 100-150 cm. In dry years, on crowded spawning grounds, nests can be found at shallower depths of 10-15 cm. Water velocities in pink salmon spawning grounds vary from 30-100 cm/s, sometimes reaching 140 cm/s (Hourston and MacKinnon 1956, Smirnov 1975, Graybill 1979, Golovanov 1982), but usually average 60-80 cm/s.

In general, pink salmon select sites in gravel where the gradient increases and the currents are relatively fast. In these areas, surface stream water must have permeated sufficiently to provide intragravel flow for dissolved oxygen delivery to eggs and alevins. Pink salmon spawning beds consist primarily of coarse gravel with a few large cobbles, a mixture of sand, and a small amount of silt. Pink salmon are often found spawning in the same river reaches and habitats as chinook salmon. High quality spawning grounds of pink salmon can best be summarized as clean, coarse gravel (Hunter 1959).

Pink salmon have the lowest fecundity of Pacific salmon, averaging 1,200-1,900 eggs per female, and also some of the smallest eggs (Pritchard 1937, Neave 1948, Beacham *et al.* 1988, Beacham and Murray 1993). In Washington and southern British Columbia spawning areas, eggs are deposited from August to October—slightly earlier in northern Puget Sound and the upper Dungeness River than elsewhere in northwestern Washington (WDF *et al.* 1993, Hard *et al.* 1996).

TABLE A-5. Pink salmon habitat use by life stage. (See key to abbreviations and EFH data levels on page A-16.)

Stage - EFH Data Level	Duration or Age	Diet/Prey	Season/Time	Location	Water Column	Bottom Type	Oceanographic Features	Other
Eggs EFH Data Level 0-4; not all habitats have been sampled	90-100 d	Non-feeding stage; eggs consumed by birds, fish and mammals	Late summer, fall, and winter	Intragravel in stream beds	15-50 cm depth in gravel; water depth 10-15 cm	Medium to course gravel	NA	**DO** < 2 mg/l lethal, optimum > 8 mg/l; **Temperature** 0-17°C, optimum 4.4-13.3°C; **Water velocity** 20-140 cm/s
Larvae (alevins) EFH Data Level 0-4; not all habitats have been sampled	100-125 d, fry emerge and migrate quickly from stream	Non-feeding stage; alevins consumed by birds, fish, and mammals	Fall, winter, and early spring	Intragravel until fry emergence	15-50 cm depth in gravel; water depth 10-15 cm	Medium to course gravel	NA	**DO** < 3 mg/l lethal, optimum > 8 mg/l; **Temperature** 0-17°C, optimum 4.4-13.3°C; **Water velocity** 20-140 cm/s
Juveniles EFH Data Level 0-3; not all habitats have been sampled	2 yrs	Copepods, euphausiids, decapod larvae, amphipods, fish squid	Estuary: spring Ocean: year-round	BCH BAY, IP	P, N; migration influenced by currents, salinity, and temperature	All bottom types	Estuarine, littoral then open water; UP, F, CL, E; migration may be influenced by surface currents, salinities and temperatures	**DO** lethal at <2 mg/l, optimum at saturation; **Temperature** 0-26°C, optimum 12-14°C; **Salinity** sea water; School with other salmon and Pacific sandfish
Adults EFH Data Level 0-2; not all habitats have been sampled	2 yrs of age from egg to mature adult	Fish, squid, euphausiids, amphipods, and copepods	Spawning: Aug-Dec	Oceanic to nearshore migrations	P, N	NA	Different regional stock groups have specific oceanic migratory patterns	**DO** lethal at <3 mg/l, optimum at saturation; **Temperature** 0-26°C, optimum <14°C; Migration timing for different regional stock groups varies; earlier in the north, later in the south

Primary sources: NOAA 1990, Bjornn and Rieser 1991, Heard 1991, Spence *et al.* 1996.

2.3.4.2 Larvae/Alevins

Fertilized eggs begin their five- to eight-month period of embryonic development and growth in intragravel interstices (Heard 1991). To survive successfully, the eggs, alevins, and pre-emergent fry must first be protected from freezing, desiccation, stream bed scouring or shifting, mechanical injury, and predators. Water surrounding them must be non-toxic and of sufficient quality and quantity to provide basic requirements of suitable temperatures, adequate supply of oxygen, and removal of waste materials. These requirements are only met partially even under the most favorable natural conditions. Overall, freshwater survival of pink salmon from egg to advanced alevin and emerged fry is frequently 10-20%, but can be as low as 1% (Neave 1953, Hunter 1959, Wickett 1962, Taylor 1983). Some British Columbia artificial spawning channels have achieved egg-to-fry survival as high as 57% (Cooper 1977, MacKinnon 1963).

2.3.4.3 Juveniles (Freshwater)

Newly emerged pink salmon fry are fully capable of osmoregulation in sea water. Schools of pink salmon fry may move quickly from the natal stream area or remain to feed along shorelines up to several weeks. The timing and pattern of seaward dispersal is influenced by many factors, including general size and location of the spawning stream, characteristics of adjacent shoreline and marine basin topography, extent of tidal fluctuations and associated current patterns, physiological and behavioral changes with growth, and possibly different genetic characteristics of individual stocks (Heard 1991).

Pink salmon fry emerge from gravels at a size of 28-35 mm, and begin migrating downstream shortly thereafter. This downstream migration timing varies widely by region and from year to year within regions and individual streams. In Puget Sound and southern British Columbia, fry migrate downstream in March and April, occasionally extending into May.

2.3.4.4 Juveniles (Estuarine and Marine)

The use of estuarine areas by pink salmon varies widely, ranging from passing directly through the estuary en route to nearshore areas to residing in estuaries for one to two months before moving to the ocean (Hoar 1956, McDonald 1960, Vernon 1966, Heard 1991). In general, most pink salmon populations use this former pattern; and, therefore, depend on nearshore, rather than estuarine environments, for their initial rapid growth.

Pink salmon populations that reside in estuaries for extended periods utilize shallow, protected habitats such as tidal channels and consume a variety of prey items, such as larvae and pupae of various insects (especially chironomids), cladocerans, and copepods (Bailey *et al.* 1975, Hiss 1995). Even more estuarine-dependant pink salmon populations have relatively short residence period when compared to fall chinook and chum salmon that use estuaries extensively. For example, while these other species reside in estuaries throughout the summer and early fall, pink salmon are rarely encountered in estuaries beyond June (Hiss 1995).

Immediately after entering marine waters, pink salmon fry form schools, often in tens or hundreds of thousands of fish (McDonald 1960, Vernon 1966, Heard 1991). During this time, they tend to follow shorelines and, at least for the first few weeks at sea, spend much of their time in shallow water of only a few centimeters deep (LeBrasseur and Parker 1964, Healey 1967, Bailey *et al.* 1975, Simenstad *et al.* 1982). It has been suggested that this inshore period involves a distinct ecological life-history stage in pink salmon (Kaczynski *et al.* 1973). In many areas throughout their ranges, pink salmon and chum salmon fry of similar age and size co-mingle in both large and small schools during early sea life (Heard 1991).

Pink salmon juveniles routinely obtain large quantities of food sufficient to sustain rapid growth from a broad range of habitats providing pelagic and epibenthic foods (Parker 1965, Martin 1966, Neave 1966, Healey 1967, Bailey *et al.* 1975). Collectively, diet studies show that pink salmon are both opportunistic and generalized feeders and, on occasion, they specialize in specific prey items. Diel stomachs sampling suggests that juvenile pink salmon are diurnal feeders, foraging primarily at night (Parker and LeBrasseur 1974, Bailey *et al.* 1975, Simenstad *et al.* 1982, Godin 1981). Common prey items include copepods (especially harpacticoids), barnacle nauplii, mysids, amphipods, euphausiids, decapod larvae, insects, larvaceans, eggs of invertebrates and fishes, and fish larvae (Gerke and Kaczynski 1972, Bailey *et al.* 1975, Healey 1980, Simenstad *et al.* 1982, Godin 1981, Takagi *et al.* 1981, Landingham 1982). Growth rates during this period of early marine residence range from 3.5-7% of body weight per day, equivalent to an approximately 1 mm increase in length per day (LeBrasseur and Parker 1964, Phillips and Barraclough 1978, Healey 1980, Karpenko 1987).

At approximately 45-70 mm in length, pink salmon move out of the nearshore environment into deeper, colder waters to begin their ocean migration (Manzer and Shepard 1962, LeBrasseur and Parker 1964, Phillips and Barraclough 1978, Healey 1980). For populations originating from Puget Sound and southern British Columbia rivers, this movement begins in July and lasts through October as fish migrate out of protected, inland waters and northward along the coast towards Alaska (Pritchard and DeLacy 1944, Barraclough and Phillips 1978, Hartt 1980, Healey 1980). After reaching approximately Yakutat in central Alaska, Washington-origin pink salmon move out into the Gulf of Alaska and follow the main current in the gyre, subsequently migrating southward during their first fall and winter in the ocean, then northward the following spring and summer. They then begin their homewards migration, again entering coastal waters as they move south toward their natal streams (Manzer *et al.* 1965, Neave *et al.* 1967, Takagi *et al.* 1981, Ogura 1994). Tagging studies indicate that juvenile and maturing Puget Sound pink salmon are most concentrated in nearshore areas of Vancouver Island and the Hecate Strait extending as far north as approximately 58° N latitude (Yukatat Bay, Alaska), and seaward to approximately 140° W longitude (Myers *et al.* 1996). The southernmost distribution of Puget Sound pink salmon is not clear, but in general the largest concentrations of pink salmon of British Columbia and Washington-origin are found north of 48° N latitude (Hartt and Dell 1986, Myers *et al.* 1996).

Pink salmon from Washington State and British Columbia and those originating in southeastern, central, and southwestern Alaska, occur in marine waters where they might interact in some way with the salmon fisheries off the coast of southeast Alaska. Pink salmon from these regions also co-mingle in the Gulf of Alaska during their second summer at sea while migrating toward natal areas (Manzer *et al.* 1965, Neave *et al.* 1967, Takagi *et al.* 1981).

In contrast to this extended ocean migration, it is believed that some Stillaguamish River and possibly other Puget Sound pink salmon remain within Puget Sound for their entire ocean residence period (Jensen 1956, Hartt and Dell 1986). This tendency to reside in Puget Sound and the Strait of Georgia is commonly exhibited by both coho and chinook salmon, but is unusual for pink salmon. These "resident" fish are much smaller than individuals that migrated to the ocean, reaching only 35-45 cm as adults, some 10 cm shorter than migratory fish from the same area (Hartt and Dell 1986).

In the ocean, pink salmon primarily consume fish, squid, euphausiids, and amphipods, with lesser numbers of pteropods, decapod larvae, and copepods (Allen and Aron 1958, Ito 1964, LeBrasseur 1966, Manzer 1968, Takagi *et al.* 1981). During this phase, most pink salmon are found in the upper-most 12 m of the water column, the actual depth varying with seasonal and diurnal patterns (Manzer and LeBrasseur 1959, Manzer 1964).

2.3.4.5 Adults

Ocean growth of pink salmon is a matter of considerable interest; because, although this species has the shortest life span among Pacific salmon, it also is among the fastest growing (Heard 1991). Entering the estuary as fry at around 30 mm in length, maturing adults return to the same area 14-16 months later ranging in length from 450 to 550 mm. Adults display a latitudinal trend in size, with the largest fish occurring in the southern portion of the range (Heard 1991). Most odd-year Fraser River and Washington fish weigh approximately 2.5 kg, while Washington even-year fish may be slightly smaller at 2.1 kg. By comparison, pink salmon from central and southeast Alaska typically weigh 1.3-1.8 kg (Takagi *et al.* 1981, Heard 1991).

Adult pink salmon enter freshwater between June and September, with northern populations generally entering earlier than southern populations (Neave *et al.* 1967, Takagi *et al.* 1981). Odd-year pink salmon from Puget Sound typically enter freshwater between mid-July and late September, with considerable local variation—the earliest run (Dungeness River) begin entering freshwater in mid-July, while the median return date of the latest-returning runs is October 15 (WDF *et al.* 1993, Hiss 1995). Snohomish River even-year fish enter freshwater three to four weeks earlier than the odd-year run in the same system, even though the two populations use the same habitat (WDF *et al.* 1993).

As with other Pacific salmon, fertilization of pink salmon eggs occurs upon deposition (Heard 1991). Males compete with each other to breed with spawning females. Pink salmon females remain on their redds one to two weeks after spawning, defending the area from superimposition of eggs from another female (McNeil 1962, Ellis 1969, Smirnov 1975).

Measured marine survivals of pink salmon, from entry of fry into stream mouth estuaries to returning adults, have ranged from 0.2% to over 20%. For North America, estimated fry-to-adult survival averages between 1.7% and 4.7% (Pritchard 1948, Parker 1962, Ricker 1964, Ellis 1969, McNeil 1980, Taylor 1980, Vallion *et al.* 1981, Blackbourn 1990). Generally, much of the natural mortality of pink salmon in the marine environment occurs within the first few months before advanced juveniles move offshore into more pelagic ocean waters (Parker 1965, 1968). Pink salmon populations can be very resilient, rebounding from weak to strong run strength in regional stock groups within one or two generations. Conversely, strong runs may also become weak within several generations, causing pink salmon populations to exhibit high natural variability (Neave 1962, Ricker 1962).

2.3.4.6 Databases on Distribution/Habitat Areas of Particular Concern

Annual spawner survey data are available for most streams in the Puget Sound basin utilized by pink salmon. Furthermore, WDF *et al.* (1993) and Williams *et al.* (1975) provide information on streams and stream reaches most utilized for pink salmon spawning. Because pink salmon enter freshwater primarily to spawn and juveniles spend little to no time in freshwater, adequate spawning habitat is critical to sustaining productive pink salmon populations. Therefore, it is important that pink salmon spawning areas and estuarine rearing areas receive adequate protection.

2.3.4.7 Freshwater Essential Fish Habitat

Freshwater EFH for Puget Sound pink salmon consists of four major components, (1) spawning and incubation; (2) juvenile rearing; (3) juvenile migration corridors; and (4) adult migration corridors. Important features of essential habitat for spawning, rearing, and migration include adequate, (1) substrate composition; (2) water quality (e.g., dissolved oxygen, nutrients, temperature, etc.); (3) water quantity, depth, and velocity; (4) channel gradient and stability; (5) food; (6) cover and habitat complexity (e.g., large woody debris, channel complexity, etc.); (7) space; (8) access and passage; and (9) habitat and flood plain connectivity. This incorporates, but is not limited to, life-stage specific habitat criteria summarized in Table A-5. Pink salmon essential freshwater habitat includes all those streams, lakes, ponds, wetlands, and other water bodies currently viable and most of the habitat historically accessible to pink salmon within Washington. Figure A-6 illustrates the watersheds currently utilized by Puget Sound pink salmon within the USGS hydrologic units identified in Table A-6. Figure A-7 depicts the approximate historical freshwater distribution and currently identified range of common marine occurrence of Puget Sound pink salmon. The geographic extent of these pink salmon is based on data from Table A-6. Data on the marine range of Puget Sound pink salmon is from NOAA (1990).

The inadequacy of existing species distribution maps makes it extremely difficult to identify all specific stream reaches essential for the species at this time. Designating each specific river reach would invariably exclude small, important tributaries from designation as EFH. Adopting a more inclusive, watershed-based description of EFH is appropriate, because it (1) recognizes the species' use of diverse habitats and underscores the need to account for all of the habitat types supporting the species' freshwater and estuarine life stages, from small headwater streams to migration corridors and estuarine rearing areas; (2) takes into account the natural variability in habitat quality and habitat use (e.g., some streams may have fish present only in years with plentiful rainfall) that makes precise mapping difficult; and (3) reinforces the important linkage between aquatic and adjacent upslope areas. Moreover, this watershed-based approach is consistent with other Pacific salmon habitat protection and recovery efforts such as the ESA, Northwest Forest Plan, and the OCSRI. Therefore, the geographic extent of Puget Sound pink salmon essential habitat was delineated using USGS cataloging unit boundaries.

2.3.4.8 Marine Essential Habitat

The important elements of pink salmon marine EFH are (1) estuarine rearing; (2) early ocean rearing; and (3) juvenile and adult migration. Important features of this estuarine and marine habitat are (1) adequate water quality; (2) adequate temperature; (3) adequate prey species and forage base (food); and (4) adequate depth, cover, and marine vegetation in estuarine and nearshore habitats. Overall pink salmon marine distribution is extensive, varies seasonally, interannually, and can only be defined generally (Figure A-7). Estuarine and nearshore areas such as Puget Sound and other inland marine waters of Washington State and British Columbia are critical to the early marine survival of pink salmon. Therefore, essential marine habitat for Puget Sound pink salmon includes all nearshore marine waters north and east of Cape Flattery, Washington, including Puget Sound, the Strait of Juan de Fuca and Strait of Georgia. It is difficult to determine a western limit for pink salmon essential marine habitat, because of limited information on their ocean distribution, but it is clear that the vast majority are found in Canadian, Alaskan, and international waters both within and outside the EEZ north of Cape Flattery, Washington (Figure A-7).

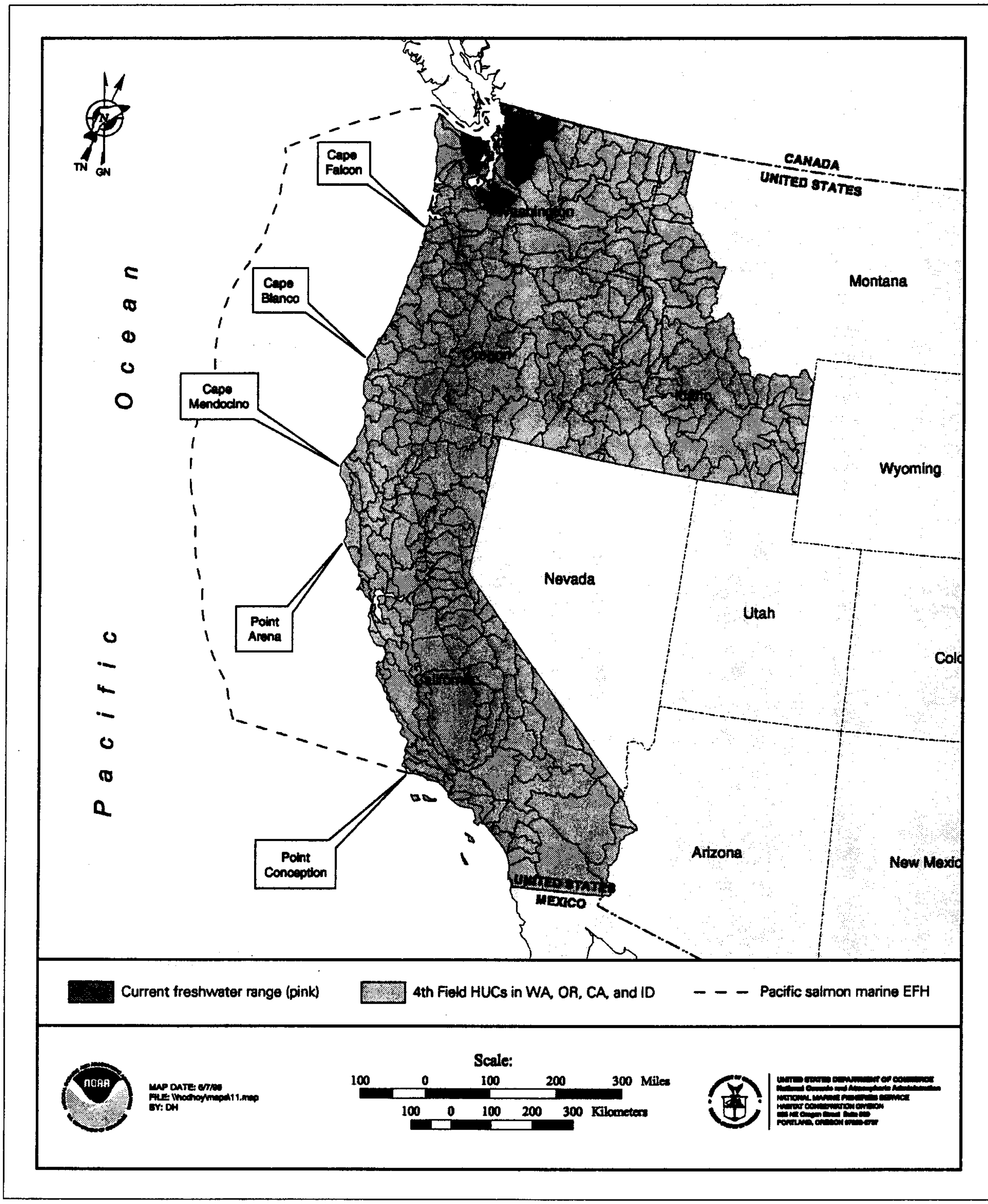

FIGURE A-6. Watersheds currently utilized by pink salmon from Washington.

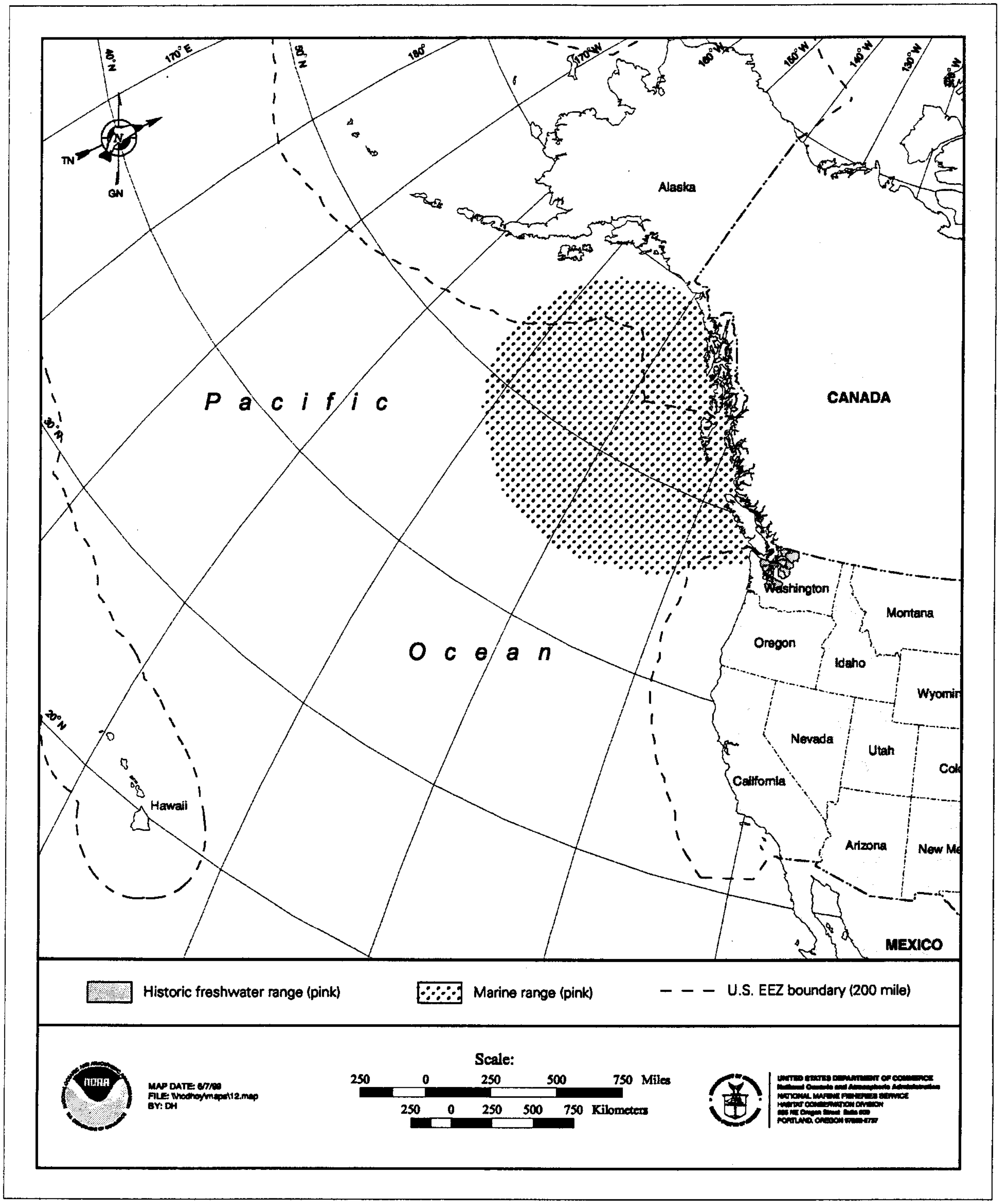

FIGURE A-7. Approximate historically accessible freshwater distribution, and currently identified range of common marine occurrence of Puget Sound pink salmon.

2.4 USGS HYDROLOGIC UNITS UTILIZED BY PACIFIC SALMON AND ADDITIONAL SOURCES OF SALMON DISTRIBUTION INFORMATION

A listing of the USGS hydrologic units utilized by salmon is provided in Table A-6. This information was used as a basis for the current and historic geographic distribution of salmon in freshwater habitat. Table A-7 provides a summary of additional sources of salmon distribution information utilized for this appendix.

TABLE A-6. Current and historic salmon distribution as defined by USGS hydrologic units. Superscripted numbers indicate salmon species present: 1=Chinook, 2=Coho, and 3=Puget Sound Pink. Unit # designates USGS Hydrological Unit Code. C/H indicates whether salmon distribution is current habitat (C), inaccessible historic (H), or currently accessible, but unutilized historic habitat (H*). (Page 1 of 7)

Unit #	State(s)	Hydrologic Unit Name	C/H	Documentation
17110001	WA/BC	Fraser/Whatcom	C^{2}	WDF *et al.* 1993
17110002	WA	Strait of Georgia	$C^{1,2,3}$	WDF *et al.* 1993
17110003	WA	San Juan Islands	C^{2}	WDF *et al.* 1993
17110004	WA	Nooksack R.	$C^{1,2,3}$	WDF *et al.* 1993
17110005	WA	Upper Skagit	$C^{1,2,3}$	WDF *et al.* 1993
17110006	WA	Sauk R.	$C^{1,2,3}$	WDF *et al.* 1993
17110007	WA	Lower Skagit R.	$C^{1,2,3}$	WDF *et al.* 1993
17110008	WA	Stillaguamish R.	$C^{1,2,3}$	WDF *et al.* 1993
17110009	WA	Skykomish R.	$C^{1,2,3}$	WDF *et al.* 1993
17110010	WA	Snoqualmie R.	$C^{1,2,3}$	WDF *et al.* 1993
17110011	WA	Snohomish R.	$C^{1,2,3}$	WDF *et al.* 1993
17110012	WA	Lake Washington	$C^{1,2}$	WDF *et al.* 1993
17110013	WA	Duwamish R.	$C^{1,2}$	WDF *et al.* 1993
17110014	WA	Puyallup R.	$C^{1,2,3}$	WDF *et al.* 1993
17110015	WA	Nisqually R.	$C^{1,2,3}$	WDF *et al.* 1993
17110016	WA	Deschutes R.	$C^{1,2}$	WDF *et al.* 1993
17110017	WA	Skokomish R.	$C^{1,2}$	WDF *et al.* 1993
17110018	WA	Hood Canal	$C^{1,2,3}$	WDF *et al.* 1993
17110019	WA	Puget Sound	$C^{1,2}$	WDF *et al.* 1993
17110020	WA	Dungeness - Elwha	$C^{1,2,3}$	WDF *et al.* 1993
17110021	WA	Crescent - Hoko	$C^{1,2}$	WDF *et al.* 1993
17100101	WA	Hoh - Quillayute	$C^{1,2}$	WDF *et al.* 1993
17100102	WA	Queets - Quinault	$C^{1,2}$	WDF *et al.* 1993
17100103	WA	U. Chehalis R.	$C^{1,2}$	WDF *et al.* 1993
17100104	WA	L. Chehalis R.	$C^{1,2}$	WDF *et al.* 1993
17100105	WA	Grays Harbor	$C^{1,2}$	WDF *et al.* 1993
17100106	WA	Willapa Bay	$C^{1,2}$	WDF *et al.* 1993
17080001	OR/WA	L. Columbia - Sandy	$C^{1,2}$	Fulton 1968[1], 1970[2]; WDF *et al.* 1993[1,2]; Oregon Department of Fish and Wildlife (ODFW) 1996[2]
17080002	WA	Lewis R.	$C^{1,2}$	Fulton 1968[1], 1970[2]; WDF *et al.* 1993[1,2]
17080003	OR/WA	L. Columbia-Clatskanie	$C^{1,2}$	Fulton 1968[1], 19702; WDF *et al.* 1993[1,2]; ODFW 1996[2]
17080004	WA	Upper Cowlitz R.	$C^{1,2}$	Fulton 1968[1], 1970[2]; WDF *et al.* 1993[1,2]
17080005	WA	Lower Cowlitz R.	$C^{1,2}$	Fulton 1968[1], 1970[2]; WDF *et al.* 1993[1,2]

TABLE A-6. Current and historic salmon distribution as defined by USGS hydrologic units. Superscripted numbers indicate salmon species present: 1=Chinook, 2=Coho, and 3=Puget Sound Pink. Unit # designates USGS Hydrological Unit Code. C/H indicates whether salmon distribution is current habitat (C), inaccessible historic (H), or currently accessible, but unutilized historic habitat (H*). (Page 2 of 7)

Unit #	State(s)	Hydrologic Unit Name	C/H	Documentation
17080006	OR/WA	L. Columbia	$C^{1,2}$	Fulton 1968[1], WDF *et al.* 1993[1,2], ODFW 1996[2]
17090001	OR	M.F. Willamette R.	C^{1}	Fulton 1968
17090002	OR	Coast F. Willamette R.	H^{1}	Fulton 1968, ODFW 1996
17090003	OR	U. Willamette R.	$C^{1,2}$	Fulton 19681, BPA 1994[2], ODFW 1996[1]
17090004	OR	McKenzie R.	$C^{1,2}$	Fulton 1968[1], BPA 1994[2]
17090005	OR	North Santiam R.	$C^{1,2}$	Fulton 1968[1],BPA 1994[2], ODFW 1996[1],
17090006	OR	South Santiam R.	$C^{1,2}$	Fulton 1968[1], BPA 1994[2]
17090007	OR	Mid. Willamette R.	$C^{1,2}$	Fulton 1968[1], BPA 1994[2], ODFW 1996[1]
17090008	OR	Yamhill R.	C^{2}, H^{*1}	Parkhurst *et al.* 1950[1,2], BPA 1994[2]
17090009	OR	Mollala-Pudding	$C^{1,2}$	Fulton 1968[1], Parkhurst *et al.* 1950[2], BPA 1994[2], ODFW 1996[1]
17090010	OR	Tualatin R.	C^{2}, H^{*1}	Parkhurst *et al.* 1950[1], BPA 1994[2]
17090011	OR	Clackamas R.	$C^{1,2}$	Fulton 1968[1], BPA 1994[2], ODFW 1996[1]
17090012	OR	L. Willamette R.	$C^{1,2}$	Fulton 1968[1],BPA 1994[2], ODFW 1996[1]
17070101	OR/WA	M. Columbia-L. Wallula	$C^{1,2}$	Fulton 1968 [1], Fulton 1970[2]
17070102	OR/WA	Walla Walla R.	$H^{*1,2}$	Fulton 1968 [1], Fulton 1970[2]
17070103	OR	Umatilla R.	H^{*1}	Fulton 1968
17070104	OR	Willow	H^{1}	NMFS 1998
17070105	OR/WA	Mid. Columbia-Hood	$C^{1,2}$	Fulton 1968[1], 1970[2]; WDF *et al.* 1993[2], ODFW 1996[2]
17070106	WA	Klickitat R.	$C^{1,2}$	Fulton 1968[1], 1970[2]
17070301	OR	Upper Deschutes R.	H^{1}	Nielson 1950, Fulton 1968, Nehlson 1995
17070303	OR	Beaver - South Fork	H^{1}	Fulton 1968, Nehlson 1995, ODFW 1996
17070304	OR	Upper Crooked R.	H^{1}	Nielson 1950, Fulton 1968, Nehlson 1995
17070305	OR	Lower Crooked R.	H^{1}	Nielson 1950, Fulton 1968, Nehlson 1995
17070306	OR	Lower Deschutes R.	$C^{1,2}$	Nielson 1950[1], Fulton 1968[1], 1970[2]; BPA 1994[2]
17070307	OR	Trout Creek	C^{2}, H^{*1}	Nielson 1950[1], BPA 1994[2]
17070201	OR	Upper John Day R.	C^{1}	Nielson 1950, Fulton 1968
17070202	OR	N.F. John Day R.	C^{1}	Nielson 1950, Fulton 1968
17070203	OR	Middle F. John Day R.	C^{1}	Nielson 1950, Fulton 1968
17070204	OR	Lower John Day R.	C^{1}	Nielson 1950, Fulton 1968
17030001	WA	Upper Yakima R.	$C^{1,2}$	Fulton 1968, WDF *et al.* 19932
17030002	WA	Naches R.	$C^{1,2}$	Fulton 1968, WDF *et al.* 19932
17030003	WA	Lower Yakima R.	$C^{1,2}$	Fulton 1968, WDF *et al.* 19932
17020005	WA	Chief Joseph	C^{1}, H^{*2}	Fulton 1968[1], Bryant and Parkhurst 1950[2], WDF *et al.* 1993[1]
17020006	WA/BC	Okanogan R.	C^{1}	Fulton 1968, WDF *et al.* 1993
17020007	WA/BC	Similkameen	H^{1}	Fulton 1968, WDF *et al.* 1993
17020008	WA	Methow R.	C^{1}, H^{*2}	Fulton 1968[1], Bryant and Parkhurst 1950[2] WDF *et al.* 1993[1]

TABLE A-6. Current and historic salmon distribution as defined by USGS hydrologic units. Superscripted numbers indicate salmon species present: 1=Chinook, 2=Coho, and 3=Puget Sound Pink. Unit # designates USGS Hydrological Unit Code. C/H indicates whether salmon distribution is current habitat (C), inaccessible historic (H), or currently accessible, but unutilized historic habitat (H*). (Page 3 of 7)

Unit #	State(s)	Hydrologic Unit Name	C/H	Documentation
17020010	WA	Upper Columbia-Entiat	C^{1},H^{2}	Fulton 1968^{1}, Fulton 1970^{2}, WDF *et al.* 1993^{1}, Bryant and Parkhurst 1950^{2}, BPA 1994^{2}
17020011	WA	Wenatchee R.	$C^{1,2}$	Fulton 1968^{1}, Bryant and Parkhurst 1950^{2}, WDF *et al.* 1993^{1}, BPA 1994^{2}
17020016	WA	U. Colum.-Priest Rapids	$C^{1,2}$	Fulton 1968^{1}, 1970^{2}; WDF *et al.* 1993^{1}
17020001	WA/BC	F. D. Roosevelt Lake	$H^{1,2}$	Bryant and Parkhusrt 1950^{1,2}, Fulton 1968^{1}
17020002	WA/BC	Kettle R.	H^{1}	Bryant and Parkhusrt 1950, Fulton 1968
17020003	WA	Colville R.	H^{1}	Bryant and Parkhusrt 1950, Fulton 1968
17020004	WA	Sanpoil R.	H^{1}	Bryant and Parkhusrt 1950, Fulton 1968
17010307	WA	Lower Spokane R.	$H^{1,2}$	Bryant and Parkhusrt 1950^{1,2}, Fulton 1968^{1}, Fulton 1970^{2}
17010216	WA/BC	Pend Oreille R.	H^{1}	Bryant and Parkhurst 1950, Fulton 1968
17060101	OR/ID	Hells Canyon	C^{1}	Fulton 1968, Mathews and Waples 1991
17060102	OR	Imnaha R.	C^{1}	Fulton 1968, Mathews and Waples 1991, ODFW 1996
17060103	OR/WA/ID	Lower Snake - Asotin	$H^{*1,2}$	Parkhurst 1950^{2}, Mathews and Waples 1991^{1}
17060104	OR	Upper Grande Ronde	C^{1}, H^{*2}	Parkhurst 1950^{2}, Fulton *et al.* 1969^{1}, Mathews and Waples 1991^{1}
17060105	OR	Wallowa R.	C^{1}, H^{*2}	Parkhurst 1950^{2}, Fulton 1968^{1}, Mathews and Waples 1991^{1}
17060106	OR/WA	Lower Grande Ronde	C^{1}, H^{*2}	Parkhurst 1950^{2}, Mathews and Waples 1991^{1}, ODFW 1996^{1}
17060107	WA	L. Snake/Tucannon R.	C^{1}, H^{*2}	Parkhurst 1950^{2}, WDF *et al.* 1993^{1}
17060110	WA	Lower Snake R.	C^{1}, H^{*2}	Parkhurst 1950^{2}, Mathews and Waples 1991, ODFW 1996^{1}
17060201	ID	U. Salmon R.	C^{1}	Fulton 1968, Mathews and Waples 1991
17060202	ID	Pahsimeroi R.	C^{1}	Fulton 1968, Mathews and Waples 1991
17060203	ID	M. Salmon - Panther	C^{1}	Fulton 1968, Mathews and Waples 1991
17060204	ID	Lemhi R.	C^{1}	Fulton 1968, Mathews and Waples 1991
17060205	ID	Upper M.F. Salmon	C^{1}	Fulton 1968, Mathews and Waples 1991
17060206	ID	Lower M.F. Salmon	C^{1}	Fulton 1968, Mathews and Waples 1991
17060207	ID	M. Salmon-Chamberlain	C^{1}	Fulton 1968, Mathews and Waples 1991
17060208	ID	S.F. Salmon R.	C^{1}	Fulton 1968, Mathews and Waples 1991
17060209	ID	Lower Salmon R.	C^{1}	Fulton 1968, Mathews and Waples 1991
17060210	ID	Little Salmon R.	C^{1}	Fulton 1968, Waples *et al.* 1991
17060301	ID	Upper Selway R.	C^{1}	Fulton 1968, Mathews and Waples 1991
17060302	ID	Lower Selway R.	C^{1}	Fulton 1968, Mathews and Waples 1991
17060303	ID	Lochsa R.	C^{1}	Fulton 1968, Mathews and Waples 1991
17060304	ID	M.F. Clearwater R.	C^{1}	Fulton 1968
17060305	ID	S.F. Clearwater R.	C^{1}	Fulton 1968
17060306	WA/ID	Clearwater	C^{1}, H^{*2}	Parkhurst 1950^{2}, Fulton 1968^{1}

TABLE A-6. Current and historic salmon distribution as defined by USGS hydrologic units. Superscripted numbers indicate salmon species present: 1=Chinook, 2=Coho, and 3=Puget Sound Pink. Unit # designates USGS Hydrological Unit Code. C/H indicates whether salmon distribution is current habitat (C), inaccessible historic (H), or currently accessible, but unutilized historic habitat (H*). (Page 4 of 7)

Unit #	State(s)	Hydrologic Unit Name	C/H	Documentation
17060307	ID	Upper N.F. Clearwater	H[1]	Fulton 1968, Mathews and Waples 1991
17060308	ID	Lower N.F. Clearwater	H[1]	Fulton 1968, Mathews and Waples 1991
17050201	OR/ID	Brownlee Reservoir	H[1]	Fulton 1968, Mathews and Waples 1991
17050202	OR	Burnt R.	H[1]	Fulton 1968
17050203	OR	Powder R.	H[1]	Fulton 1968
17050101	ID	C.J. Strike Resevoir	H[1]	Fulton 1968, Mathews and Waples 1991
17050102	ID/NV	Bruneau R.	H[1]	Fulton 1968
17050103	ID	Middle Snake - Succor	H[1]	Fulton 1968, Mathews and Waples 1991
17050104	ID	Upper Owyhee	H[1]	Fulton 1968
17050105	ID/NV/OR	S.F. Owyhee R.	H[1]	Fulton 1968
17050106	ID/NV/OR	E. Little Owyhee R.	H[1]	Fulton 1968
17050107	ID/OR	Middle Owyhee R.	H[1]	Fulton 1968
17050108	ID/OR	Jordan Cr.	H[1]	Fulton 1968
17050109	OR	Crooked - Rattlesnake	H[1]	Fulton 1968
17050110	OR	Lower Owyhee R.	H[1]	Fulton 1968
17050111	ID	North and M.F Boise R.	H[1]	Fulton 1968
17050112	ID	Boise - Mores	H[1]	Fulton 1968
17050113	ID	S.F. Boise R.	H[1]	Fulton 1968
17050114	ID	Lower Boise R.	H[1]	Fulton 1968
17050115	ID/OR	Middle Snake - Payette	H[1]	Fulton 1968, Mathews and Waples 1991
17050116	OR	Upper Malheur R.	H[1]	Fulton 1968
17050117	OR	Lower Malheur R.	H[1]	Fulton 1968
17050118	OR	Bully Cr.	H[1]	Fulton 1968
17050119	OR	Willow Cr.	H[1]	Fulton 1968
17050120	ID	S.F Payette R.	H[1]	Fulton 1968
17050121	ID	M.F. Payette R.	H[1]	Fulton 1968
17050122	ID	Payette R.	H[1]	Fulton 1968
17050123	ID	N.F. Payette R.	H[1]	Fulton 1968
17050124	ID	Weiser R.	H[1]	Fulton 1968
17040212	ID	U. Snake - Rock	H[1]	Fulton 1968, Mathews and Waples 1991
17040213	ID/NV	Salmon Falls	H[1]	Fulton 1968, Mathews and Waples 1991
17100201	OR	Necanicum R.	C[1,2]	ORIS 1994[1,2], ODFW 1996[2]
17100202	OR	Nehalem R.	C[1,2]	ORIS 1994[1,2], ODFW 1996[1,2]
17100203	OR	Wilson-Trask-Nestuccu	C[1,2]	ORIS 1994[1,2], ODFW 1996[1,2]
17100204	OR	Siletz-Yaquina R.	C[1,2]	ORIS 1994[1,2], ODFW 1996[1,2]
17100205	OR	Alsea R.	C[1,2]	ORIS 1994[1,2], ODFW 1996[1,2]
17100206	OR	Siuslaw R.	C[1,2]	ORIS 1994[1,2], ODFW 1996[1,2]
17100207	OR	Siltcoos R.	C[1,2]	ORIS 1994[1,2], ODFW 1996[1,2]
17100301	OR	N. Umpqua R.	C[1,2]	ORIS 1994[1,2], ODFW 1996[1,2]

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Unit #	State(s)	Hydrologic Unit Name	C/H	Documentation
17100302	OR	S. Umpqua R.	C[1,2]	ORIS 1994[1,2], ODFW 1996[1,2]
17100303	OR	Umpqua R.	C[1,2]	ORIS 1994[1,2], ODFW 1996[1,2]
17100304	OR	Coos R.	C[1,2]	ORIS 1994[1,2], ODFW 1996[1,2]
17100305	OR	Coquille R.	C[1,2]	ORIS 1994[1,2], ODFW 1996[1,2]
17100306	OR	Sixes R.	C[1,2]	ORIS 1994[1,2], ODFW 1996[1,2]
17100307	OR	Upper Rogue R.	C[1,2]	ORIS 1994[1,2], ODFW 1996[1,2]
17100308	OR	Middle Rogue R.	C[1,2]	ORIS 1994[1,2], ODFW 1996[1,2]
17100309	CA/OR	Applegate R.	C[1,2]	ORIS 1994[1,2], ODFW 1996[1,2]
17100310	OR	Lower Rogue R.	C[1,2]	ORIS 1994[1,2], ODFW 1996[1,2]
17100311	CA/OR	Illinois R.	C[1,2]	ORIS 1994[1,2], ODFW 1996[1,2]
17100312	CA/OR	Chetco R.	C[1,2]	ORIS 1994[1,2], ODFW 1996[1,2]
18010101	CA/OR	Smith R.	C[1,2]	Nehlsen *et al.*1991[1], Klamath River Basin Fisheries Task Force (KRBFTF) 1991[1], Brown and Moyle 1991[2]
18010201	OR	Williamson R.	H[1]	KRBFT 1991, Nehlson *et al.* 1991
18010202	OR	Sprague R.	H[1]	KRBFT 1991, Nehlson *et al.* 1991
18010203	OR	Upper Klamath Lake	H[1]	KRBFT 1991, Nehlson *et al.* 1991
18010206	CA/OR	Upper Klamath R.	C[1,2]	KRBFT 1991[1], Brown and Moyle 1991[2]
18010207	CA	Shasta R.	C[1,2]	Nehlsen *et al.* 1991[1], KRBFT 1991, Brown and Moyle 1991[2]
18010208	CA	Scott R.	C[1,2]	KRBFT 1991[1], Brown and Moyle 1991[2]
18010209	CA/OR	Lower Klamath R.	C[1,2]	KRBFT 1991[1], Brown and Moyle 1991[2]
18010210	CA	Salmon R.	C[1,2]	KRBFT 1991[1], Brown and Moyle 1991[2]
18010211	CA	Trinity R.	C[1,2]	KRBFT 1991[1], Brown and Moyle 1991[2]
18010212	CA	S.F. Trinity R.	C[1,2]	KRBFT 1991[1], California Department of Fish and Game (CDFG) 1998[2]
18010102	CA	Mad-Redwood	C[1,2]	Higgins *et al.* 1992[1,2]
18010103	CA	Upper Eel R.	C[1,2]	Brown and Moyle 1991[2], Higgins *et al.* 1992[1]
18010104	CA	Middle Fork Eel R.	C[1,2]	Brown and Moyle 1991[2], Higgins *et al.* 1992[1]
18010105	CA	Lower Eel R. R.	C[1,2]	Brown and Moyle 1991[2], Nehlsen *et al.* 1991[1], Higgins *et al.* 1992[1,2]
18010106	CA	South Fork Eel R.	C[1,2]	Brown and Moyle 1991[2], Nehlsen *et al.* 1991[1], Higgins *et al.* 1992[1,2]
18010107	CA	Mattole R.	C[1,2]	Nehlsen *et al.* 1991[1], Brown and Moyle 1991[2], Higgins *et al.* 1992[2]
18010108	CA	Big - Navarro - Garcia	C[2], H*[1]	Brown and Moyle 1991[2], Higgins *et al.* 1992[2], Maahs and Gilleard 1994[1]
18010109	CA	Gualala - Salmon R.	C[2], H*[1]	Brown and Moyle 1991[2], Nehlsen *et al.* 1991[1], Higgins *et al.* 1992[2]
18010110	CA	Russian R.	C[1,2]	Nehlsen *et al.* 1991[1], Brown and Moyle 1991[2]
18010111	CA	Bodega Bay	C[2], H*[1]	Nehlsen *et al.* 1991[1], Brown and Moyle 1991[2]
18050001	CA	Suisun Bay	C[1,2]	Clark 1929[1], Evermann and Clark 1931[1], Brown and Moyle 1991[2]

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Unit #	State(s)	Hydrologic Unit Name	C/H	Documentation
18050002	CA	San Pablo Bay	C[1,2]	Clark 1929[1], Evermann and Clark 1931[1], Brown and Moyle 1991[2]
18050003	CA	Coyote	C[1,2]	Clark 1929[1], Evermann and Clark 1931[1], Brown and Moyle 1991[2], NMFS 1998[1]
18050004	CA	San Francisco Bay	C[1,2]	Clark 1929[1], Evermann and Clark 1931[1], Brown and Moyle 1991[2], NMFS 1998[1]
18020001	CA, OR	Goose Lake	H[1]	Clark 1929, Evermann and Clark 1931
18020003	CA	Lower Pit R.	H[1]	Clark 1929, Yoshiyama *et al.* 1996
18020004	CA	McCloud R.	H[1]	Clark 1929, Yoshiyama *et al.* 1996
1802005	CA	Sacramento Headwaters	H[1]	Clark 1929, Yoshiyama *et al.* 1996
18020101	CA	Sac. L. - Cow L. Clear	C[1]	Clark 1929, Evermann and Clark 1931
18020102	CA	Lower Cottonwood Cr.	C[1]	Clark 1929, Hanson *et al.* 1940
18020103	CA	Sac.-Lower Thomes	C[1]	Clark 1929, Evermann and Clark 1931
18020104	CA	Sac.-Stone Corral	C[1]	Clark 1929, Evermann and Clark 1931
18020105	CA	Lower Butte	C[1]	Clark 1929, Yoshiyama *et al.* 1996
18020106	CA	Lower Feather R.	C[1]	Clark 1929, Yoshiyama *et al.* 1996
18020107	CA	Lower Yuba R.	C[1]	Clark 1929, Nehlsen *et al.* 1991
18020108	CA	Lower Bear R.	C[1]	Clark 1929, Hanson *et al.* 1940
18020109	CA	Lower Sacramento R.	C[1]	Clark 1929
18020110	CA	L. Cache Creek	H[1]	Yoshiyama *et al.* 1996
18020111	CA	Lower American R.	C[1]	Clark 1929, Yoshiyama *et al.* 1996
18020112	CA	Sac.-Upper Clear	C[1]	Clark 1929, Yoshiyama *et al.* 1996
18020113	CA	Cottonwood Headwaters	C[1]	Clark 1929, Hanson *et al.* 1940, Yoshiyama *et al.* 1996
18020114	CA	U. Elder- U. Thomes	H[1]	Yoshiyama *et al.* 1996
18020115	CA	Upper Stony Creek	H[1]	Yoshiyama *et al.* 1996
18020118	CA	Upper Cow-Battle	C[1]	Clark 1929, Yoshiyama *et al.* 1996
18020119	CA	Mill-Big Chico	C[1]	Clark 1929, Yoshiyama *et al.* 1996
18020120	CA	Upper Butte Cr.	C[1]	Clark 1929, Yoshiyama *et al.* 1996
18020121	CA	N.F. Feather R.	H[1]	Clark 1929, Hanson *et al.* 1940
18020122	CA	E. Branch N.F. Feather	H[1]	Clark 1929, Hanson *et al.* 1940
18020123	CA	M.F. Feather R.	H[1]	Clark 1929, Hanson *et al.* 1940
18020125	CA	Upper Yuba R.	C[1]H[1]	Clark 1929, Yoshiyama *et al.* 1996
18020128	CA	N.F. American R.	H[1]	Clark 1929, Yoshiyama *et al.* 1996
18020129	CA	S.F. American R.	H[1]	Clark 1929, Yoshiyama *et al.* 1996
18030010	CA	Upper King	H[1]	Yoshiyama *et al.* 1996
18030012	CA	Tulare-Buena Vista Lakes	H[1]	Yoshiyama *et al.* 1996
18040001	CA	U. Mid. San Joaquin - Lower Chowchilla	H*[1]	Clark 1929, Yoshiyama *et al.* 1996

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Unit #	State(s)	Hydrologic Unit Name	C/H	Documentation
18040002	CA	Mid. San Joaquin - L. Merced - L. Stanislaus	H^{*1}	Clark 1929, Yoshiyama *et al.* 1996
18040003	CA	San Joaquin Delta	C^{1}	Clark 1929, Yoshiyama *et al.* 1996
18040004	CA	L. Calaveras-Mormon Slough	H^{*1}	Clark 1929, Yoshiyama *et al.* 1996
18040005	CA	L. Consumnes-L. Mokelumne	C^{1}	Clark 1929, Yoshiyama *et al.* 1996
18040006	CA	Upper San Joaquin	H^{1}	Clark 1929, Yoshiyama *et al.* 1996
18040008	CA	Upper Merced	H^{1}	Clark 1929, Yoshiyama *et al.* 1996
18040009	CA	Upper Tuolumne	$C^{1}H^{1}$	Clark 1929, Campbell and Moyle 1990
18040010	CA	Upper Stanislaus	H^{1}	Clark 1929, Campbell and Moyle 1990
18040011	CA	Upper Calaveras	C^{1}	Clark 1929
18040012	CA	Upper Mokelumne	H^{1}	Clark 1929
18040013	CA	Upper Cosumnes	$C^{1}H^{1}$	Clark 1929
18060001	CA	San Lorenzo - Soquel	C^{2}, H^{*1}	Snyder 1914[1], Brown and Moyle 1991[2], Bryant 1994[2]
18060002	CA	Pajaro R.	C^{2}, H^{*1}	Snyder 1914[1], Bryant 1994[2]
18060006	CA	Central Coastal	$H^{*1,2}$	Jordan 1895[1], Brown and Moyle 1991[2], Bryant 1994[2]
18050005	CA	Tomales-Drake Bays	C^{2}	Brown and Moyle 1991
18050006	CA	San Fran.-Coastal South	C^{2}	Brown and Moyle 1991
18060012	CA	Carmel R.	H^{*2}	Brown and Moyle 1991

Note: Juvenile chinook salmon were also reported in the Ventura River (USGS No. 18010101) by Jordan and Gilbert (1881), but no other reports of adults or a self sustaining population were located.

TABLE A-7. Selected databases on salmon distribution and habitat evaluated for EFH mapping and identification. (Page 1 of 6)

Data – Source	Format	Type – Scale	Extent	EFH Utility	Quality	Species	Life Stage	Contact
EFH DATA LEVEL 1 - PRESENCE/ABSENCE:								
StreamNet/ Northwest Environmental Database (NED)- Pacific States Marine Fisheries Commission (PSMFC)	River Reach Number (RRN) linked dBase files - online database	Dynamically segmented reach file - 1:100,000	CRB, coastal OR, WA, limited CA data	Mapping, consultation	Species distribution information, escapement, hatcheries, (wetlands, wildlife and other data in NED)	Chinook, Coho, Sockeye, Pink	Adult spawning Egg-smolt rearing	Matt Freid PSMFC Gladstone, OR (503) 650-5400 www.psmfc.org
USFS/Bureau of Land Management (BLM) habitat surveys and distribution data, aquatic inventory and stream identification	Hardcopy and some digital files	Individual habitat units - some data linked to 1:100,000 reaches	Federal forest/range lands, private lands in matrix	Consultation	Species distribution and habitat quality data not collected using consistent criteria, needs evaluation	Chinook, Coho, Sockeye, Pink	Adult spawning Egg-smolt rearing	Shaun McKinney USFS Siuslaw, NF (541) 750-7188
National Wetlands Inventory (NWI) - U.S. Fish and Wildlife Service (USFWS)	ArcInfo digital line graph (DLG) coverages - online dBase.	DLG files - 1:24,000 scale	Nationwide	Mapping, consultation	Wetland and estuarine habitats nationwide	General	Egg to smolt Juvenile marine	www.nwi.fws.gov
Estuarine Living Marine Resources (ELMR) – NOAA National Ocean Service (NOS)	Hardcopy, digital development proposed	Relative estuarine abundance/ 1:500,000	All major West Coast estuaries	Mapping	Relative species abundance in West Coast estuaries, validates species presence, digital data of limited utility for EFH mapping	Chinook, Coho, Sockeye, Pink	Juvenile marine Adult marine	Steve Brown NOAA - Ocean Resources Conservation and Assessment Division (ORCA) Sephen.K.Brown@noaa.gov (301) 713-3000
Pacific Salmon Tagging database - Fisheries Research Institute (FRI), University of Washington	Hardcopy and digital database	Tag release/ recovery data - scale N/A	CA, OR, WA, ID	Mapping	Tag release recovery data showing ocean distribution of West Coast stocks	Chinook, Coho, Sockeye, Pink	Adult Marine	Katherine Myers Box 35790 University of Washington Seattle, WA 98195
Minerals Management Service, National Marine Sanctuaries databases	Hardcopy reports/ maps, digital availability unknown.	Substrates, key habitat areas - Variable data formats, completeness	Various sites on CA, OR, WA coasts	Needs further evaluation	Data sources being reviewed by PFMC Groundfish Management Team for nearshore distribution, possible relevance to anadromous EFH effort	General	Adult marine	National Marine Sanctuary Program
Pacific Fisheries Information Network (PACFIN) - PSMFC	Online database	Commercial catch data - scale variable	Coastal CA, OR, WA	Needs further evaluation	Some salmonid presence information inferred from catch data	Chinook, Coho, Sockeye, Pink	Adult marine	PSMFC Gladstone, OR www.psmfc.org

TABLE A-7. Selected databases on salmon distribution and habitat evaluated for EFH mapping and identification. (Page 2 of 6)

Data – Source	Format	Type – Scale	Extent	EFH Utility	Quality	Species	Life Stage	Contact
EFH DATA LEVEL 1 - PRESENCE/ABSENCE (continued):								
California Rivers Assessment (CARA) – Public Service Research Program, UC Davis	PC database, some online data	Presence data by reach/ 1:250,000	CA	Mapping	Presence/absence for a subsample of rivers, some historic use data	Chinook, Coho	Adult spawning Egg-smolt rearing	David Hudson (916)752-0532 http://endeavor.des.ucdavis.edu
Environmental Protection Agency (EPA)/USGS Hydrography – USGS Water Information Clearinghouse	GIS polylines	1:100,000 scale reach file	CA, OR, WA, ID	Template for general EFH mapping	Hydrography template for mapping species distribution data	General	Adult spawning Egg-smolt rearing	Tom Haltom USGS (916)278-3061 tchaltom@usgs. gov
Brown and Moyle Report - NMFS Southwest Regional Office (SWR)	Hardcopy	Current and historical coho freshwater distribution	Northern/ central CA coast	Mapping, integrated with SW region coho data	Historic extent of coho salmon habitat in CA from available documentation by stream name	Coho	Adult spawning Egg-smolt rearing	NMFS Northwest Regional Office (NWR) 525 NE Oregon St. Portland, OR 97323
CA Dept. of Forestry and Fire Protection (CDFFP)/Private timberland surveys	Hardcopy reports, various GIS, and other databases	Land use, cover, own., hab. surveys, etc. variable scales	Private forest lands, CA	EFH consultation	Variable scale/structure data collected on private forest lands, much of these data are proprietary	Coho, Chinook, General	Adult spawning Egg-smolt rearing	Robin Marose CDFFP (916)227-2656 Various sources for private data
CDFG - Eel River surveys	PC database	Presence data attached to reach file - 1:100,000	Eel River, CA	EFH mapping	Coho distribution limited to the Eel River basin in CA, integrated with NMFS SW region coho data	Coho	Adult spawning Egg-smolt rearing	Paul Veisze (916)323-1667 pveisze@dfg.ca. gov
CDFG Hazardous Materials Spill Response database	Various hardcopy reports, GIS, and other databases	Shoreline and substrates data - various scales and formats	Local to state level	EFH consultation	Habitat type, substrate, and other data useful to long term EFH management	General	Juvenile marine Adult marine	Kim McKlegneghan (916)322-9210
NMFS San Francisco Bay and Gulf of Farralones surveys	Hardcopy reports, digital not available	Beach seine/trawl data for pathology studies	San Francisco Bay Delta and Gulf of Farallones chinook dist.	EFH consultation	Chinook salmon parr, smolts, and juveniles collected for pathology studies, useful for presence/absence.	Chinook, General	Juvenile marine Adult marine	Bruce Macfarlane (415)435-3149 Bruce.Macfarlane@noaa.gov
San Francisoco Bay National Estuary Program	Hardcopy reports, digital data availability unknown	Habitat and pollutant sites - variable scales	San Francisco Bay and Delta	EFH consultation	Possible source for data on key habitat areas (e.g., submerged aquatic vegetation)	General	Juvenile marine Adult marine	www.abag. ca.gov/bayarea/sfep/sfep.html

TABLE A-7. Selected databases on salmon distribution and habitat evaluated for EFH mapping and identification. (Page 3 of 6)

Data – Source	Format	Type – Scale	Extent	EFH Utility	Quality	Species	Life Stage	Contact
EFH DATA LEVEL 1 - PRESENCE/ABSENCE (continued):								
CDFG San Francisco Bay Delta surveys	Hardcopy reports, digital data availability unknown	Trawl/seine data for relative abundance	All species, San Francisco Bay/Delta CA	EFH consultation	CDFG surveys of fish community composition at several stations throughout S.F. Bay Estuary	Chinook, General	Juvenile marine Adult marine	Judd Muscat CDFG (916)324-3411
Oregon River Information Coverages - ODFW	GIS polyline coverages and attribute data	Dynamically segmented reach file - 1:100,000	OR	EFH mapping, consultation and manage-ment	ORIS data updated to larger scale, preferred scale for province maps, species distribution segregated by use type, useful for general mapping	Chinook, Coho	Adult spawning Egg-smolt rearing	http://rainbow.dfw.state.or.us/ ftp
Oregon Rivers Information System - ODFW	GIS and reach linked attribute database	Dynamically segmented reach file - 1:250,000	OR	EFH mapping	Useful for coarse maps of large areas, under-represents spawning habitat. Migration corridor and spawning areas not clearly distinguished	Chinook, Coho	Adult spawning Egg-smolt rearing	Brent Forsberg ODFW P.O. Box 59 Portland, OR 97297
ODFW Core Area Maps	GIS and attribute database	Dynamically segmented 1:100,000 reach files	OR	Mapping, consultation	Preferred spawning and rearing habitats in key river basins information is good for coastal streams, less detailed in Columbia River Basin	Chinook, Coho	Adult spawning Egg-smolt rearing	http://rainbow.dfw.state.or.us/ ftp
ODFW Habitat Surveys	Hardcopy data, linkage to GIS in progress	Habitat units, will be linked to 1:24,000 scale reaches	OR coast state and private lands	Consultatio n	Habitat suitability surveys for salmonids at management relevant scales, identifies current and potential anadromous habitats	General	Adult spawning Egg-smolt rearing	Kim Jones ODFW (541)737-7619 jonesk@fsl.orst. edu
OR Dept. of Land Conservation & Development estuarine inventories	Various hardcopy reports and digital databases	Estuarine extent, habitat types	OR Coast	Consultatio n	Statewide criteria for estuarine inventories implemented at the county level	General	Adult spawning Juvenile marine	Various county level data sources

TABLE A-7. Selected databases on salmon distribution and habitat evaluated for EFH mapping and identification. (Page 4 of 6)

Data – Source	Format	Type – Scale	Extent	EFH Utility	Quality	Species	Life Stage	Contact
EFH DATA LEVEL 1 - PRESENCE/ABSENCE (continued):								
Coastal Change Analysis Program (CCAP) - NOAA Coastal Services Center (CSC)/ Columbia R. National Estuary Prog. - EPA	GIS and attribute database - CD format	Habitat/land cover data - variable scales	Columbia River Estuary, OR coast to Tillamook Bay	Consultation	Time series remote sensing images of uplands habitat change, useful for identifying long term EFH trends	General	Adult spawning Egg-smolt rearing Juvenile marine	NOAA - CSC www.csc.noaa.gov
Tillamook Bay National Estuary Project - Oregon State University	Hardcopy reports, GIS coverages	Reach/land cover data/ 1:24,000 - 1:100,000 scale	Tillamook Bay basin, OR HUC# 17100203	Mapping, consultation	Species distribution data for coho, chinook and chum, segregated by use type for Tillamook Bay tributaries	Chinook, Coho, General	Adult spawning Egg-smolt rearing Juvenile marine	www.orst.edu/ dept/tbaynep/ active.html
State/Private watershed analysis data, watershed organization databases	Various hardcopy and digital databases	Numerous data categories, variable scales	State and private lands OR/WA/CA/ ID	Consultation	Locally specific data useful for EFH consultation	Chinook, Coho, Sockeye, Pink, General	Adult spawning Egg-smolt rearing	Various sources
WARIS - Washington Department of Fish and Wildlife (WDFW)	GIS and attribute database	Dynamically segmented reach file - 1:100,000	WA	Mapping, consultation	Species distribution segregated by use type, useful for general mapping.	Chinook, Coho, Sockeye, Pink	Adult spawning Egg-smolt rearing	Martin Hudson WDFW (360) 902-2487 hudsomgh@dfw.wa.gov
Western Washington Watershed Screening Database (WWWSD) - WDFW	GIS ArcInfo coverages, database	Reach, land cover data, road density - 1:24,000	Western WA	Mapping, consultation	Habitat screening tool potentially useful for identifying key stream reaches, demonstrates extent of river miles at 1:24,000	Chinook, Coho, Sockeye, Pink	Adult spawning Egg-smolt rearing	Brad Johnson EPA Region 10 (206)553-4150 bjohnson@r0dj05.r10.epa. gov
Washington State Department Natural Resources Stream Typing Database	Digital	1:24,000	WA	EFH consultation and mapping	Fish presence and absence, template for Salmon and Steelhead Habitat Inventory and Assessment (SSHIAP)	general (salmonid presence and absence)	Adult spawning Egg-smolt rearing	Wash. DNR 1111Wash. St. SE Olympia, WA 98504 (360) 902-1000
Salmon and Steelhead Stock Inventory (SASSI) - WDFW	Hardcopy (integrated with WARIS)	Dynamically segmented 1:100,000 reach files	WA	Mapping, consultation	Preferred spawning and rearing habitats by species for river basins with critical spawning habitat	Chinook, Coho, Sockeye, Pink	Adult spawning Egg-smolt rearing	WDFW P.O. Box 43138 Olympia, WA 98504-3150 (360)902-2700

TABLE A-7. Selected databases on salmon distribution and habitat evaluated for EFH mapping and identification. (Page 5 of 6)

Data – Source	Format	Type – Scale	Extent	EFH Utility	Quality	Species	Life Stage	Contact
EFH DATA LEVEL 1 - PRESENCE/ABSENCE (continued):								
SSHIAP - WDFW and Northwest Indian Fisheries Commission (NWIFC)	Hardcopy, GIS database in development	Channel morphology, stream flows, seral stage - 1:24,000	Western WA (partially complete)	Mapping, consultation	Habitat suitability surveys at management relevant scales useful for identifying currently and potentially suitable anadromous habitats	Chinook, Coho, Sockeye, Pink	Adult spawning Egg-smolt rearing	Randy McIntosh NWIFC (360)438-1180
Willapa Watershed Information System - Interrain Pacific	GIS and attribute database - CD format	GIS reach and land cover - variable scales	Willapa Bay basin, WA	Consultation	Time series remote sensing images of uplands habitat change, useful for identifying long term trends	Chinook, Coho	Adult spawning Egg-smolt rearing Juvenile marine Adult marine	Interrain Pacific (503)226-8108 www.interrain.org
Idaho Rivers Information System - Idaho Department of Fish and Game (IDFG)	GIS and attribute database	Dyna. seg. reach file - 1:250,000 (in conversion to 1:100,000)	ID	Mapping	Data scale limits utility to general mapping for information purposes only	Chinook	Adult spawning Egg-smolt rearing	Jerome Hansen IDFG 600 S. Walnut Boise, ID 83707 (208)334-3098
Puget Sound Intertidal Habitat Inventory - Washington Department of Natural Resources	GIS and attribute database - CD format	Substrates and vegetation - 1:24,000 scale	Puget Sound, WA	Consultation	Puget Sound shoreline habitat inventories, partially complete coverage of Bellingham Bay to Canadian border	General	Juvenile marine Adult marine	WA Nat. Heritage Program Mail Stop 47027 Olympia, WA 98504
Puget Sound National Estuary Program (NEP) - EPA	Hardcopy, digital avail. unknown	unknown	Puget Sound, WA	Consultation	Sediment contamination, point source pollution location data, etc.	General	Juvenile marine Adult marine	Nancy McKay Puget Sound NEP (360)407-7300
Tribal/local government habitat, land cover, zoning maps, etc.	Various hardcopy and digital formats	Various data types and scales	Local: CA, OR, WA, ID	Consultation	Numerous tribal/local government data sources may have consultation and management utility	Chinook, Coho, Sockeye, Pink	Adult spawning Egg-smolt rearing	Various sources
Commercial fishing logbooks	Hardcopy	Location of key marine habitat areas - scale N/A	Coastal CA, OR, WA	Needs further evaluation	Experience based knowledge of key salmonid marine habitat areas and characteristics	Chinook, Coho, Sockeye, Pink	Adult marine	Various sources

TABLE A-7. Selected databases on salmon distribution and habitat evaluated for EFH mapping and identification. (Page 6 of 6)

Data – Source	Format	Type – Scale	Extent	EFH Utility	Quality	Species	Life Stage	Contact
EFH DATA LEVEL 2 - HABITAT-RELATED DENSITIES:								
NMFS Salmonid Escapement Database (prepared by Big Eagle Associates and LGL), Incorporated into StreamNet	Restricted database	Salmonid escapement in selected West Coast rivers - 1:100,000 reaches	Selected river basins CA, OR, WA, ID	See StreamNet (incorporated into StreamNet)	Escapement data acquired from state, federal, tribal and intergovernmental agencies for Washington, Oregon, and California	Chinook, Coho, Sockeye, Pink	Adult spawning	NMFS - Northwest Fisheries Science Center (NWFSC) 2725 Montlake Blvd. E Seattle, WA 98112
Klamath Resources Information System – USFWS	GIS and interactive database - CD format	Multiple data coverages, bibliographic data - variable scales	Klamath River basin below Iron Gate dam	consultation	Escapement data for all species in selected area sub-basins, model system for consultation and management	Chinook, Coho	Adult spawning Egg-smolt rearing	USFWS Klamath River Fishery Resource Office, P.O. Box 1006, Yreka, CA 96097
Desktop GIS System for Salmonid Resources in the Columbia River	GIS database	1:250,000	Columbia River Basin (WA, OR, ID)	mapping and consultation	Spawning escapement and hatchery release data, similar to StreamNet	Coho, Chinook, Sockeye	Adult spawning, juvenile (hatchery smolts)	Bob Emmett NMFS 2030 S. Marine Sciences Dr. Newport, OR 87365
EFH DATA LEVEL 3 - REPRODUCTION, GROWTH, SURVIVAL RATES BY HABITAT:								
NA								
EFH DATA LEVEL 4 - PRODUCTION RATES BY HABITAT:								
NA								

3.0 DESCRIPTION OF ADVERSE EFFECTS ON PACIFIC SALMON ESSENTIAL FISH HABITAT AND ACTIONS TO ENCOURAGE THE CONSERVATION AND ENHANCEMENT OF ESSENTIAL FISH HABITAT

3.1 FISHING ACTIVITIES AFFECTING SALMON ESSENTIAL FISH HABITAT

The Magnuson-Stevens Act requires the PFMC to minimize adverse effects of fishing activities on EFH to the extent practicable. The interim final rule implementing EFH provisions of the Magnuson-Stevens Act states that adverse effects of fishing may include physical, chemical, or biological alterations of the substrate, and loss of or injury to benthic organisms, prey species and their habitat, and other components of the ecosystem.

Marine activities which PFMC can directly influence are the effects of fishing gear, prey removal by other fisheries, and the effect of salmon fishing on the reduction of nutrient enrichment in salmon spawning streams. This section also considers similar activities under control of the states and tribes, as well as disturbance of redds or fish in shallow water environments from fishing activities (e.g., vessel operation).

Other activities that may be directly or indirectly associated with fishing, but are not regulated by state, federal or tribal fishery management entities, are considered in the section on nonfishing activities. These activities include environmental impacts from fish processing, hatchery operation, vessel operation and maintenance, and marina construction and dredging. The direct harvest and injury impacts of fishing activities on salmon abundance are addressed primarily in Chapters 2 and 3 of the *Pacific Coast Salmon Plan.*

Actions PFMC will take to reduce fishing effects on habitat, and actions PFMC recommends others take to protect habitat, are not the only efforts being undertaken, nor the only efforts necessary, to help restore sustainable fisheries. For example, to restore salmon abundance, many fish hatchery operations have been improved to minimize negative effects on wild salmon populations, and extensive restrictions on salmon fishing have been imposed. In the past decade, PFMC has significantly reduced fishing limits and seasons coastwide to assure sufficient numbers of adult salmon from various stocks reach their spawning grounds. Specifically, to protect salmon listed under the ESA, PFMC has limited recreational salmon fishing on healthy California salmon stocks to reduce the chance of catching endangered Sacramento River winter chinook. Similarly, PFMC limited all commercial ocean fisheries on healthy salmon runs in 1997 to reduce the incidental take of threatened Snake River fall chinook. (It should be noted that PFMC-managed salmon fisheries do not affect Snake River spring-summer chinook or sockeye salmon and have only minor effects on pink salmon stocks.)

Despite fishing curtailments or closures and improved hatchery practices, coho and chinook populations have continued to decline in Oregon, Washington, and California (Nehlsen 1997). Four of 15 stocks of Puget Sound pink salmon are classified as not healthy, with two populations considered depressed and two in critical condition (WDF 1993). In earlier studies of salmon declines, habitat problems were a factor contributing to about 91% of these declines (Nehlsen *et al.* 1991).

3.1.1 Fishing Activities under the Control of the Council – Potential Effects on EFH and Measures to Minimize Adverse Affects

3.1.1.1 Gear Effects

Currently, there are no studies that indicate direct gear effects on salmon EFH from PFMC-managed fisheries. A report prepared for NMFS by Auster and Langton (1998) provides a review and analysis of the studies done on fishing gear and habitat effects (primarily trawl and dredging studies from nonWest Coast sites). Additionally, the 1998 draft EFH report of NPFMC (1998) provides a review of some of the current research of the Alaska Fisheries Science Center on the effects of trawling on the seafloor and on benthic organisms and their habitat. Fishing effects on habitat include the reduction of fish habitat complexity by directly removing or damaging epifauna leading to mortality, smoothing sedimentary bedforms and reducing bottom roughness, removing taxa which produce structure (i.e., taxa which produce burrows and pits), or decreasing eelgrass or seagrass density.

Because salmon are not known to be directly dependent on soft ocean bottom habitats, fishing gear that has the potential for disturbing these habitats is not likely to directly affect EFH for salmon. If fishing gear were operated in areas of eelgrass beds and if it removed or caused a decrease in this habitat, this would be of concern. Studies done in the Pacific Northwest have documented the importance of the nearshore environment and eelgrass beds to salmonids (Simenstad 1983; Simenstad and Fresh 1995).

Since chinook salmon may be associated with "bottom topography" at depths of 30-70 m (see Section 2.1), and because juvenile and adult chinook are associated with structure such as channels, ledges, pinnacles, reefs, vertical walls, and artificial structure in marine environments (NPFMC 1998); fishing gear which disrupts these habitats has a potential to affect salmon EFH. However, there is no research information available that documents direct effects on salmon or their prey.

Anecdotal information from fishermen notes concern over the potential effect that both longline and rock-hopper trawl gear have on rocky habitat that supports juvenile rockfish that are prey for juvenile salmon. In studies reviewed by Auster and Langton (1998) and by the NPFMC, trawl gear was found to be able to move or drag boulders, damage and kill organisms, reduce habitat complexity, and resuspend sediments. In studies reviewed by the NPFMC, longline gear was found to snag rocks and corals, break corals and dislodge invertebrates. There is also anecdotal information that lost gill nets can continue to intercept salmon and their prey (both in marine and freshwater environments), until the net tangles up on itself or becomes fouled by marine growth. State and federal regulations preclude the use of gill nets in ocean waters north of 38° N latitude, and gill net usage in nearshore waters south of that line is very limited. Moreover, mesh size restrictions tend to preclude the capture of prey species.

Gear Types Used In Salmon EFH - Types of fishing gear used in PFMC-area fisheries are listed below. The list includes fisheries managed by PFMC, states, and tribes. The potential effects of any gear depends on the specifics of each fishery and each gear type (e.g., some trawl gear is fished on or near the bottom and some in mid-water, nets vary by configuration and in response to mesh size restrictions, fisheries are controlled by various time and area restrictions, etc.). Detailed management measures have not been developed, because of the lack of information demonstrating an adverse effect on EFH from salmon "gear".

Fishery	Gear
Anchovy, sardine, mackerel	purse seine, lampara net
Clam	shovel, hydraulic dredge, clam gun
Crab	pot/trap
Groundfish	bottom/mid-water trawl, longline, hook-and-line, pot/trap, set gill net, spear
Hagfish	pot/trap
Halibut (Pacific)	longline, hook-and-line, troll
Herring	purse seine, gill net, pound net, hook-and-line, weir
Lobster	pot/trap
Salmon	troll, gill net, purse seine, hook-and-line, dip net, weir
Sea urchin, abalone	hand rake, abalone iron
Sea cucumber	hand rake, trawl
Scallop	abalone iron, dredge
Shrimp, prawn	pot/trap, trawl
Smelt	dip net, gill net
Squid	seine
Sturgeon	hook-and-line, gill net
Swordfish, thresher shark	drift gill net
Tuna (Albacore)	troll, hook-and-line
Tuna (Yellowfin, skipjack tuna)	purse seine, hook-and-line
White croaker, white sea bass, California halibut, *et al.*	set gill-net, hook-and-line

Measures - Research is needed to study gear effects on EFH of salmon and their prey, especially disturbance of eelgrass beds and rocky habitat.

3.1.1.2 Harvest of Prey Species

Commercial or recreational fisheries exist or have existed for herring, sardine, anchovy, squid, smelt, groundfish, and crab. These species, either as adults or juveniles (e.g., juvenile rockfish, crab larvae) serve as important prey for salmon, and their take in fisheries may affect salmon. Additionally, it is known that pinnipeds eat herring, anchovy, mackerel, whiting, and other schooling fish. Significant fisheries on these prey species could increase pinniped predation on salmon (W. Pearcy, Oregon State University, College of Oceanic and Atmospheric Science, Corvallis, Oregon, 1998, pers. comm.). It is also known that whiting and mackerel prey on juvenile salmon so that harvests of these species may reduce predation on salmon populations.

Measures - PFMC manages fisheries for groundfish and anchovy and is expanding the coastal pelagic species plan to include sardine, squid, Pacific mackerel, and jack mackerel. The groundfish and coastal pelagic species plans will include provisions to prevent overfishing and protect EFH for all of the species in these management units, including those that are prey for salmon and other predators. In addition, the harvest formulas proposed for anchovy and sardine set aside a portion of the biomass as forage reserves for predator species. The states manage other fisheries for prey species, (e.g., herring). The herring fisheries occur in bays and estuaries and are tightly regulated by the states to prevent overfishing. Herring and squid are harvested primarily as spawning adults, after which many or most die.

3.1.1.3 Removal of Salmon Carcasses (Effects on Stream Nutrient Levels)

Salmon carcasses as well as their eggs, embryos, alevins, and fry provide vital nutrients to stream and lake ecosystems. Carcasses have been shown to enhance salmon growth and survival. Salmon fishing activities, as well as removal of returning fish to support hatchery operations, remove a portion of the fish whose carcasses could otherwise perform that habitat function.

One study in the Willapa Bay basin estimated that more than several thousand metric tons of salmon tissue have been lost each year as a nutrient source to streams, because of reductions in salmon returns. Present amounts of salmon carcasses and their nutrients in that basin were thought to be generally less than 10% of historical levels (NRC 1996).

Carcasses have been shown to be an important habitat component, enhancing smolt growth and survival by contributing significant amounts of nitrogen and phosphorus compounds to streams. (Spence *et al.* 1996). These are the nutrients that most often limit production in oligotrophic (nutrient poor) systems.

During their first year or so, salmon may obtain nourishment from "spawners" by directly feeding on carcasses (as well as eggs) as well as by eating insects or other organisms have fed on decomposing salmon. Additionally, aquatic and riparian plants uptake nutrients from salmon carcasses. These plants are in turn consumed by invertebrates which are the prey for juvenile salmon (Bilby *et al.* 1997). Studies in western Washington have shown that as much as 40% of the nitrogen and carbon in juvenile salmonids derive from salmon carcasses, and the amount of marine-derived nitrogen increased, up to a point, with increased density of spawning fish. Waters that contained salmon carcasses were also found to have higher densities of juveniles, and those fish grew much faster over the winter than young salmon in waters without salmon carcasses. Following spawning, fingerling coho salmon exhibited a doubling of the rate of growth in streams sections that had been enriched with salmon carcasses (Bilby *et al.* 1997).

Although placing carcasses in streams may be helpful, it is not as effective as allowing natural escapement, because (1) natural spawners provide eggs as well as carcass tissue, (2) natural escapement provides carcasses over about one or two months rather than in a one-shot approach usually associated with carcass placement, and (3) carcasses are also present in the spring, which provides juveniles with food right before they begin their downstream migration (Bilby *et al.* 1997). This multi-month benefit is particularly evident in systems that are managed for natural production and have maintained a broad run timing such as Cedar River sockeye salmon and Snohomish River coho salmon (K. Bauersfeld, WDFW, Olympia, 1998, pers. comm.).

Additionally, naturally spawning salmon perform the additional function of cleaning redd site gravel, which reduces the amount of fine sediment in the gravel.

Measures - Theoretically, managing for maximum sustainable yield spawner escapements, the underlying basis for PFMC conservation objectives, should address meeting stream system nutrient recharge needs over the long-term. Section 3.2 of the fishery management plan addresses how PFMC will prevent overfishing and rebuild overfished stocks. Many stocks are currently locked in a state of chronic low abundance as a result of various overall negative environmental conditions and/or specific freshwater habitat degradation, or have been largely replaced by mitigation from hatchery production programs. These stocks are at levels far below their historic maximum sustainable yields and, even with no fishing impacts, are not likely to return in sufficient numbers to provide stream nutrient recharge from carcasses at historic levels. More study is needed on the present importance of carcasses to specific ecosystems and whether or not PFMC conservation goals sufficiently account for nutrient needs. These studies should provide insight into regional differences in the hydrological dynamics affecting natural salmon production, identify limiting factors to production for various stream systems, and account for background levels of nutrient enrichment from other sources, including man-caused pollution.

3.1.2. Fishing Activities Not under the Control of the Council – Potential Effects on Essential Fish Habitat and Measures to Minimize Adverse Affects

3.1.2.1 Gear Effects on Essential Fish Habitat

See previous section entitled Gear Effects on Essential Fish Habitat.

3.1.2.2 Harvest of Prey Species

See previous section entitled Harvest of Prey Species.

3.1.2.3 Removal of Salmon Carcasses (Affects on Stream Nutrient Levels)

See previous section entitled Removal of Salmon Carcasses (Affects on Stream Nutrient Levels).

3.1.2.4 Redd or Juvenile Fish Disturbance

Trampling of redds during fishing and recreational activities has a potential to cause high mortality of salmonids. Most information on redd disturbance is anecdotal. However, one study of angler wading caused high mortality (43%-96%) of alevins (very young salmon that remain in the gravel) with only one or two passes per day. The extent or cumulative effects of this type of disturbance are not known (Roberts and White 1992).

Studies in Alaska and New Zealand (Horton 1994, Sutherland and Ogle 1975) have found that in shallow water where boat use is high, and especially where channels are constricted, developing salmon eggs and alevins in the gravel can suffer high mortalities as a result of pressure changes caused by boat operations, which can result in removal of gravel or mechanical shock generated in the area under the mid-line of the boat. Studies done on the effects of jet sleds (power boats with jet units), drift boat, or kayak operation on the behavior and survival of free swimming juvenile salmon on the Rogue River have shown minimal effects, though behavioral responses are observed when vessels pass directly overhead (especially nonmotorized kayaks or driftboats) (Satterwaithe 1995). Studies along the Columbia River indicated that the wake (uprush of the bow wave) of large ships (but not smaller vessels, e.g., tugs) caused significant numbers of chinook juveniles to be killed from being washed-up and stranded on sand bars and mud flats. Stranding was not observed on the Skagit River from jet sled use (K. Bauersfeld, WDFW, 1998, pers. comm.), nor on the Rogue River from private motorboat and commercial tour boat use (Satterwaithe 1995).

Measures - Conservation recommendations to minimize the effects of anglers/vessels on salmon EFH include angler/vessel restrictions and/or closures in key spawning areas during the time frame when spawning is occurring and while eggs and alevins may be present in the stream substrate, and promoting angler awareness of redd trampling. The states close important spawning reaches during spawning periods to protect spawning fish and their eggs.

3.1.2.5 Effects of Fishing Vessel Operation on Habitat

Although effects to eelgrass meadows on the West Coast do not normally result from physical disturbance and cuts made by fishing boat propellers (Phillips 1984), monitoring of effects in shallow water areas with eelgrass and significant vessel activities is needed. Sediment stirred up by constant vessel operation can decrease water clarity and reduce eelgrass survival. Additionally, in both estuarine and stream environments, the wake from boats and ships may cause increased bank erosion, increasing turbidity and sedimentation effects. Also, for navigational safety or to open up stream areas to vessel use, logs are often cleared from estuaries and channels. Effects of activities of nonfishing vessels are discussed in Section 3.2 of this appendix.

Measures - Conservation recommendations to minimize the effects of fishing vessels on salmon EFH include speed limits and channel markings to avoid damage to EFH areas susceptible to bank scour and eelgrass damage and shallow water areas susceptible to redd disturbance and alevin mortality.

3.2 NONFISHING ACTIVITIES AFFECTING SALMON ESSENTIAL FISH HABITAT

In addition to the effects from fishing activities, adverse effects of habitat alterations, dam and hatchery operations are widely recognized as major contributors to the decline of salmon in the region. Nehlsen *et al.* (1991) associate these activities with over 90% of the documented stock extinctions or declines. The importance of habitat is underscored in undammed coastal watersheds with declining salmon populations. Surveys of both public and private lands in the Pacific Northwest reveal widespread degradation of freshwater, wetland, and estuarine habitat conditions. Attempts to improve salmon survival by reduction in fishing pressure may have little effect on salmon populations if EFH quantity and quality are inadequate. Ocean survival by adults, for example, is of little value if appropriate tributary habitat is not available for spawning and early life history survival of offspring (Gregory and Bisson 1997).

The Magnuson-Stevens Act mandates a consultation process for federal agencies whose activities may adversely affect EFH. This consultation process is intended to provide those agencies with technical assistance in making their activities consistent with conservation of EFH. This section first provides information on the **consultation process** itself, then provides a brief overview of **salmon habitat requirements**, and lastly a discussion of **potential adverse effects** and a **menu of conservation options** which might alleviate those effects. The purpose of identifying adverse effects and companion conservation measures is to provide general guidance for consultations and to make this information available ahead of time to federal and nonfederal actors so they may proactively include habitat conservation in their planning.

3.2.1 The Consultation Process

The value of early consultation in avoiding downstream issues can be seen in a review by Drabelle (1985) of the first ten years of the ESA implementation when informal consultations increased about 30% per year, correlating with the annual decrease of 30% in formal consultations and jeopardy opinions. While there is no formal requirement for state and private collaboration in the consultation process on adverse effects to salmon EFH, there is a common interest in the reduction of threats to ESA-listed species, prevention of future listings, and productive and sustainable coastal fisheries in the context of the Magnuson-Stevens Act. Conservation of anadromous fish resources through voluntary coordination is a goal without geographical or jurisdictional boundaries.

Established habitat conservation policies and approaches of PFMC and NMFS provide the framework for implementing the Magnuson-Stevens Act. The Magnuson-Stevens Act requires federal agencies undertaking, permitting or funding activities that may adversely affect EFH to consult with NMFS. Under Section 305(b)(4) of the Magnuson-Stevens Act, NMFS is required to provide EFH conservation and enhancement recommendations to federal and state agencies for actions that adversely affect EFH; however, state agencies and private parties are not required to consult with NMFS. EFH consultations will be combined with existing interagency consultations and environmental review procedures that may be required under other statutes such as the ESA, Clean Water Act, the National Environmental Policy Act, the Fish and Wildlife Coordination Act, the Federal Power Act, or the Rivers and Harbors Act. To the extent that EFH and ESA consultations are integrated, NMFS will apply the provisions of the 1997 Secretarial Order 3206. NMFS NWR and NMFS SWR will provide additional information on the consultation process upon request.

3.2.1.1 A Programmatic Approach to the Consultation Process

EFH consultations may be at either a broad programmatic level or project-specific level. Programmatic is defined as "broad" in terms of process, geography, or policy (e.g., "national level" policy, a "batch" of similar activities at a "landscape level" involving metapopulation dynamics, etc.). The goal of a programmatic consultation is to address as many adverse effects as possible through programmatic EFH conservation recommendations. Programmatic consultations would result in a letter from NMFS to the federal action agency containing advisory programmatic EFH conservation recommendations, as well as identification of any adverse impacts that could not be addressed by the programmatic EFH conservation recommendations. Where appropriate, NMFS will use a programmatic approach designed to reduce redundant paperwork and to focus on the appropriate level of analysis whenever possible. The approach would permit project activities to proceed at broad levels of resolution so long as they conform to the programmatic consultation process. The wide variety of development activities over the extensive range of the salmon EFH, and the Magnuson-Stevens Act requirement for a cumulative effects analysis warrants this programmatic approach.

In collaboration with other federal agencies, states and tribes, NMFS will use and further develop analytic tools. Examples of these include tools for determining adverse effects (e.g., the 1996 NMFS "Matrix of Pathways and Indicators" for evaluating the effects of human activities on anadromous salmonid habitat), watershed assessment protocols, research programs, predictive watershed models for testing policies and assessing adverse impacts, etc. These can be particularly useful for assessing cumulative impacts. Cumulative impact analysis is intended to monitor the effect on EFH of the incremental impacts occurring within a watershed or marine ecosystem context that may result from minor but collectively significant actions. Cumulative impact analysis is a corollary of tiering from the programmatic since iterative actions of increasing focus can have various kinds of adverse effects (additive, synergistic, catalytic, threshold) over the life of a project and beyond. Utilization of such programmatic tools will enhance the predictive capability of cumulative impact analyses and help inform the selection of appropriate mitigation. Another programmatic approach is the development of incentives to defray costs of protecting and enhancing aquatic and associated terrestrial habitats. These include the Conservation Reserve Enhancement Program designed to reduce soil erosion into fragile aquatic habitats, the Federal-State Cooperative Endangered Species Restoration Fund (ESA Section 6), and cost-sharing through the Agricultural Stabilization and Conservation Service.

3.2.1.2 Consultation Scenarios

Table A-8 lists examples of habitat alteration and corresponding potential effects on Pacific salmon. Table A-9 describes most (but not all) of the types of activities which are likely to generate these effects and which may require consultation if undertaken, funded, or permitted by a federal agency in salmon EFH. Specific conservation recommendations for meeting the habitat objectives listed in Table A-10 will be refined during the consultation process and will be based on the particulars of the proposed program or project activities. The range of conservation recommendations will be based on the premise that activities such as aquaculture, forestry, grazing, etc., need not retard or prevent achievement of the habitat objectives listed in Table A-10.

TABLE A-8. How habitat alteration affects Pacific salmon. (Page 1 of 3)

Ecosystem Feature	Altered Component	Effects on Salmonid Fishes and Their Ecosystems*
Water Quality	Increased Temperature	Altered adult migration patterns, accelerated development of eggs and alevins, earlier fry emergence, increased metabolism, behavioral avoidance at high temperatures, increased primary and secondary production, increased susceptibility of both juveniles and adults to certain parasites and diseases, altered competitive interactions between species, mortality at sustained temperatures of >73-84°F, reduced biodiversity.
	Decreased Temperature	Cessation of spawning, increased egg mortalities, susceptibility to disease (U.S. Army Corps of Engineers [USACOE] 1991).
	Dissolved Oxygen	Reduced survival of eggs and alevins, smaller size at emergence, increased physiological stress, reduced growth.
	Gas Supersaturation	Increased mortality of migrating salmon.
	Nutrient Loading	Increased primary and secondary production, possible oxygen depletion during extreme algal blooms, lower survival and productivity, increased eutrophication rate of standing waters, certain nutrients (e.g., nonionized ammonia, some metals) possibly toxic to eggs and juveniles at high concentrations.
Sediment	Surface Erosion	Reduced survival of eggs and alevins, reduced primary and secondary productivity, interference with feedings, behavioral avoidance and breakdown of social organization, pool filling.
	Mass Failures and Landslides	Reduced survival of eggs and alevins, reduced primary and secondary productivity, behavioral avoidance, formation of upstream migration barriers, pool filling, addition of new large structure to channels.
Habitat Access	Physical Barriers	Loss of spawning habitat for adults; inability of juveniles to reach overwintering sites or thermal refugia, loss of summer rearing habitat, increased vulnerability to predation.
Channel Structure	Flood Plains	Loss of overwintering habitat, loss of refuge from high flows, loss of inputs of organic matter and large wood, loss of sediment removal capacity.
	Side-Channels	Loss of overwintering habitat, loss of refuge from high flows.
	Pools and Riffles	Shift in the balance of species, loss of deep water cover and adult holding areas, reduced rearing sites for yearling and older juveniles.
	Large Wood	Loss of cover from predators and high flows, reduced sediment and organic matter storage, reduced pool-forming structures, reduced organic substrate for macroinvertebrates, formation of new migration barriers, reduced capacity to trap salmon carcasses.
	Substrate	Reduced survival of eggs and alevins, loss of inter-gravel spaces used for refuge by fry, reduced macroinvertebrate production, reduced biodiversity.
	Hyporheic Zone (biologically active interface between groundwater area and stream bed)	Reduced exchange of nutrients between surface and subsurface waters and between aquatic and terrestrial ecosystems, reduced potential for recolonizing disturbed substrates.
Hydrology	Discharge	Altered timing of discharge related life cycle cue (e.g., migrations), changes in availability of food organisms related to timing of emergence and recovery after disturbance, altered transport of sediment and fine particulate organic matter, reduced prey diversity.

TABLE A-8. How habitat alteration affects Pacific salmon. (Page 2 of 3)

Ecosystem Feature	Altered Component	Effects on Salmonid Fishes and Their Ecosystems*
Hydrology, (continued)	Peak Flows	Scour-related mortality of eggs and alevins, reduced primary and secondary productivity, long-term depletion of large wood and organic matter, involuntary downstream movement of juveniles during high water flows, accelerated erosion of streambanks.
	Low Flows	Crowding and increased competition for foraging sites, reduced primary and secondary productivity, increased vulnerability to predation, increased fine sediment deposition.
	Rapid Fluctuations	Altered timing of discharge-related life cycle events (e.g., migrations), stranding, redd dewatering, intermittent connections between mainstream and floodplain rearing habitats, reduced primary and secondary productivity.
Riparian Forest	Production of Large Wood	Loss of cover from predators and high flows, reduced sediment and organic matter storage, reduced pool-forming structures, reduced organic substrate for macroinvertebrates.
	Production of Food Organisms and Organic Matter	Reduced production and abundance of certain macroinvertebrates, reduced surface-drifting food items, reduced growth in some seasons.
	Shading	Increased water temperature, increased primary and secondary production, reduced overhead cover, altered foraging efficiency.
	Vegetative Rooting Systems and Streambank Integrity	Loss of cover along channel margins, decreased channel stability, increased streambank erosion, increased landslides.
	Nutrient Modification	Altered nutrient inputs from terrestrial ecosystems, altered primary and secondary production.
Exogenous Material	Chemicals	Reduced survival of eggs and alevins, toxicity to juveniles and adults, increased physiological stress, altered primary and secondary production, reduced biodiversity.
Exogenous Material	Exotic Organisms/Plants	Increased mortality through predation, increased interspecific competition, introduction of diseases, habitat structure alteration.
Estuarine Structure	Tide Flats	Loss of primary and secondary productivity, loss of prey.
	Eelgrass Beds	Loss of cover from predators, loss of primary productivity, loss of prey.
	Marshes (salt water, brackish, and tidal-freshwater)	Loss of cover, loss of primary productivity, loss of prey, loss of sediment and nutrient filter.
	Tidal Freshwater Swamps, Including Sloughs	Loss of cover, loss of primary productivity, loss of prey, loss of refuge area during high flows.
	Channels	Loss of cover, loss of refuge from tidal cycles, high flows, loss of sediment/nutrient filter.
	Large Woody Debris	Loss of cover, organic matter storage, habitat complexity.
Estuarine Water Quality	Dissolved Oxygen	Increased physiological stress, reduced growth.
	Nutrients	Increased primary and secondary production, possible oxygen depletion during extreme algal blooms.
	Temperature	Susceptibility to diseases, parasites, behavioral avoidance.

TABLE A-8. How habitat alteration affects Pacific salmon. (Page 3 of 3)

Ecosystem Feature	Altered Component	Effects on Salmonid Fishes and Their Ecosystems*
Estuarine Water Quality, (continued)	Exogenous Chemicals	Toxicity to juveniles and adults and their prey, increased stress, lower disease resistance, behavioral alterations.
	Exogenous Organisms, Plants	Introduction of diseases, habitat competition, increased predation, changes to habitat structure, nutrient cycling, prey species.
Estuarine Hydrology	Low Freshwater Inflows/Alterations in Timing of Flows	Alterations of juvenile survival, alterations in timing of migrations, altered transport of sediment and organic matter, altered estuarine circulation, loss of cover, increased vulnerability to predators.
Marine Water Quality	Water Quality (Sediment, Nutrients)	Reduced cover, prey effects, reduced feeding efficiency.
	Exogenous Chemicals	Toxicity to juveniles and adults, toxicity to prey, increased stress, susceptibility to disease, altered primary and secondary production.
	Low Freshwater Inflows/Timing Alterations	Reduced cover (e.g., in plumes), altered nutrient input.

* Freshwater portions of this table are excerpted from Gregory and Bisson (1997) with minor adaptions from that paper. See Gregory and Bisson (1997) for references to original documents on freshwater effects. Also see Spence *et al.* (1996), and National Research Council (NRC) (1996) for additional narrative explanation of how alterations in habitat components effect salmon. Estuarine effects from: Casillas *et al.* 1997, Cohen (1997), Cortright *et al.* (1987), FRI (1981); Lebovitz (1992); Levings and Bouillon (1997); Felsot (1997); Levy (1982); NRC (1996); Luiting *et al.* (1997); Phillips (1984); The Resources Agency of California (RAC) (1997); Simenstad (1983, 1985); and Simenstad *et al.* (1990).

TABLE A-9. Actions with the potential to adversely affect salmon habitat and habitat components likely to be altered (see tables A-8 and A-10 for cross reference on how changes in habitat components affect salmon and generally desired habitat conditions). (Page 1 of 2)

ACTIONS LIKELY TO EFFECT SALMON EFH	COMPACTION OF SOIL / CREATION OF IMPERVIOUS SURFACES	DISCHARGE OF WASTE-WATER, RUN-OFF	ESTUARINE HABITAT ALTERATION	INTRODUCE/ TRANSFER/ CONTROL OF EXOTIC ORGANISMS/ PLANTS/DISEASE	CREATION OF MIGRATION BARRIERS/ HAZARDS	MARINE HABITAT ALTERATION	REMOVAL OF PREY (DIRECT REMOVAL)	REDD DISTURBANCE (DIRECT)
EXAMPLES OF ACTIVITIES THAT MAY INVOLVE THOSE ACTIONS	forestry, agriculture, ranching, road building, construction, urbanization	industrial/food processing, mining, desalinization, aquaculture, forestry, agric. grazing, urbanization, vessel fueling/repair, dredging, oil/mineral development	jetty or dock constr., dredging, spoil disposal, waste discharge, vessel oper. (shallow water), ballast water disposal, aquaculture, pipeline install.	aquaculture, bilge water discharge, inter-basin water/fish transfer, fish introduction, boating	dam and irrigation facility constr./operation, road building, navigation lock oper., dock installation, stream bed mining, tide gate installation/ maintenance	dredge spoil disposal, mineral, oil level/transport, wastewater discharge, ballast discharge, spill dispersal, incineration,	fishing, dredging, water intakes, water diversions	grazing, fishing, dredging, sand and gravel extraction, reservoir excavation for flood control
HABITAT COMPONENTS:								
Steam Water Quality:								
Temperature	X	X			X			
Dissolved Oxygen	X	X		X	X			
Sediment/Turbidity	X	X	X		X			X
Nutrients	X	X	X	X	X			
Contaminants	X	X	X	X	X			
Habitat Access:								
Physical Barriers					X			
Stream Habitat:								
Substrate	X	X	X		X			X
Large Woody Debris	X	X			X			
Pool Frequency	X	X			X			
Pool Quality	X	X			X			
Off-Channel Habitat		X	X		X			
Prey	X	X		X	X		X	X
Predators				X	X		X	
Channel Condition & Dynamics:								
Width/Depth Ratio	X	X			X	X		
Streambank/Channel Complexity	X	X			X	X		
Floodplain Connectivity	X	X	X		X			
Stream Flow/Hydrology:								
Change in Peak/Base Flows	X	X			X			
Increase in Drainage Network	X	X			X			
Estuarine Habitat:								
Extent/Cond. of Habitat/Types			X		X	X		
Extent/Cond. of Eelgrass Beds			X			X		
Water Quality, Also Disease & Contaminants		X	X	X		X		
Water Quantity/Timing of Fresh Water Inflow	X				X	X		
Prey			X	X	X	X	X	
Predators			X	X	X	X	X	
Marine Habitat Elements:								
Water Quality/Disease/Contaminants		X		X		X		
Water Quantity/Timing-Riverine Plumes	X							
Prey			X			X	X	

TABLE A-9. Actions with the potential to adversely affect salmon habitat and habitat components likely to be altered (see tables A-8 and A-10 for cross reference on how changes in habitat components affect salmon and generally desired habitat conditions). (Page 2 of 2)

ACTIONS LIKELY TO EFFECT SALMON EFH	REMOVAL/ ALTERATION OF RIPARIAN VEGETATION	ALTER AMOUNT OR RATES OF WOODY DEBRIS INPUT	REMOVAL OF WOODY DEBRIS FROM STREAM, LAKES, BAYS	INCREASE/ DECREASE IN SEDIMENT DELIVERY	STREAMBANK OR SHORELINE ALTERATION	STREAM BED AND CHANNEL ALTERATION (ALSO BEDS, CHANNELS OF LAKES, BAYS)	WATER REMOVAL/ DIVERSION	WETLAND OR FLOODPLAIN ALTERATION
EXAMPLES OF ACTIVITIES THAT MAY INVOLVE THOSE ACTIONS	forestry, agriculture, ranching, road building, construction, gravel and mineral mining	forestry, fire suppression, flood suppression, road building, dams, beaver removal	channel clearing for navigation, rafting, flood or erosion control, wood scavenging, beaver dam removal	forestry, agriculture, ranching, road building, construction, sand and gravel extraction, mineral mining, dredging	forestry, agriculture, grazing, urbanization, erosion or flood control, dock construction, habitat restoration	dredging, sand and gravel removal, erosion control, placement of pipelines, habitat restoration	dam/irrigation/ municipal/ industrial power facility operation, push up dams, groundwater pumping, desalinization	agriculture, ranching, construction, road building, flood control, dredging, beaver removal, habitat restoration
HABITAT COMPONENTS								
Steam Water Quality:								
Temperature	X		X	X	X	X	X	X
Dissolved Oxygen	X			X	X	X	X	X
Sediment/Turbidity	X	X	X	X	X	X	X	X
Nutrients	X	X	X	X		X	X	X
Contaminants	X			X		X	X	X
Habitat Access:								
Physical Barriers		X	X			X	X	X
Stream Habitat:								
Substrate	X	X	X	X	X	X	X	X
Large Woody Debris	X	X	X		X	X	X	X
Pool Frequency	X	X	X	X	X	X	X	X
Pool Quality	X	X	X	X		X	X	X
Off-Channel Habitat	X	X	X		X	X	X	X
Prey	X	X	X		X	X	X	X
Predators	X	X	X		X	X		X
Channel Condition & Dynamics:								
Width/Depth Ratio	X	X	X	X		X	X	X
Streambank/Channel Complexity	X	X	X	X	X	X	X	X
Floodplain Connectivity	X	X	X	X	X	X	X	X
Stream Flow/ Hydrology:								
Change in Peak/Base Flows	X	X	X		X	X	X	X
Increase in Drainage Network	X				X	X	X	X
Estuarine Habitat:								
Extent/Cond. of Habitat Types	X	X	X	X	X	X	X	
Extent/Cond. of Eelgrass Beds				X	X	X	X	X
Water Quality, Also Disease and Contaiminents				X	X	X	X	
Water Quantity/Timing of Fresh Water Inflow					X		X	X
Prey	X			X	X	X		X
Predators	X			X	X	X		X
Marine Habitat Elements:								
Water Quality, Also Disease & Contaminants								
Water Quantity/Timing-Riverine Plumes								
Prey								

TABLE A-10. Habitat objectives and indicators. The ranges of criteria presented here are generally applicable, but not absolute, some watersheds may have unique geology, geomorphology, hydrology, and other conditions that may not permit achieving the target habitat conditions. Target conditions can be established on a regional or watershed (USGS 5th Field) basis as needed to account for those factors (*please see footnote). (Page 1 of 3)

HABITAT ELEMENT	INDICATORS	PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
Water Quality:	Temperature	50-57˚F [a/]	57-60˚F (spawning) 57-64˚F (migration & rearing)[b/]	> 60˚F (spawning) > 64˚F (migration & rearing)[b/]
	Sediment/Turbidity	<12% fines (<0.85mm) in gravel, [c/] turbidity low	12-17% (west-side), [c/] 12-20% (east-side), [b/] turbidity moderate	>17% (west-side), [c/] >20% (east side) fines at surface or depth in spawning habitat, turbidity high [b/]
	Chemical Contamination/ Nutrients	low levels of chemical contamination from agricultural, industrial, and other sources, no excess nutrients, no CWA 303d designated reaches [d/]	moderate levels of chemical contamination from agricultural, industrial and other sources, some excess nutrients, one CWA 303d designated reach [d/]	high levels of chemical contamination from agricultural, industrial, and other sources; high levels of excess nutrients, more than one CWA 303d designated reach [d/]
Habitat Access:	Physical Barriers	any man-made barriers present in watershed allow upstream and downstream juvenile and adult fish passage at all flows	any man-made barriers present in watershed do not allow upstream and/or downstream fish passage at base/low flows	any man-made barriers present in watershed do not allow upstream and/or downstream fish passage at a range of flows
Stream Habitat Elements:	Substrate	dominant substrate is gravel or cobble (interstitial spaces clear), or embeddedness <20%[c/]	gravel and cobble is subdominant, or if dominant, embeddedness 20-30%[c/]	bedrock, sand, silt or small gravel dominant or if gravel and cobble dominant, embeddedness >30%[b/]
	Large Woody Debris Quantity of Key Pieces	<u>Coast</u>: >80 pieces/mile >24"diameter >50 ft. length;[e/] <u>East-side:</u> >20 pieces/mile >12"diameter >35 ft. length [b/]; and adequate sources of woody debris recruitment in riparian areas.	currently meets standards for properly functioning, but lacks potential sources from riparian areas of woody debris recruitment to maintain that standard	does not meet standards for properly functioning and lacks potential large woody debris recruitment
	Pool Frequency [f/] <u>channel width</u> <u># pools/mile</u> 5 feet 184 10 " 96 15 " 70 20 " 56 25 " 47 50 " 26 75 " 23 100 " 18	meets pool frequency standards (left) and large woody debris recruitment standards for properly functioning habitat (above)	meets pool frequency standards but large woody debris recruitment inadequate to maintain pools over time	does not meet pool frequency standards
	Pool Quality	pools >1 m deep (holding pools) with good cover and cool water,[c/] minor reduction of pool volume by fine sediment	few deeper pools (>1 meter) and present or inadequate cover/temperature,[c/] moderate reduction of pool volume by fine sediment	no deep pools (>1 meter) and inadequate cover/temperature[c/] major reduction of pool volume by fine sediment
	Off-Channel Habitat	backwaters with cover, and low energy off-channel areas (ponds, oxbows, etc.)[c/]	some backwaters and high energy side channels[c/]	few or no backwaters, no off-channel ponds[c/]
	Refugia (important remnant habitat for sensitive aquatic species)	habitat refugia exist, and are adequately buffered (e.g., by intact riparian reserves); existing refugia are sufficient in size, number and connectivity to maintain viable populations or sub-populations[g/]	habitat refugia exist, but are not adequately buffered (e.g., by intact riparian reserves); existing refugia are insufficient in size, number and connectivity to maintain viable populations or sub-populations[g/]	adequate habitat refugia do not exist.[g/]

TABLE A-10. Habitat objectives and indicators. The ranges of criteria presented here are generally applicable, but not absolute, some watersheds may have unique geology, geomorphology, hydrology, and other conditions that may not permit achieving the target habitat conditions. Target conditions can be established on a regional or watershed (USGS 5th Field) basis as needed to account for those factors (*please see footnote). (Page 2 of 3)

HABITAT ELEMENT	INDICATORS	PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
Channel Condition & Dynamics:	Width/Depth Ratio	<10[b/e/]	>10	>10
	Streambank Condition	>90% stable; i.e., on average, less than 10% of banks are actively eroding[b/]	80-90% not eroding	<80% not eroding
	Floodplain Connectivity	off-channel areas are frequently hydrologically linked to main channel; overbank flows occur and maintain wetland functions, riparian vegetation and succession	reduced linkage of wetland, floodplains and riparian areas to main channel; overbank flows are reduced relative to historic frequency, as evidenced by moderate degradation of wetland function, riparian vegetation/succession	severe reduction in hydrologic connectivity between off-channel, wetland, floodplain and riparian areas; wetland extent drastically reduced, riparian vegetation/succession altered significantly, and channel degradation apparent
Flow/Hydrology:	Change in Peak/ Base Flows	watershed hydrograph indicates peak flow, base flow and flow timing characteristics comparable to an undisturbed watershed of similar size, geology and geography	some evidence of altered peak flow, baseflow and/or flow timing relative to an undisturbed watershed of similar size, geology and geography.	pronounced changes in peak flow, baseflow and/or flow timing relative to an undisturbed watershed of similar size, geology and geography
	Increase in Drainage Network	zero or minimum increases in drainage network density from roads[h/i/]	moderate increases in drainage network density from roads (e.g., about 5%)[h/i/]	significant increases in drainage network density from roads (e.g., 20-25%)[h/i/]
Watershed Conditions:	Road Density & Location	<2 mi/mi², [j/] no valley bottom roads	2-3 mi/mi², some valley bottom roads	>3 mi/mi², many valley bottom roads
	Disturbance History	<15% ECA **(entire watershed) with no concentration of disturbance in unstable or potentially unstable areas, and/or refugia, and/or riparian area; and for NWFP area (except AMAs**), ≥15% retention of LSOG in watershed[k/]	<15% ECA** (entire watershed), but disturbance concentrated in unstable or potentially unstable areas, and/or refugia, and/or riparian area; and for NWFP area (except AMAs), ≥15% retention of LSOG in watershed[k/]	>15% ECA** (entire watershed) and disturbance concentrated in unstable or potentially unstable areas, and/or refugia, and/or riparian area; does not meet NWFP standard for LSOG retention
	Riparian Reserves	the riparian reserve system provides adequate shade, large woody debris recruitment, and habitat protection and connectivity in all subwatersheds, and includes known refugia for sensitive aquatic species (>80% intact), and/or for grazing effects: percent similarity of riparian vegetation to the potential natural community/ composition >50%[l/]	moderate loss of connectivity or function (shade, LWD recruitment, etc.) of riparian reserve system, or incomplete protection of habitats and refugia for sensitive aquatic species (≈70-80% intact), and/or for grazing effects: percent similarity of riparian vegetation to the potential natural community/composition 25-50% or better[l/]	riparian reserve system is fragmented, poorly connected, or provides inadequate protection of habitats and refugia for sensitive aquatic species (<70% intact), and/or for grazing effects: percent similarity of riparian vegetation to the potential natural community/composition <25%[l/]
Estuarine Conditions:	Habitat Quantity/ Quality	the estuarine system provides for adequate, prey production, cover, and habitat complexity, for both smolts and returning adults	moderate loss of prey production, cover, and habitat complexity	gross loss of prey production, cover, and habitat complexity
	Aerial Extent	estuary provides for most (i.e., greater than 80% intact) of its historical areal extent and diversity of shallow water habitat types including vegetated wetlands and marshes, tidal channels, submerged aquatic vegetation, tidal flats, and large woody debris	50-80% of pre-modification area or volume and diversity of habitats	<50% of pre-modification area or volume; low diversity of habitats
	Hydrologic Conditions/ Sediment/ Nutrient Input	fresh water inflow and other hydrologic circulation patterns and sediment and nutrient inputs are similar to historic conditions	Moderate interrruption of estuarine circulation and nutrient and sediment delivery	Gross interrruption of estuarine circulation and nutrient and sediment delivery

TABLE A-10. Habitat objectives and indicators. The ranges of criteria presented here are generally applicable, but not absolute, some watersheds may have unique geology, geomorphology, hydrology, and other conditions that may not permit achieving the target habitat conditions. Target conditions can be established on a regional or watershed (USGS 5th Field) basis as needed to account for those factors (*please see footnote). (Page 3 of 3)

HABITAT ELEMENT	INDICATORS	PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
Estuarine Water Quality	Dissolved Oxygen, Temperature, Nutrients, Chemical Contamination	water quality standards for aquatic life protection met	water quality standards are not met intermittently when salmon are present	water quality standards are consistently not met when salmon are present
	Sediments	sediments have low levels of chemical contamination, especially of persistent aromatic hydrocarbons, heavy metals, or other compounds known to bio-accumulate	sediments have moderate levels of chemical contaminants	sediments have high levels of chemical contaminants
	Exotic Species That are Non-indigeneous Aquatic Nuisance Species	exotic species that are non-indigeneous and aquatic nuisance species are at low and decreasing levels and not interfering with estuarine system functions	sustained presence of multiple exotic species that are nonindigeneous and aquatic nuisance species in significant abundance	predominance of exotic species that are nonindigenous and aquatic nuisance species, low abundance of many native species with some low or extirpated.

* This table is adapted from an August 1996 NMFS report entitled *Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale*. Since this table was designed to be applied to a wide range of environmental conditions, there will be circumstances where the ranges of numerics or descirptions in the table do not apply to a specific watershed or basin. In such instances, more appropriate biological values for the target habitat objectives should be established on a watershed-specific basis. Target conditions to account for specific conditions in various areas have been developed, including, but not limited to: Oregon Coast Province, Southwest Province Tyee Sandstone, Western Cascades Physiographic Region, High Cascades Physiographic Region, Klamath Province/Siskyou Mountains.

** ECA= Equivalent Clear-Cut Area; AMA = Adaptive Management Area

a/ Bjornn, T. and D. Reiser. 1991. Habitat Requirements of Salmonids in Streams. American Fisheries Society Special Publication 19:83-138. Meehan, W.R., ed.

b/ Biological Opinion on Land and Resource Management Plans for the: Boise, Challis, Nez Perce, Payette, Salmon, Sawtooth, Umatilla, and Wallowa-Whitman National Forests. March 1, 1995.

c/ Washington Timber/Fish Wildlife Cooperative Monitoring Evaluation and Research Committee, 1993. Watershed Analysis Manual (Version 2.0). Washington Department of Natural Resources.

d/ A Federal Agency Guide for Pilot Watershed Analysis (Version 1.2), 1994.

e/ NMFS Biological Opinion on Implementation of Interim Strategies for Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California (PACFISH).

f/ USDA Forest Service, 1994. § 7 Fish Habitat Monitoring Protocol for the Upper Columbia River Basin.

g/ Frissell, C.A., Liss, W.J., and David Bayles, 1993. An Integrated Biophysical Strategy for Ecological Restoration of Large Watersheds. Proceedings from the Symposium on Changing Roles in Water Resources Management and Policy, June 27-30, 1993 (American Water Resources Association), p. 449-456.

h/ Wemple, B.C., 1994. Hydrologic Integration of Forest Roads with Stream Networks in Two Basins, Western Cascades, Oregon. M.S. Thesis, Geosciences Department, Oregon State University.

I/ e.g., see Elk River Watershed Analysis Report, 1995. Siskiyou National Forest, Oregon.

j/ U.S. Department of Agriculture (USDA) Forest Service, 1993. Determining the Risk of Cumulative Watershed Effects Resulting from Multiple Activities.

k/ Northwest Forest Plan, 1994. Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl. USDA Forest Service and U.S. Department of Industry (USDI) Bureau of Land Management.

l/ Winward, A.H., 1989 Ecological Status of Vegetation as a base for Multiple Product Management. Abstracts 42nd annual meeting, Society for Range Management, Billings, Montanta, Denver, Colorado: Society for Range Management: p. 277.

Four broad scenarios set the stage for EFH consultations. The specifics of each consultation, including suggested EFH conservation and enhancement recommendations, will be tailored to meet the proposed program or project activity.

1. **Federal actions involving ESA-listed species:** In the situation where federal agency actions are subject to Section 7 consultations under the ESA, such consultations will be combined with EFH consultations to accommodate the substantive requirements of both ESA and the Magnuson-Stevens Act as appropriate.

2. **Federal actions that do not involve ESA-listed species:** Under this scenario, federal agency actions are not subject to the ESA Section 7 consultation requirements, but are subject to the EFH consultation requirements of the Magnuson-Stevens Act. In this circumstance, a programmatic approach to consultation, tiering from the general program to specific actions, will be most appropriate. When programmatic consultations are completed, project-specific consultations should only be necessary on those actions not contemplated by the programmatic consultation, or those actions identified as needing individual consultation in the programmatic consultation.

   Included in this scenario are federal agency actions subject to the National Environmental Policy Act, Federal Power Act, and/or Section 404 of the Clean Water Act. The federal agency would request NMFS make a finding that an existing process can be used to meet EFH consultation requirements. NMFS would respond with a letter detailing how the existing process would be used for the EFH consultation and would work with the action agency to ensure the EFH consultation process is folded into the agency's environmental review process under one of these statutes. EFH information would be submitted through the existing practice, and NMFS would provide conservation recommendations as part of its existing role in the process.

3. **Nonfederal actions involving ESA-listed species:** For nonfederal actors, EFH consultation is voluntary. In situations where nonfederal actions occur in areas under a NMFS-approved conservation plan, NMFS participation in, and approval of the plan would be combined with the EFH consultation and would constitute the NMFS requirements of the Magnuson-Stevens Act for providing conservation recommendations to state agencies. Included in this scenario would be coordination with Section 4(d) rulemaking, Section 4(f) recovery planning, and Section 10 permitting under the ESA.

4. **Nonfederal actions that do not involve ESA-listed species:** States and tribes are not required to consult with NMFS under the Magnuson-Stevens Act provisions for EFH unless there is a federal nexus. However, NMFS will provide conservation recommendations to state agencies on actions identified by PFMC as having a substantial adverse effect on salmon habitat or upon state agency request.

3.2.1.3 NMFS/PFMC Cooperation on EFH

Section 305(b)(3) of the Magnuson-Stevens Act allows regional fishery management councils to comment on and make recommendations to NMFS and any federal or state action agency concerning any activity that, in the view of the Councils, may adversely affect the habitat, including EFH, of a fishery resource under its authority. However, while NMFS and PFMC have the authority to act independently, it is the intention of both to cooperate as closely as possible to identify actions that may adversely affect EFH, to develop comments and EFH conservation recommendations to federal and state agencies, and to provide EFH information to federal or state agencies.

PFMC and NMFS will develop agreements to facilitate sharing information on actions that may adversely affect EFH and in coordinating Council and NMFS comments and recommendations on those actions. For example, if a federal action agency decision is also inconsistent with a PFMC recommendation made pursuant to Section 305(b)(3) of the Magnuson-Stevens Act, PFMC may request NMFS initiate further review of the federal agency's decision and involve PFMC in any interagency discussion to resolve disagreements with the federal agency.

3.2.2 Salmonid Habitat Requirements

To maintain or restore habitat necessary for a sustainable salmon fishery requires the biophysical processes producing properly functioning habitat be maintained or restored. However, since watersheds and streams differ in their characteristic flow, temperature, sedimentation, nutrient levels, physical structure, biological components, etc.; specific habitat requirements of salmonids differ among species and life-history types; and these requirements change with season, life stage, and presence/absence of other biota; there is no simple definition of salmonid habitat requirements. Table A-11 is an overview of the general major habitat requirements and habitat concerns during each life stage of the salmon's life cycle. The goal of salmonid conservation should be to ensure salmonid habitat requirements are met by maintaining habitat features within the natural range for the particular system. The range of patterns and processes which define the properly functioning habitat conditions within which salmon can exist are enumerated in the first three columns of Table A-10 ("Habitat objectives and indicators"). These conditions can be used for evaluating the effects of development-related activities on properly functioning habitat conditions for salmonids and as target habitat objectives to be achieved by implementing the conservation measures recommended by NMFS during the EFH consultation process.

Table A-10, modified from the 1996 NMFS "Matrix of Pathways and Indicators" for evaluating the effects of human activities on anadromous salmonid habitat, lists eight major **habitat elements** (column 1), **measurable indicators** associated with habitat function (column 2), and **general parameters or criteria** for the proper functioning of each habitat indicator (column 3). The habitat elements include stream water quality, habitat access, stream habitat elements, channel conditions and dynamics, flow/hydrology, watershed conditions, estuarine conditions, and estuarine water quality. The ranges of criteria presented in this table are generally applicable, and are designed to be applied to a wide range of environmental conditions. The target habitat objectives listed under the "properly functioning condition" column of Table A-10 are by no means absolute since each watershed has a unique geomorphology, hydrology, etc. There will be circumstances where the range of numerics or descriptions simply do not apply to a specific watershed or basin. In such instances, more appropriate biological values for target habitat objectives should be established on a watershed or site-specific basis as needed to account for ecological variability. Maintenance and recovery of such properly functioning conditions can be used to assess effects of proposed federal agency actions on anadromous salmonid habitat.

An extensive review of existing information on salmonid habitat requirements generated the data summarized in Tables A-3, A-4, and A-5 (chinook, coho, and pink salmon habitat use by life history stage), Table A-11 (Summary of major habitat requirements and concerns during each stage of the salmon's life cycle), and Table A-10 ("Habitat objectives and indicators").

- Tables A-3 through A-5 summarize, by species, the life history stage, diet, season/time, location in substrate and in water column, ocean features, and oxygen/temperature/salinity requirements for the stage.

- Table A-11 reviews salmon movements and habitat use (e.g., for adult migration pathways, spawning and incubation, stream rearing, smolt migration, estuarine and marine residence), the characteristic features required in each habitat (e.g., gravel and cobble with sufficient water and oxygen during spawning and rearing), and the commonest expression of habitat degradation found (e.g., elevated temperatures, reduced pool frequency, etc.).

- Table A-10, by describing indicators of the functioning of specified habitat elements or "pathways", as well as criteria for proper functioning/risk/malfunction of the listed habitat elements, sets the broad habitat conditions to be targeted by conservation and enhancement activities.

The information cited on salmonid life history, range of requirements, and types of adverse effects detailed in the tables are reconfirmed throughout the existing technical literature and appear to provide reliable descriptions of generalized baseline habitat.

TABLE A-11. Summary of major habitat requirements and concerns during each stage of the salmon's life cycle.

HABITAT REQUIREMENTS	HABITAT CONCERNS
Adult Migration Pathways Adult salmon leave the ocean, enter fresh water, migrate upstream to spawn in the stream of their birth.	Passage blockage (e.g., culverts, dams) Water quality (high temperatures, pollutants) High flows/low flows/water diversions Channel modification/simplification Reduced frequency of holding pools Lack of cover, reduced depth of holding pools Reduced cold-water refugia Increased predation resulting from habitat modifications
Spawning and Incubation Salmon lay their eggs in gravel or cobble nests called redds. To survive eggs (and the alevins that hatch and remain in the gravel) must receive sufficient water and oxygen flow within the gravel.	Availability of spawning gravel of suitable size Siltation of spawning gravels Redd scour caused by high flows Redd de-watering Temperature/water quality problems Redd disturbance from trampling (human, animal).
Stream Rearing Habitat Juvenile salmon may remain in fresh water streams over a year. They must find adequate food, shelter, and water quality conditions to survive, avoid predators, and grow. They must be able to migrate upstream and downstream within their stream and into the estuary to find these conditions and to escape high water or unfavorable temperature conditions.	Diminished pool frequency, area, or depth Diminished channel complexity, cover Temperature/water quality problems Blockage of access to habitat (upstream or down) Loss of off-channel areas, wetlands Low water flows/high water flows Predation caused by habitat simplification or loss of cover Nutrient availability Diminished prey/competition for prey
Smolt Migration Pathways Smolts swim and drift through the streams and rivers, and must reach the estuary or ocean when there are adequate prey and water quality conditions and must find adequate cover to escape predators as they migrate.	Water quality Low water flows/high water flows Altered timing/quantity of water flows Passage blockage/diversion away from stream Increased predation resulting from habitat simplification or modification
Estuarine Habitat Estuaries provide a protected and food-rich environment for juvenile salmon growth and allow the transition for both juveniles and adults between the fresh and salt water environments. Adults also may hold and feed in estuaries before beginning their upstream migration.	Water quality Altered timing/quantity of fresh water in-flow Loss of habitat resulting from diking dredging, filling Diminished habitat complexity Loss of channels, eelgrass beds, woody debris Increased predation resulting from habitat simplification Diminished prey/competition for prey
Marine Habitat The ocean environment provides the food resources necessary for development and growth. Juvenile salmon may depend on near shore rocks and kelp beds for food resources. Depending on species and stock, salmon may spend from one to five years growing in the ocean.	Water quality Altered timing/quantity/composition of river water plumes Diminished prey/competition for prey Increased predation

3.2.3 Adverse Effects on Essential Fish Habitat

The intent of EFH guidance is to enable regional development activities to avoid or minimize adverse effects by forward, informed planning. This is the essence of sustainable development. A measure of its success is the maintenance of properly functioning salmonid habitat conditions (Table A-10). A corollary is the restoration of diminished salmonid resources and their roles in regional economies, culture, and ecosystems through restoration of degraded or lost habitat. Maintenance and recovery of properly functioning conditions can be used to assess effects of proposed federal agency actions on EFH. Useful tools in the assessment of project effects are the NMFS' 1996 "Matrix of Pathways and Indicators" and associated decision tree for making effective determinations for individual or grouped actions at the watershed scale. The highest benefit to cost ratios of mitigations are achieved with timely informed plans which detail likely resources to be affected and actions which can avoid or minimize adverse effects to properly functioning habitat.

Having established the elements of salmonid habitat and objectives for its proper functioning in Table A-10, the likely adverse effects of common development-associated activities are outlined in Table A-9. Table A-9 shows the various types of actions that are likely to have either a direct, indirect, cumulative, or synergistic effect on salmon EFH. The check marks in Table A-9 indicate the habitat elements, or pathways, that are likely to be altered by the specified action. In other words, this matrix cross-references habitat elements, or pathways, (e.g., channel condition and dynamics) with indicators for these components (e.g., flood plain connectivity or channel width/depth) with sixteen types of adverse actions likely to affect salmon EFH, and examples of activities which generate these actions (e.g., forestry, grazing, spoil disposal, etc.). Table A-9 ("Examples of habitat alteration effects on Pacific salmon") summarizes how habitat alterations listed in Table A-9 can harm salmon. For example, if increased temperature results from grazing activities, altered adult migration patterns, accelerated egg development, parasite susceptibility in juveniles can be expected. The value of describing the effect on the behavior, physiology, and development of the fish, is in devising targeted, effective, useful mitigation.

3.2.4 Conservation and Enhancement Measures

3.2.4.1 Background

Section 600.815 (a)(7) of the interim final EFH regulations states that FMPs must describe options to avoid, minimize, or compensate for the potential adverse effects and promote the conservation and enhancement of EFH. Terrestrial activities may have adverse impacts on EFH. Activities that may result in significant adverse effects on EFH should be avoided where less environmentally harmful alternatives are available. Environmentally sound engineering and management practices should be employed for all actions which may adversely affect EFH. Disposal or spillage of any material (dredge material, sludge, industrial waste, or other potentially harmful materials) which would destroy or degrade EFH should be avoided. If avoidance or minimization is not possible, or will not adequately protect EFH, compensation for damage to, and/or mitigation to conserve and enhance EFH should be recommended. FMPs may recommend proactive measures to conserve or enhance EFH. When developing proactive measures, regional fishery management councils may develop a priority ranking of the recommendations to assist federal and state agencies undertaking such measures.

3.2.4.2 Measures

Established policies and procedures of PFMC and NMFS provide the framework for conserving and enhancing EFH. Components of this framework include adverse impact avoidance and minimization, compensatory mitigation, and enhancement. New and expanded responsibilities contained in the Magnuson-Stevens Act will be met through appropriate application of these policies and principles. The Interim Final Rule on EFH provides that NMFS' EFH consultation recommendations will not suggest that federal or state agencies take actions beyond their statutory authority [62 Federal Register 66559, Section 600.925(a)]. In assessing the potential impacts of proposed projects, PFMC and NMFS are guided by the following general considerations:

- The extent to which the activity would directly and indirectly affect the distribution, abundance, health, and continued existence of salmon and their EFH.
- The extent to which the potential for cumulative impact exists.
- The extent to which adverse impacts can be avoided through project modification, alternative site selection or other safeguards.
- The extent to which minimization or mitigation may be used to reduce unavoidable loss of habitat functions and values.

- The extent to which compensation mitigation may be used to offset unavoidable loss of habitat functions and values.

The range of potential conservation measures necessary to avoid, minimize, and compensate for adverse effects needs to be suggested to project proponents and sponsors during an “early involvement” process [e.g., consultation streamlining (USFS/BLM), pre-licensing procedures (FERC), permit comment letters (COE), comments on draft biological assessments, etc.]. NMFS involvement with federal agencies at this stage allows for planning of actions in a manner that maintains properly functioning salmonid habitat. Both land use and remedial actions need to promote achievement of the habitat objectives for properly functioning conditions listed in Table A-10. The logic of the approach which employs the Tables described above is illustrated in Figure A-8. A number of technically informed approaches and methods have been developed for mitigating the adverse effects of different project actions. Experience indicates the specific selection of conservation and enhancement measures, and, mitigation strategies and tactics must respond to the particular kinds of actions and site characteristics. More specific guidelines tailored to specific agency activities and category of threat can be developed during, or prior to, the consultation process in conjunction with federal and state agencies, tribes, and interested parties.

FIGURE A-8. Example of logic train in the use of salmonid EFH conservation recommendations relative to one indicator.

ACTION

Spring grazing near riparian area – Table A-9, column 2

EFFECTS

Soil compaction, creation of impervious surfaces and soil erosion leading to increased sediment delivered to stream (Table A-10, column 1), degradation to in-stream water quality (increased sediment/turbidity of >12% fines), and degradation of stream habitat elements (reduced substrate gravel, cobble and > 20% embeddedness, – Table A-10, columns 1,2,3

IMPACTS TO FISH

Reduced egg and alevin survival, primary/secondary productivity, interference with feeding, behavioral avoidance and breakdown of social organization, pool filling (i.e., reduced spawning and incubation success) – Table A-8, column 3

RESPONSE TO ACHIEVE PROPERLY FUNCTIONING HABITAT CONDITIONS

Conservation measures which reduce sediment loads to <12% fines, lower turbidity, and reduce embeddedness to <20% – Table A-10, columns 1,2,3

3.2.5 Potential Impacts and Conservation Measures for Nonfishing Activities That May Affect Salmon Essential Fish Habitat

Section 600.815 (a) (5) of the draft interim EFH regulations pertain to identifying nonfishing related activities that may adversely affect EFH. The section states that FMPs must identify activities that have the potential to adversely affect, directly or cumulatively, EFH quantity or quality, or both. Broad categories of activities which can adversely affect salmonid EFH include, but are not limited to:

Agriculture
Artificial Propagation of Fish and Shellfish
Bank Stabilization
Beaver Removal and Habitat Alteration
Construction/Urbanization
Dam Construction/Operation
Dredging and Dredged Spoil Disposal
Estuarine Alteration
Forestry
Grazing
Habitat Restoration Projects
Irrigation Water Withdrawal, Storage and Management
Mineral Mining
Nonnative Species, Introduction/Spread of
Offshore Oil and Gas Exploration, Drilling and Transportation Activities
Road Building and Maintenance
Sand and Gravel Mining
Vessel Operations
Wastewater/Pollutant Discharge
Wetland and Floodplain Alteration
Woody Debris/Structure Removal From Rivers and Estuaries

Any of the above activities may eliminate, diminish, or disrupt the functions of salmonid EFH. These activities can potentially affect EFH through associated factors, including increased suspended solids, sedimentation, nutrient loading, toxic chemicals, high bacterial concentrations and physical disruption of habitat. While toxic contaminants, nutrient loading, oxygen depletion and eutrophocation, increased suspended solids, bacterial contamination, and hypoxia may not directly affect loss of physical habitat, all these factors are elements of water quality and hence EFH quality. The goals specified under Section 101(a)(2) of the federal Clean Water Act inherently address the EFH needs of aquatic organisms: "water quality which provides for the protection and propagation of fish, shellfish, and wildlife ...". Section 303(d) of the federal Clean Water Act used in conjunction with standards, provides the tools to manage water quality, and hence EFH quality. Under the mandate promulgated by the 1996 amendment to the Magnuson-Stevens Act, only federal agencies are required to consult with Fishery Management Councils and NMFS regarding activities that may adversely affect EFH. Under the Clean Water Act, states, territories and tribes obtain approval of water quality standards from the EPA. Under EFH, EPA will have the opportunity to consult with NMFS prior to standards approval.

Each of these nonfishing-related activities may directly, indirectly, or cumulatively, temporarily or permanently, threaten the physical, chemical, and biological properties of the habitat utilized by salmonid species and/or their prey. The direct results of these threats is that salmonid EFH may be eliminated, diminished, or disrupted. The list includes common activities with known or potential impacts to salmonid EFH. The list is not prioritized, nor is it all-inclusive. Each of the above activities is described below along with conservation measures and management alternatives.

The conservation measures and management alternatives are not designed to be site-specific, but rather to be indicative of the spectrum of possible considerations for the conservation and enhancement of salmon EFH, and which might be applied to specific activities. This menu of suggested conservation options is based on the best scientific information available at this time. NMFS and PFMC are not bound by these measures in the future. All of these measures are not necessarily applicable to each future project or activity that may adversely impact salmon EFH. More specific or different measures based on the best and most current scientific information may be developed during or prior to the consultation process and communicated to the appropriate agencies.

3.2.5.1 Agriculture

During agricultural activities, land surface alterations may be extensive, because vegetation alteration and disturbances to the soil can occur several times per year. In addition, agriculture can take place on historical flood plains of river systems, where it has a direct effect on stream channels and riparian functions. Furthermore, irrigated agriculture frequently requires diversion of surface waters, which may decrease streamflow, lower water tables, and increase water quality problems, e.g., higher water temperatures. (See section on irrigation water withdrawal below.)

Replacing natural grasslands, forests, and wetlands with annual crops may leave areas unvegetated during part of the year and can change the function of plants and soil microbes in the tilled areas. Repeated tillage, fertilization, pesticide application and harvest can permanently alter soil character, resulting in reduced infiltration and increased surface runoff. These changes alter seasonal streamflow patterns by increasing high flows, lowering water tables, and reducing summer base flows in streams.

Agricultural land use can contribute substantial quantities of sediments to streams (Spence *et al.* 1996). Deposited sediment can reduce juvenile salmonid rearing and adult habitat by the filling of pools (Waters 1995), filling the interstitial spaces of bottom gravel, and by reducing the overall surface area available for invertebrates (i.e., prey) and fish production. Suspended sediment can decrease primary productivity, deplete invertebrate populations (by increasing downstream drifting) as well as interfere with feeding behavior (Waters 1995).

Agriculture can negatively affect stream temperatures by the removal of riparian forests and shrubs which reduces shading and increases wind speeds. In addition, bare soils may retain greater heat energy than vegetated soils, thus increasing conductive transfer of heat to water that infiltrates the soil or flows overland into streams (Spence *et al.* 1996). In areas of irrigated agriculture, temperature increases during the summer may be exacerbated by heated return flows (Dauble 1994). Warm water temperatures can harm fish directly through various mechanisms (see Table A-8) including oxygen depletion and increased stress and decreased survival.

Agricultural crops may require substantial inputs of water, fertilizer, and pesticides to thrive. Nutrients (e.g., phosphates, nitrates), insecticides, and herbicides are typically elevated in streams draining agricultural areas, reducing water quality, and affecting fish and other aquatic organisms (Omernik 1977; Waldichuk 1993). These changes in water quality can cause ecosystem alterations that affect many biological components of aquatic systems including vegetation within streams, as well as the composition, abundance, and distribution of macroinvertebrates and fishes. These changes can affect the spawning, survival, food supply, and the health of salmon (Stober *et al.* 1979, Northwest Power Planning Council [NPPC] 1986). Though currently used pesticides are not as persistent as previously used chlorinated hydrocarbons, most are still toxic to aquatic life. However, where biocides are applied at recommended concentrations and rates and where there is a sufficient riparian buffer, the toxic effects to aquatic life may be minimal (Spence *et al.* 1996).

Chemicals such as some pesticides, phosphorus, and ammonium are transported with sediment in the adsorbed state. Changes in the aquatic environment, such as a lower concentration of chemicals in the overlying waters or the development of anaerobic conditions in the bottom sediments, can cause these chemicals to be released from the sediment. Phosphorus transported by the sediment may not be immediately available for aquatic plant growth, but does serve as a long-term contributor to eutrophication, a form of pollution caused by over-enrichment (EPA 1993).

Agricultural practices may also include stream channelization, large woody debris removal, installation of rip-rap and revetments along stream banks, and removal of riparian vegetation (Spence *et al.* 1996). Natural channels in easily eroded soils tend to be braided and meander, creating considerable channel complexity as well as accumulations of fallen trees, which help create large, deep, relatively permanent pools, and meander cutoffs. These factors are important to salmon habitat.

Confined animal facilities (e.g., feed lots) may also adversely affect salmon habitat if the concentrated animal waste, process water (e.g., from that of a milking operation), and the feed, bedding, litter, and soil which comes intermixed with the fecal and urinary wastes is not properly contained and managed. If not properly treated, storm water run-off water and process water can carry nutrients, sediment, organic solids, salts, as well as bacteria, viruses, and other microorganisms into salmon habitat (EPA 1993). These pollutants can cause oxygen depletion, turbidity, eutrophication and other effects on the water quality and habitat quality for salmon.

Conservation Measures for Agriculture - The restoration of natural vegetative communities and functions should be a goal of riparian restoration and management projects on agricultural lands. Once riparian areas have recovered, agricultural activities should strive to protect riparian vegetation and water quality through conservation practices and management plans. Conservation practices and management plans should include the measurement of water quality and the attainment of applicable federal and state water quality standards.

The 1996 reauthorization of the Farm Bill (the "Federal Agricultural Improvement and Reform Act") included several conservation programs that provide potential benefit to EFH. They are the Environmental Quality Incentives Program, the Wetlands Reserve Program, and the Conservation Reserve and Enhancement Programs . These programs provide farmers assistance for idling erosion-prone land, preserving wetlands, and undertaking land management conservation practices. Land owners are encouraged to contact their local agricultural extension agents to find out further information about these programs.

Following are the types of measures that can be undertaken by the action agency on a site-specific basis to conserve salmon habitat to conserve, enhance, or restore EFH adjacent to agricultural lands that have the potential to be adversely affected by agricultural activities. Not all of these suggested measures are necessarily applicable to any one project or activity that may adversely affect salmon EFH. More specific or different measures based on the best and most current scientific information may be developed prior to or during the EFH consultation process, and communicated to the appropriate agency. The options represent a short menu of general types of conservation actions that can contribute to the restoration and maintenance of properly functioning salmon habitat. These recommendations are broadly applicable and useful inland as well as in coastal areas. The following suggested measures are adapted from EPA (1993).

- Maintain riparian management zones of appropriate width on all permanent and ephemeral streams that include or influence EFH. The riparian management zones should be wide enough to restore and support riparian functions including shading, large woody debris input, leaf litter inputs, sediment and nutrient control, and bank stabilization functions.

- Reduce erosion and run-off by using such practices as contour plowing and terracing, nontill agriculture, conservation tillage, crop sequencing, cover and green manure cropping and crop residue, and, by maximizing the use of filter strips, field borders, grassed waterways, terraces with safe outlet structures, contour strip cropping, diversion channels, sediment retention basins, and other mechanisms including re-establish vegetation

- Participate in, and benefit from existing programs to encourage wetland conservation and conservation reserves, avoid planting in areas of steep slopes and erodible soils, and avoid disturbance or draining of wetlands and marshes.

- Incorporate water quality monitoring as an element of land owner assistance programs for water quality. Evaluate monitoring results and adjust practices accordingly.

- Minimize the use of chemical treatments within the riparian management zone. Review pesticide use strategies to minimize impact to EFH. Reduce pesticide application by evaluating pest problems, past pest control measures, and following integrated pest management strategies. Select pesticides considering their persistence, toxicity, runoff potential, and leaching potential.

- Optimize the siting of new confined animal facilities or the expansion of existing facilities to avoid areas adjacent to surface waters containing EFH or in areas with high leaching potential to surface or groundwater. Use appropriate methods to minimize discharges from confined animal facilities (for both wastewater and process water).

- Where water quality is limited from nutrients or where leaching potential is high, avoid land application of manure or other fertilizer unless appropriate management measures are in place to assure that sediment and nutrient input to surface water is controlled. Observe best management practices to assure that application and timing measures fostering high nutrient utilization are employed.

- Apply conservation measures for water intake (see irrigation water withdrawal, storage and management section below) to agricultural activities where applicable.

3.2.5.2 Artificial Propagation of Fish and Shellfish

Public and private hatcheries, acclimation sites, and net pens producing Pacific salmon (coho, chinook, chum, pink, kokanee, sockeye, steelhead, and cutthroat), trout (Atlantic salmon, brown, rainbow, and golden), char (eastern brook, and lake trout), sturgeon, and several species of warmwater fish operate in and adjacent to salmon EFH in fresh and sea water (NRC 1996, WDFW 1998). Additionally, captive breeding of threatened or endangered stocks of sockeye and spring chinook salmon occurs in Idaho, Oregon, and Washington, and of endangered winter chinook salmon in California (Flagg *et al.* 1995). Shellfish culture in salmon EFH consists primarily of oyster culture, although clams, mussels, and abalone are grown as well.

Currently, there are several hundred public facilities (federal, tribal, and state-operated) producing Pacific salmonids for release into fresh and sea water salmon EFH (NRC 1996). In addition, hundreds of private hatcheries in salmon EFH produce various salmon and trout species, as well as catfish and tilapia, for commercial sale.

The artificial propagation of native and nonnative fish and shellfish species in or adjacent to salmon EFH has the potential to adversely affect that habitat by altering water quality, modifying physical habitat, and creating impediments to passage. Artificial propagation may also adversely impact EFH by predation of native fish by introduced hatchery fish, competition between hatchery and native fish for food and habitat, exchange of diseases between hatchery and wild populations, the release of chemicals in natural habitat, and the establishment of nonnative populations of salmonids and nonsalmonids. Many of these potential adverse affects have been summarized by Fresh (1997). These concerns have lead to revision of many hatchery policies to eliminate or reduce impacts on wild fish (USFWS 1984; ODFW 1995; WDF 1991; NWIFC/WDFW 1998).

Various methods of shellfish culture and harvest also have the potential to adversely impact salmon EFH, such as dredging in eelgrass beds, off-bottom culture, raft and line culture, and the use of chemicals to control burrowing organisms detrimental to oyster culture. To control burrowing shrimp, for example, Washington State has used the pesticide carbaryl since 1963. About 800 acres are treated with carbaryl annually in Grays Harbor and Willapa Bay, with a given oyster bed sprayed about every 6 years. Nontarget effects of carbaryl use include short-term decreases in the density of prey species for salmon as well as the mortality of nontarget benthic invertebrates and nonsalmonid fish (Pozarycki *et al.* 1997, Simenstad and Fresh 1995). Concerns over such potential adverse impacts have led to the development of regulations for the use of chemicals in natural habitat and policies for offsetting losses to eelgrass beds (WDF 1992). On a positive note, some methods of mollusc culture have been shown to create beneficial habitat for salmonids (Johnson 1998, pers. comm.).

Treated wood structures in salmon EFH (e.g., creosote, chromated copper, arsenate) used for docks, pilings, raceway separators, fish ladders etc., and other structures can release toxic heavy metals and persistent aromatic hydrocarbons into the aquatic environment (see estuarine section).

Conservation Measures for Artificial Propagation of Fish and Shellfish) - The following lists the types of measures that can be undertaken by the action agency on a site-specific basis to conserve salmon EFH in areas that have the potential to be adversely affected by the artificial propagation of fish and shellfish. Not all of these suggested measures are necessarily applicable to any one project or activity that may adversely affect salmon EFH. More specific or different measures based on the best and most current scientific information may be developed prior to, or during, the EFH consultation process and communicated to the appropriate agency. The options represent a short menu of general types of conservation actions that can contribute to the restoration and maintenance of properly functioning salmon habitat.

- Follow published guidelines and policies designed for artificial propagation operations in salmon EFH to reduce or eliminate ecological interactions between cultured and native salmonids (Alaska Department of Fish and Game [ADFG] 1985; ODFW 1995; WDF 1991; NWIFC/WDFW 1998).

- Follow state, tribal, and federal regulations pertaining to the transfer of fish and eggs to minimize the potential for adverse effects from the transfer of disease organisms (ADFG 1988; USFWS 1984; NWIFC/WDFW 1998).

- Use either local stocks, or a stock or species with no documented or likely risk for ecological interactions with Pacific salmonids in public or private marine net-pen and aquaculture systems for salmonids which are located near streams with depressed population(s) of native salmonids (ODFW 1995; WDF 1991; NWIFC/WDFW 1998).

- Comply with state and federal regulations on use and reporting of drugs, pesticides, and chemicals (ADFG 1983; USFWS 1984; NWIFC/WDFW 1998) .

- Comply with state and federal regulations for discharge, monitoring, and reporting of water quality (e.g., discharge of fish and food wastes), sediment, and benthic habitat conditions in and around artificial propagation facility discharges (Washington Department of Ecology [WDOE] 1986), disease outbreaks, and for the disposal of dead fish .

- Minimize the use of biocides and wood preservatives. Promote the use of plastic building materials. Treated wood should be certified as produced in accordance with the most current version of "Best Management Practices for Treated Wood in Western Aquatic Environments" (Western Wood Preservers Institute [WWPI] 1996). Treated materials containing copper compounds should not be installed when migrating salmon are present.

- Comply with current policies for release of hatchery fish to minimize impacts on native fish populations and their ecosystems and to minimize the percentage of nonlocal hatchery fish spawning in streams containing native stocks of salmonids (ODFW 1995; WDFW 1997).

- Manage shellfish culture activities to provide levels of salmon prey production, cover, and habitat complexity for both salmon smolts and returning adults which are similar to, or better than, levels provided by the natural environment.

3.2.5.3 Bank Stabilization

The extent and magnitude of stream bank erosion has been greatly increased by human activities that remove riparian vegetation, increase sediment inputs, relocate and straighten channels, or otherwise cause channel down-cutting. Vessel traffic and the resulting wakes can also create bank scour.

Attempts to deal with the bank erosion resulting from these activities often involve the use of adding adamantine-like materials. In smaller streams, particularly those that seasonally become dry or nearly dry, bulldozing of streambed gravel against the banks has been a common practice to retard erosion. In larger streams (and rivers) the dumping or placement of rock (riprap), broken concrete, and mixtures of materials (i.e., rocks, dirt, branches) along the banks is a common practice (Oregon Water Resources Research Institute [OWRRI] 1995). Additionally bulkheads and concrete walls have been used on lake and estuarine shores. Concerns for salmon that are associated with shoreline stabilization include loss of shallow edgewater rearing habitat, changes to benthic vegetation, impacts to eelgrass and other vegetation important for herring spawning, loss of shoreline riparian vegetation and reduction in leaf fall, loss of wetland vegetation, alteration of groundwater flows, loss of large woody debris, changes in food resources, and loss of migratory corridors (Puget Sound Water Quality Action Team [PSWQAT] 1997, Thom and Shreffler 1994).

The installation of riprap or other streambank stabilization devices can reduce or eliminate recruitment of crucial spawning gravel by eliminating lateral erosion, as has occurred in the Sacramento River (PFMC 1988). By confining the stream or shoreline with hard materials, the development of side channels, functioning riparian and floodplain areas, and off-channel sloughs are precluded (WDFW 1997).

Another concern is the use of chemicals (e.g., creosote, chromated copper arsenate, copper zinc arsenate) on bulkheads or other wood materials used for bank stabilization. These chemicals can introduce toxic substances into the water, injure or kill prey organisms and salmon directly, or concentrate in the food chain ([WMOA] 1995). Their use is generally prohibited. In freshwater, copper concentrations are acutely toxic to yearly coho salmon at 60-74 mg/l in freshwater, but affect smoltification, migration, and survival at 5–30 mg/l (Lorz and McPherson 1976).

Conservation Measures for Bank Stabilization - Following are the types of measures that can be undertaken by the action agency on a site-specific basis to conserve salmon EFH in areas that have the potential to be affected by bank stabilization activities. Not all of these suggested measures are necessarily applicable to any one project or activity that may adversely affect salmon EFH. More specific or different measures based on the best and most current scientific information may be developed prior to, or during, the EFH consultation process and communicated to the appropriate agency. The options represent a short menu of general types of conservation actions that can contribute to the restoration and maintenance of properly functioning salmon habitat. The following suggested measures are adapted from Streif (1996) and Meyer (1997 pers. comm.).

- Use vegetative methods of bank erosion control whenever feasible. Where vegetative mechanisms are not sufficient alone, explore these methods in conjunction with ground contouring. Hard bank protection should be a last resort and the following options should be explored, in order of priority: tree revetments, stream barbs/flow deflectors, toe-rock, and vegetation riprap.

- Determine the cumulative effects of existing and proposed bio-engineered or bank hardening projects on salmon EFH, including salmon prey species before planning new bank stabilization projects.

- Contour slopes according to the preferred ratio of 3-5:1 and avoid slopes of less than 2:1.

- Develop plans that minimize alteration or disturbance of the bank and existing riparian vegetation. Use temporary fencing to minimize disturbance from intrusion.

- Revegetate sites to resemble the appropriate natural community associations, utilizing vegetation management to limit livestock grazing and maintain an appropriate buffer zone.

- Minimize the use of creosote or treated wood in lakes and in estuarine or other areas with low circulation or flow. Where treated wood is used, it should be certified as produced in accordance with the most current version of “Best Management Practices for Treated Wood in Western Aquatic Environments” (WWPI 1996). Treated materials containing copper compounds should not be installed when migrating salmon are present.

3.2.5.4 Beaver Removal and Habitat Alteration

Beavers have long co-existed with salmon and were once much more abundant in the region. Beavers have multiple effects on water bodies and riparian ecosystems, altering hydrology, channel morphology, biochemical pathways, and the productivity of a stream system (Olson and Hubert 1994). Their presence can have both positive and negative influences on salmon habitat, but overall, beavers are considered to impart a significant positive benefit to both water quality and salmon, particularly juvenile coho. The removal of beavers has fundamentally altered natural aquatic ecosystem processes.

Beaver dams can cause channel obstruction, the redirection of channel flow, and the flooding of streambanks and side channels. By ponding water, beaver dams create enhanced rearing and over-wintering habitat that offer juvenile salmonids protection from both freezing and high winter flows (NRC 1996).

Bank dens and channels can increase erosion potential, but ponds can lessen bank erosion by reducing the channel gradient during high flows as well as by settling out and trapping sediment. Beaver ponds also provide a sink for nutrients from tributary streams and create conditions that promote anaerobic decomposition and de-nitrification. Anaerobic decomposition and de-nitrification results in nutrient enrichment and increased primary and secondary production downstream from the pond and increased nutrient retention time and enhanced invertebrate prey production (NRC 1996).

Although beaver dams can occasionally block the upstream migration by adult and juvenile salmonids, studies on trout movement indicate that fish not only can pass over dams during high water, but also can travel upstream and downstream through most beaver dams during all seasons (Olson and Hubert 1994).

Beaver ponds increase the surface-to-volume ratio of the impounded area, which can result in increased summer temperatures (Spence *et al.* 1996). However, beaver ponds also cause increased storage of water in the banks and flood plains. This increases the water table, enhances summer flows, adds cold water during summer, and causes more even stream flow throughout the year. During winter, beaver ponds in cold environments prevent anchor ice from forming and prevent super-cooling of the water. By storing spring and summer storm run-off, beaver ponds help to reduce downstream flooding and the damage from rapid increases in stream flows (Olson and Hubert 1994).

Beavers also help shape riparian habitat. Beaver ponds increase the surface area of water several hundred times and thereby enhance the overall riparian habitat development. They also enhance vegetation growth by increasing the amount of groundwater for use by riparian plants. They also create and expand wetland areas (Olson and Hubert 1994).

Conservation Measures for Beaver Removal and Habitat Alteration - Following are the types of measures that can be undertaken by the action agency on a site-specific basis to conserve salmon EFH in areas that have the potential to be affected by beaver removal/habitat alteration. Not all of these suggested measures are necessarily applicable to any one project or activity that may adversely affect salmon EFH. More specific or different measures based on the best and most current scientific information may be developed prior to, or during, the EFH consultation process and communicated to the appropriate agency. The options represent a short menu of general types of conservation actions that can contribute to the restoration and maintenance of properly functioning salmon habitat. The following suggested measures are adapted from Olson and Hubert (1994) and Buckman (1998 pers. comm.).

- Reintroduce beaver as a watershed restoration technique when deemed appropriate by natural resource professionals.
- Manage livestock grazing to improve riparian areas (e.g., through pasture rotation, fencing, changes in the timing of grazing, rest periods, improving upslope conditions for grazers) which can, in turn, support beneficial beaver activity.
- Where appropriate, replace culverts with bridges where there are chronic culvert plugging problems that induce beaver removal activities, or install culvert protective devices that do not impede fish passage for either adult or juvenile passage.
- Explore alternatives to beaver removal with fish biologists.
- Educate the public on the value of beavers to salmon EFH and mechanisms to co-exist with beavers.
- Update land use planning guidance to avoid activity in the flood plain that would be in conflict with beaver activity (e.g., avoid the siting of structures where beaver dams would cause flooding).

3.2.5.5 Construction/Urbanization

Activities associated with urbanization (e.g., building construction, utility installation, road and bridge building, storm water discharge) can significantly alter the land surface, soil, vegetation, and hydrology and adversely impact salmon EFH through habitat loss or modification. Construction in and adjacent to waterways can involve dredging and/or filling activities, bank stabilization (see other sections), removal of shoreline vegetation, waterway crossings for pipelines and conduits, removal of riparian vegetation, channel re-alignment, and the construction of docks and piers. These alterations can destroy salmon habitat directly or indirectly by interrupting sediment supply that creates spawning and rearing habitat for prey species (e.g., sand lance, surf smelt, herring), by increasing turbidity levels and diminishing light penetration to eelgrass and other vegetation, by altering hydrology and flow characteristics, by raising water temperature, and by re-suspending pollutants (Phillips 1984).

Projects in or along waterways can be of sufficient scope to cause significant long-term or permanent adverse affects on aquatic habitat. However, most waterway projects and other projects associated with growth, urbanization, and construction within the region are small-scale projects that individually cause minor losses or temporary disruptions and often receive minimal or no environmental review. The significance of small-scale projects lies in the cumulative and synergistic effects resulting from a large number of these activities occurring in a single watershed.

Construction activities can also have detrimental effects on salmon habitat through the run-off of large quantities of sediment, as well as the nutrients, heavy metals, and pesticides. Run-off of petroleum products and oils from roads and parking lots and sediment, nutrients, and chemicals from yards as well as discharges from municipal sewage treatment plants and industrial facilities are also associated with urbanization (EPA 1993). Urbanized areas also alter the rate and intensity of run-off into streams and waterways. Urban runoff can cause immunosuppression by organic contaminants (Arkoosh *et al.* 1998).

Similarly, effects on run-off rates can be much greater than in any other type of land use, because of the amount of impervious surfaces associated with urbanization. Buildings, rooftops, sidewalks, parking lots, roads, gutters, storm drains, and drainage ditches, in combination, quickly divert rainwater and snow melt to receiving streams, resulting in an increased volume of runoff from each storm, increased peak discharges, decreased discharge time for runoff to reach the stream, and increased frequency and severity of flooding (EPA 1993). Flooding reduces refuge space for fish, especially where accompanied by loss of instream structure, off-channel areas, and habitat complexity. Flooding can also scour eggs and young from the gravel. Increases in streamflow disturbance frequencies and peak flows also compromises the ability of aquatic insects and fish life to recover (May *et al.* 1997)

The amount of impervious surfaces also can influence stream temperatures. Summer time air and ground temperatures in impervious areas can be 10-12° warmer than in agricultural and forested areas (Metro 1997). In addition, the trees that could be providing shade to offset the effects of solar radiation are often missing in urban areas. The alteration in quantity and timing of surface run-off also accelerates bank erosion and the scouring of the streambed, as well as the downstream transport of wood. This results in simplified stream channels and greater instability, all factors harmful to salmon (Spence *et al.* 1996). The lack of infiltration also results in lower stream flows during the summer by reducing the interception, storage, and release of ground water into streams. This affects habitat availability and salmonid production, particularly for those species that have extended freshwater rearing requirements (e.g., coho). Generally, it has been found that instream functions and value begin to seriously deteriorate when the levels of impervious surfaces exceed 10% of a sub-basin (WDFW 1997).

Conservation Measures for Construction/Urbanization - Existing urban and industrial sites, highways, and other permanent structures will prevent restoration of riparian zones in heavily developed areas. In these areas, generally along major river systems, buffers will not be continuous, and riparian areas will remain fragmented. Habitat improvement plans will need to identify locations of healthy riparian zones and opportunities for re-establishing corridors of riparian vegetation between them, so that nodes of good quality habitat can be maintained and managed in ways that protect salmon habitat (Sedell *et al.* 1997).

Following are the types of measures that can be undertaken by the action agency on a site-specific basis to conserve salmon EFH in areas that have the potential to be affected by construction and urbanization activities. Not all of these suggested measures are necessarily applicable to any one project or activity that may adversely affect salmon EFH. More specific or different measures based on the best and most current scientific information may be developed prior to, or during, the EFH consultation process, and communicated to the appropriate agency. The EPA (1993) publication "Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters" extensively describes best management practices for control of runoff from developing areas, construction sites, roads, highways and bridges affecting salmon EFH. In addition to the previous guidelines, the options following represent a short menu of general types of conservation actions that can contribute to the restoration and maintenance of properly functioning salmon habitat. The following suggested measures are adapted from Metro (1997), ODFW (1989), and EPA (1993).

- Protect existing, and wherever practicable, establish new riparian buffer zones of appropriate width on all permanent and ephemeral streams that include or influence EFH. Establish buffers wide enough to support shading, large woody debris input, leaf litter inputs, sediment and nutrient control, and bank stabilization functions.

- Plan development sites to minimize clearing and grading and cut-and-fill activities.

- During construction, temporarily fence setback areas to avoid disturbance of natural riparian vegetation and maintain riparian functions for EFH.

- Use best management practices in building as well as road construction and maintenance operations such as avoiding ground disturbing activities during the wet season, minimizing the time disturbed lands are left exposed, using erosion prevention and sediment control methods, minimizing vegetation disturbance, maintaining buffers of vegetation around wetlands, streams and drainage ways, and avoiding building activities in areas of steep slopes with highly erodible soils. Use methods such as sediment ponds, sediment traps, or other facilities designed to slow water run-off and trap sediment and nutrients.

- Where feasible, remove impervious surfaces such as abandoned parking lots and buildings from riparian areas, and re-establish wetlands.

3.2.5.6 Dam Construction/Operation

Dams built to provide power, water storage, and flood control have significantly contributed to the decline of salmonids in the region. Potential adverse effects include impaired fish passage (including blockages, diversions), alterations to water temperature, water quality, water quantity, and flow patterns, the interruption of nutrients, large woody debris, and sediment transport which affect river, wetland, riparian, and estuarine systems, increased competition with nonnative species, and increased predation and disease.

The construction of dams without fish passage facilities has blocked salmon from thousands of miles of mainstream and tributary stream habitat in the Columbia River basin, Sacramento-San Joaquin system, and other streams throughout the western United States (PFMC 1988). While technology exists for providing fish passage around dams, it has not always been successful, and migration delays and increased mortality may still occur at some projects under certain water temperatures and flows. Poorly designed fishways, or fishways that are improperly operated and maintained, can inhibit movement of adults upstream causing migration delays and unsuccessful spawning. Additionally, the fallback of adult salmon through spillways and turbines contribute to migration delays and increased mortality. Increased vulnerability to predation is also an impact of dams and fish passage structures.

Dams are also a barrier to downstream passage of juveniles. In general, reservoirs and water diversions (see section on irrigation water withdrawal) reduce water velocities and change current patterns, resulting in increased migration times (Raymond 1979), exposure to less favorable environmental conditions, and increased exposure to predation. At dams, injury and mortality to juveniles occurs as a result of passage through turbines, sluiceways, juvenile bypass systems, and adult fish ladders. Encounters with turbine blades, rough surfaces, or solid objects can cause death or injury. Changes in pressure within turbines or over spillways also can result in death or injury. Juveniles, frequently stunned and disoriented as they are expelled at the base of the dam, are particularly vulnerable to predation (PFMC 1988). Dams also result in changes in concentrations of dissolved oxygen and nitrogen. Above the dams, slow-moving water has lower dissolved oxygen levels than faster, turbulent waters, a factor that may stress fish (Spence *et al*. 1996). Below hydroelectric facilities, nitrogen supersaturation may also negatively affect migrating as well as incubating or rearing salmon by causing gas-bubble disease. Gas bubble disease increases in years of high flow and high spill.

Hydrologic effects of dams include water-level fluctuations, altered seasonal and daily flow regimes, reduced water velocities, and reduced discharge volume. These altered flow regimes can affect the migratory behavior of juvenile salmonids. Water-level fluctuations associated with hydro power peak operations may reduce habitat availability, inhibit the establishment of aquatic macrophytes that provide cover for fish, and in some cases strand fish or allow desiccation of spawning redds. Drawdowns reduce available habitat area and concentrate organisms, potentially increasing predation and transmission of disease (Spence *et al*. 1996). Drawdown in the fall for flood control produces high flows during spawning which allow fish to spawn in areas which may not have water during the winter and spring, resulting in loss of the redds.

Impoundments may also change the thermal regimes of streams causing effects on salmon. Temperatures may increase in shallow reservoirs to the detriment of salmon. Below deeper reservoirs that thermally stratify, summer temperatures may be reduced, but fall temperatures tend to increase as heated water stored during the summer is released. These changes in water temperatures affect development and smoltification of salmonids, decreasing survival. Water temperatures also can affect adult migration (Spence *et al*. 1996). Water temperature changes also influence the success of predators and competitors and the virulence of disease organisms. Additionally, in winter, drawdown of impoundments may facilitate freezing, which diminishes light penetration and photosynthesis, potentially causing fish kills through anoxia (Spence *et al*. 1996).

In watersheds where temperatures and flows may limit salmon production, dams can sometimes be operated to have positive benefits such as lowering water temperatures during the summer and providing stable flows and temperatures which may benefit both salmonid spawning, rearing, and invertebrate production.

Dam impoundments alter natural sediment and large woody debris transport processes. Water storage at dams may prevent the high flows that are needed to scour fine sediments from spawning substrate and move wood and other materials downstream. Behind dams, suspended sediments settle to the bottoms of reservoirs, depriving downstream reaches of needed sediment inputs, leading to the loss of high-quality spawning gravels (as substrate becomes dominated by cobble unsuitable for spawning) as well as to changes in channel morphology (Spence *et al.* 1996).

Dams can also affect the health and extent of downstream estuaries. Reservoir storage can alter both the seasonal pattern and the characteristics of extremes of freshwater entering the estuary. Flow damping has also resulted in a reduction in average sediment supply to the estuary. Except for times of major floods, residence time of water in estuaries has increased with decreasing salinity. Estuaries have also been converted into a less-energetic microdetritus-based ecosystem with higher organic sedimentation rates. Detritus and nutrient residence has increased; vertical mixing has decreased, likely increasing primary productivity in the water column, and enhancing conditions for detritivorous, epibenthic, and pelagic copepods (Sherwood *et al.* 1990). The effects of these changes have not been evaluated as yet, though there are concerns about possible affects on fish and other resources which depend on a highly co-evolved and biologically diverse estuarine environment (NRC 1996).

Conservation Measures for Dam Construction/Operation - Following are the types of measures that can be undertaken by the action agency on a site-specific basis to conserve salmon EFH in areas that have the potential to be affected by dam construction and operation activities. Not all of these suggested measures are necessarily applicable to any one project or activity that may adversely affect salmon EFH. More specific or different measures based on the best and most current scientific information may be developed prior to, or during, the EFH consultation process and communicated to the appropriate agency. The options represent a short menu of general types of conservation actions that can contribute to the restoration and maintenance of properly functioning salmon habitat. The following suggested measures are adapted from Spence *et al.* (1996), NMFS (1997a).

- Operate facilities to create flow conditions adequate to provide for passage, water quality, proper timing of life history stages, avoid juvenile stranding and redd dewatering, and maintain and restore properly functioning channel, floodplain, riparian, and estuarine conditions. Specific flow objectives have been developed for the Columbia and Snake river and Sacramento bay/delta river systems and other systems with federally operated facilities where there are species listed under the ESA, through FERC orders, through specific legislative acts (e.g., the Central Valley Water Improvement Act, the Bay-Delta Accord), water quality orders, and through legal settlement agreements. Federal projects are operated within the context of the projects' authorized purposes, applicable state water laws, and contractual commitments.

- Provide adequate designing and screening for all dams, hydroelectric installations, and bypasses to meet specific passage criteria developed by the Columbia Basin fish managers.

- Develop water and energy conservation guidelines and integrate them into dam operation plans and into regional and watershed-based water resource plans.

- Provide mitigation (including monitoring and evaluation) for nonavoidable adverse effects to salmon EFH .

3.2.5.7 Dredging and Dredged Spoil Disposal

Dredging is associated with improving river navigation for commercial and recreational activities and for maintaining the navigation channels of ports and marinas. Dredging may also be carried out during the construction of roads and bridges and the placement of pipe, cable, and utility lines. Dredging is also conducted to maintain channel flow capacity for flood control purposes.

Dredging results in the temporary elevation of suspended solids emanating from the project area as a turbidity plume. Excessive turbidity can affect salmon or their prey by abrading sensitive epithelial tissues, clogging gills, decreasing egg buoyancy (of prey), and affects photosynthesis of phytoplankton and submerged vegetation leading to localized oxygen depression. Suspended sediments subsequently settle, which can destroy or degrade benthic habitats (NMFS 1997).

The removal of bottom sediments during dredging operations can disrupt the entire benthic community and eliminate a significant percentage of the feeding habitat available to fish for a significant period of time. The rate of recovery of the dredge area is temporally and spatially variable and site specific. Recolonization varies considerably with geographic location, sediment composition, and types of organisms inhabiting the area (Kennish 1997). Dredging may also affect the migration patterns of juvenile salmonids as a result of noise, turbulence, and equipment (FRI 1981).

The suspended sediments dredged from estuarine and coastal marine systems are generally high in organic matter and clay, both of which may be biologically and chemically active. Dredged spoils removed from areas proximate to industrial and urban centers can be contaminated with heavy metals, organochlorine compounds, polyaromatic hydrocarbons, petroleum hydrocarbons, and other substances (Kennish 1997) and thereby prone to resuspension. Sediments in estuaries downstream from agricultural areas may also contain herbicide and pesticide residues (NMFS 1997).

Dredging and subsequent sediment deposition poses a potential threat to the eelgrass ecosystems in estuaries, which provide important structural habitat and prey for salmon (see estuary alteration section, below). Dredging not only removes plants and reduces water clarity, but can change the entire physical, biological, and chemical structure of the ecosystem (Phillips 1984). Dredging also can reverse the normal oxidation/reduction potential of the sediments of an eelgrass system, which can reverse the entire nutrient-flow mechanics of the ecosystem (Phillips 1984).

Concomitant with dredging is spoil disposal. Dredged material disposal has been used in recent years for the creation, protection and restoration of habitats (Kennish 1997). When not used for beneficial purposes, spoils are usually taken to marine disposal sites and this in itself may create adverse conditions within the marine community. When contaminated dredged sediment is dumped in marine waters, toxicity and food-chain transfers can be anticipated, particularly in biologically productive areas. The effects of these changes on salmon are not known.

Conservation Measures for Dredging and Dredged Spoil Disposal - Following are the types of measures that can be undertaken by the action agency on a site-specific basis to conserve salmon habitat in spawning redds, eelgrass beds, and other EFH areas of particular concern, that have the potential to be affected by dredging/spoil disposal activities. Not all of these suggested measures are necessarily applicable to any one project or activity that may adversely affect salmon EFH. More specific or different measures based on the best and most current scientific information may be developed prior to, or during, the EFH consultation process and communicated to the appropriate agency. The options represent a short menu of general types of conservation actions that can contribute to the restoration and maintenance of properly functioning salmon habitat. The following suggested measures are adapted from NMFS (1997), NMFS (1997d), and Meyer (1997 pers. comm.).

- Explore collaborative approaches between material management planners, pollution control agencies, and others involved in watershed planning to identify point and nonpoint sources of sediment and sediment pollution; to promote the establishment of riparian area buffers to help reduce sediment input, and to promote use of best management measures to control sediment input.

- Avoid dredging in or near spawning redds, eelgrass beds, and other EFH areas of particular concern; especially where the areal extent of the dredging could affect the prey base for outmigrating juvenile salmon.

- Monitor dredging activities especially contaminate sediments and regularly report effects on EFH. Re-evaluate activities based on the results of monitoring.

- Employ best engineering and management practices for all dredging projects to minimize water-column discharges. Avoid dredging during juvenile outmigration through estuaries. Where avoidance is not fully possible, area and timing guidelines should be established in consultation with local, state, tribal, and federal fish biologists.

- When reviewing open-water disposal permits for dredged material, identify direct and indirect effects of such projects on EFH. Consider upland disposal options as an alternative. Mitigate all nonavoidable adverse effects and monitor mitigation effectiveness.

- Determine cumulative effects of existing and proposed dredging operations on EFH.

- Explore the use of clean dredged material for beneficial use opportunities.

3.2.5.8 Estuarine Alteration

Estuaries represent transitional environments coupling land and sea water. The dominant features of estuarine ecosystems are their salinity variances, productivity, and diversity, which, in turn are governed by the tides and the amount of freshwater runoff from the land. These systems present a continuum along a fresh-brackish-salt water gradient as a river system empties into the sea. Estuarine ecosystems, containing a large diversity of species that reflect the great structural diversity and resultant differentiation of niches, may be characterized as:

- Unique hydrological features by which fresh water slows and flows over a wedge of heavier intruding tidal salt water resulting in suspended terrestrial and autochthonous products settling into the inflowing salt water or into bottom sediments.

- Shallow nutrient-rich environments resulting in an enormously productive vegetative habitat and detrital food chain for many organisms, such as crustaceans and juvenile fish.

- Critical nursery habitats for many aquatic organisms, particularly anadromous fish and ecotones for shorebirds and waterfowl.

- Contributing to the “trapping” and recycling of nutrients: an area where an accumulation of nutrients such as potassium and nitrogen are concentrated and recycled – a repeating interactive process by which the incoming tidal water re-suspends nutrients at the fresh-salt water interface while moving them back up the estuary, and the land-based sources of nutrients move towards the sea.

- Accumulating fine sediments transported in by tides and rivers, further enhancing productivity by being adsorptive surfaces for nutrients.

In Oregon and Washington where there are relatively few estuarine wetlands because of the steep topography of the shore, it is estimated that between 50% and 90% of the tidal marsh systems in estuaries have been lost this century (Frenkel and Morlan 1991). The estuarine environment benefits salmon by providing a food rich environment for rapid growth, physiological transition between fresh and salt water environments, and refugia from predators (Simenstad 1983). Estuarine eelgrass beds, macroalgae, emergent marsh vegetation, marsh channels, and tidal flats provide particularly important estuarine habitats for the production, retention, and transformation of organic matter within the estuarine food web as well as a direct source of food for salmon and their prey. Additionally, estuarine marsh vegetation, overhanging riparian vegetation, eelgrass beds, and shallow turbid waters of the estuary provide cover for predator avoidance. Estuaries provide enough habitat variety to allow the numerous species and stocks of salmonids to segregate themselves by niche.

Chinook salmon fry, for example, prefer protected estuarine habitats with lower salinity, moving from the edges of marshes during high tide to protected tidal channels and creeks during low tide (Healey 1980, 1982; Levy and Northcote 1981, 1982; Kjelson *et al.* 1982; Levings 1982). As the fish grow larger, they are increasingly found in higher salinity waters and increasingly utilize less-protected habitats, including delta fronts or the edge of the estuary before dispersing into marine waters. As opportunistic feeders, chinook salmon consume larval and adult insects and amphipods when they first enter estuaries, with increasing dependence on larval and juvenile fish such as anchovy, smelt, herring, and stickleback as they grow larger (Sasaki 1966; Dunford 1975; Birtwell 1978; Levy *et al.* 1979; Northcote *et al.* 1979; Healey 1980,1982; Kjelson *et al.* 1982; Levy and Northcote 1981; Levings 1982; Gordon and Levings 1984; Myers 1980; Reimers 1973).

For juvenile coho, large woody debris is an important element of estuarine habitat (McMahon and Holtby 1992). During their residence time in estuaries, coho salmon consume large planktonic or small nektonic animals, such as amphipods, insects, mysids, decapod larvae, and larval juvenile fishes (Myers and Horton 1982; Simenstad *et al.* 1982; Dawley *et al.* 1986; McDonald *et al.* 1987). In estuaries, smolts occur in intertidal and pelagic habitats with deep marine-influenced habitats often preferred (Pearce *et al.* 1982, Dawley *et al.* 1986; McDonald *et al.* 1987).

Although pink salmon generally pass directly through the estuary en route to nearshore areas, populations that do reside in estuaries for one to two months utilize shallow, protected habitats such as tidal channels and consume a variety of prey items, such as larvae and pupae of various insects, cladocerans, and copepods (Bailey *et al.* 1975; Hiss 1995).

While in the estuary, lake-rearing yearling sockeye are generally found in faster flowing mid-channel regions and are rarely observed in off-channel areas such as marshes and sloughs. These juvenile fish consume copepods, insects, amphipods, euphausiids, and fish larvae (Simenstad *et al.* 1982; Levings *et al.* 1995). In contrast, sea-type and river-type sockeye salmon rear in riverine and estuarine environments. For those "zero-age" sockeye that migrate to the ocean during their first year of life, Birtwell *et al.* (1987) reports extensive use of estuarine areas of up to five months in the Fraser River estuary. During estuarine residence, zero-age sockeye salmon are widely dispersed, with highest concentrations in protected, shallow water habitats with low flow. Common prey during this period include copepods, insects, cladocerans, and oligochaetes (Birtwell *et al.* 1987; Levings *et al.* 1995).

There are four general categories of impacts on estuarine ecosystems: *enrichment* with excessive levels of organic materials, inorganic nutrients, or heat; *physical alterations* which include hydrologic changes and reclamation; *introduction of toxic materials*; *introduction of exotic species* leading to direct changes in species composition and food web dynamics.

Progressive *enrichment* of estuarine waters with inorganic nutrients, organic matter, or heat leads to changes in the structure and processes of estuarine ecosystems. Nutrient enrichment can lead to excessive algal growth, increased metabolism, and changes in community structure, a condition known as eutrophication.

Jaworski (1981) discusses sources of nutrients and scale of eutrophication problems in estuaries. Addition of excessive levels of organic matter to estuarine waters results in bacterial contamination and lowered dissolved oxygen concentrations which then results in concomitant changes in community structure and metabolism. Inorganic nutrients from mineralization of the organic matter can stimulate dense algal blooms and lead to another source of excessive organic matter. The source of high levels of organic matter is normally sewage waste water, but high levels can also result from seafood processing wastes and industrial effluents (Weiss and Wilkes 1974). Impacts from thermal loading include interference with physiological processes, behavioral changes, disease enhancement, and impacts from changing gas solubilities. These impacts may combine to affect entire aquatic systems by changing primary and secondary productivity, community respiration, species composition, biomass, and nutrient dynamics (Hall *et al.* 1978).

Local *physical alterations* in estuarine systems include such activities as filling and draining of wetlands, construction of deep navigation channels, bulkheading, and canal dredging through wetlands. Two major types of impacts resulting from these activities are estuarine habitat destruction and hydrologic alteration. For example, canals and deep navigation channels can alter circulation, increase saltwater intrusion, and promote development of anoxic waters in the bottoms of channels. Upstream changes in rivers can also have pronounced effects on estuaries into which they discharge. Construction of dams, diversion of fresh water, and groundwater withdrawals lower the amount of fresh water, nutrients, and suspended input – all important factors in estuarine productivity (Day *et al.* 1989).

The measurable consequences of anthropogenic disturbances in the Columbia River estuary have been dramatic since the initial comprehensive surveys and contemporaneous initiation of dredging, diking, shipping, groin and jetty construction, and riverflow diversion between the 1870s and the end of the twentieth century. Thomas (1983) documented a 30% loss (142 square kilometers) of the surface area of the estuary, although some 45 square kilometers have been changed from open water to shallows. Thomas (1983) also reported a 43% loss of tidal marshes and a 76% loss of tidal wetlands. The loss of shallow estuarine areas can shift the estuarine prey composition from benthic crustaceans and terrestrial insects, the preferred food of most salmon smolts, to water-column dwelling zooplankton. These zooplankton are favored by species such as herring, smelt, and shad (Sherwood *et al.* 1990).

Toxic materials include such compounds as pesticides, heavy metals, petroleum products, and exotic by-products of industrial activity near estuaries. Such contaminants can be acutely toxic, or more commonly, they can cause chronic or sublethal effects. Toxins can also bioaccumulate in food chains. The same processes that lead to the trapping of nutrients, and thereby to the productivity of the estuary, also lead to the trapping and concentrating of pollutants. Fine sediments not only retain phosphorous and other nutrients, but also petroleum and pesticide residues. Odum (1971) noted that estuarine sediments can concentrate DDT over 100,000 times higher than in the water of the estuary. Such pesticides residues enter the food chain via detritus-eating invertebrates and are further concentrated. The same features of water circulation in the estuary that concentrate nutrients also concentrate pollutants such as mercury and lead, heavy metals from sewage, industrial and pulp mill effluents. Estuarine food chains are extremely complex and sensitive to alterations in the physical and chemical range of stresses. Loss or disruption of one element can have a cascading effect on species presence and productivity.

Introduction of exotic species has the potential to change species composition and food web dynamics. See the section on "Introduction and Spread of Nonnative Species" for further detail.

Conservation Measures for Estuarine Alteration - Following are the types of measures that can be undertaken by the action agency on a site-specific basis to conserve salmon habitat in areas that have the potential to be affected by estuarine alteration. Not all of these suggested measures are necessarily applicable to any one project or activity that may adversely affect salmon EFH. More specific or different measures based on the best and most current scientific information may be developed prior to, or during, the EFH consultation process and communicated to the appropriate agency. The options represent a short menu of general types of conservation actions that can contribute to the restoration and maintenance of properly functioning salmon habitat. The following suggested measures are adapted from NMFS (1997), NMFS (1997d), Lockwood (1990), and Meyer, (1997 pers. comm.).

In addition to the relevant conservation measures listed for "Dredging and Dredged Spoil Disposal", "Irrigation Water Withdrawal, Storage, and Management," "Bank Stabilization, Wastewater/Pollutant Discharge", "Artificial Propagation of Fish and Shellfish", "Offshore Oil and Gas Exploration, Drilling and Transportation", and the "Introduction and Spread of Nonnative Species", the following are suggested to minimize potential adverse effects of estuarine alteration activities.

- Minimize alteration of estuarine habitat in areas of salmon EFH, including eelgrass beds, tidal channels, and estuarine and tidally-influenced marshes. Minimize effects through appropriate site design, engineering, best management practices, and mitigate all nonavoidable adverse effects (See EPA 1993, Metro 1997, SCS Enginners 1989).
- Utilize best management practices for controlling pollution from marina operations, boatyards, and fueling facilities.
- Determine cumulative effects of a past and current estuarine alterations on salmon EFH before additional estuarine alteration occurs.
- Design appropriate restoration and mitigation performance objectives for properly functioning conditions and values of EFH and monitor achievement of these objectives.
- Utilize the placement of woody debris as a part of marsh and estuary enhancement and mitigation work; avoid scavenging logs from estuarine areas; re-position, rather than remove, logs that are hazardous to navigation within river or estuary; and maximize removal of dikes where possible.
- Promote awareness and use of the U.S. Department of Agriculture's (USDA's) Wetland Reserve Program to encourage restoration of estuarine habitat.
- Maximize maintenance of freshwater inflow to estuaries.
- Design culvert replacements and repairs in EFH to increase fish passage for both adult and juvenile fish.

3.2.5.9 Forestry

Forest practices can affect salmon habitat. Among the most important effects of forest management on fish habitat in western North America have been changes in the distribution and abundance of large woody debris in streams (Hicks *et al.* 1991). Timber harvest has reduced the amount and size of large woody debris compared to that in nonharvested areas (Ralph *et al.* 1994). Large woody debris in streams is a fundamental building block for creating and maintaining salmon habitat. Physical processes associated with debris in streams includes the formation of pools (important to both juvenile and adult salmon) and other important rearing areas, control of sediment and organic matter storage, and modification of water quality. Biological properties of debris-created structures can include blockages to fish migration, protection from predators and high streamflow, and maintenance of organic matter processing sites within the benthic community (Bisson *et al.* 1987).

Site disturbance and road construction typically increase sediment delivered to streams through mass wasting and surface erosion (Spence *et al.* 1996). This can elevate the level of fine sediments in spawning gravels and fill substrate interstices that provide habitat for aquatic invertebrates. Fine sediment (usually <0.8 mm diameter) is detrimental to embryo survival, because it reduces substrate permeability (Murphy 1995). The relative magnitude of forest practices on sediment delivery depends on factors such as soil type, topography, climate, vegetation, the aerial extent of the disturbance, the proximity of forestry activities to the stream channel, and the integrity of the riparian zone (Spence *et al.* 1996). Poor road location, construction, and maintenance, as well as inadequate culverts result in forest roads contributing more sediment to nearby streams than any other forest activity. On a per-unit basis, mass wasting events associated with forest roads produce 26-34 times the volume of sediment as undisturbed forests (Furniss *et al.* 1991).

The removal of riparian canopy reduces shading and increases the amount of solar radiation reaching the streams. The result is higher maximum stream temperatures and increased daily stream temperature fluctuations (Beschta *et al.* 1987; Beschta *et al.* 1995). Even small increases in temperature (1-2° C) can result in shifts in the timing of life history events such as spawning and incubation. The cumulative effects of stream temperature changes downstream of logged areas are not well documented.

Fertilizers, herbicides, and insecticides are commonly used in forestry operations to prepare sites for planting, to allow conifers to out compete with other vegetation and to control diseases and pests. In addition, fire retardants are used to halt the spread of wildfires. These chemicals or their carriers that reach surface waters can be toxic to salmon directly or may alter the primary and secondary production of a stream, influencing the amount and type of food available to salmon (Spence *et al.* 1996). Risks associated with these compounds depend on the form and application rate of the chemicals, the method of application, whether buffers are maintained, the soil type, weather conditions during and after application, and the persistence of the chemicals in the environment.

Conservation Measures for Forestry - Each watershed and each stream reach has a unique set of defining geologic, biological, topographic, and other characteristics. An evaluation of effective riparian zone dimensions (for buffering temperature and pollutants, provision of organic debris, and the other elements of healthy EFH) should generate riparian management zones of appropriate width for each stream reach. Mitigation of impacts of forest management activities on salmonid EFH has improved in recent decades. On many federal forests, riparian buffer areas now extend up to 300 feet on fish bearing streams. Land-owners have also become more active in fish restoration and conservation work at the watershed level. Some of this work is being undertaken through watershed groups seeking to restore salmon runs. These watershed groups are composed of the fishing industry, conservation groups, timber industry, state, federal and local government, and other stakeholders.

Following are the types of activities that can be undertaken by the action agency on a site-specific basis to conserve salmon habitat to protect and enhance EFH adjacent to forest lands that have the potential to be affected by forestry related activities. Not all of these suggested measures are necessarily applicable to any one project or activity that may adversely affect salmon EFH. More specific or different measures based on the best and most current scientific information may be developed prior to, or during, the EFH consultation process and communicated to the appropriate agency. The options represent a short menu of general types of conservation actions that can contribute to the restoration and maintenance of properly functioning salmon habitat. The following suggested measures are adapted from Murphy (1995).

- Establish riparian management zones and avoid forestry activities in zones of old growth and late successional forests. Use limited harvest, thinning, planting, or other management in second-growth forests in order to facilitate recovery and protection of the key functions identified through watershed analyses.

- Utilize appropriate buffer strips (e.g., riparian trees and shrubs, grass filter strips, etc.) as a management option to protect and enhance salmon freshwater EFH.

- As part of forestry planning, analyze the cumulative effects of past and current forestry management activities on EFH as indicated in watershed analyses.

- Determine harvest suitability methods based on risk assessment for site-specific conditions (e.g., unstable slopes, erodible soils). Avoid harvest and road building activities on sites that have a high potential for landslides and on sites that can contribute large woody debris to streams directly or through landslides and debris flows. Plan timber harvest, road construction, and site preparation activities for the dry season or on snow to minimize erosion. Design ground-based logging operations to minimize total area subject to compaction by skid trails.

- Apply chemicals by following forestry best management practices (EPA 1993) for ensuring federal and state water quality, including practices designed to avoid drift of chemical sprays, pollution from the cleaning of equipment used in spraying or fueling activities, and erosion.

- Avoid reliance on in-channel manipulation until problems in riparian and upland habitats that caused the habitat to be degraded have been addressed by to controlling erosion, stabilizing or obliterating roads, upgrading culverts for fish passage, and restoring native vegetative communities. Use silvicultural treatments which minimize stream disturbance.

3.2.5.10 Grazing

Livestock grazing represents the second most dominant land use in the Pacific Northwest (after timber production), occupying about 41% of the total land base. An aspect of grazing is the impact it imparts on riparian ecosystems. [1/]

Riparian areas provide a critical link between aquatic and terrestrial ecosystems. Sustained grazing of these areas can affect substantially fish and aquatic habitats. The riparian zone contributes over 90% of the plant detritus which supports the entire aquatic biological food chain in upper tributaries (Cummins and Spengler 1974). Even in larger downstream waters, the riparian zone provides over half (54%) of the organic matter ingested by fish (Berner in Kennedy 1977). Management efforts to enhance the riparian zone for one species will generally have positive impacts on many other organisms within this biotype.

The quality and persistence of the riparian zone is a function of its fragility. A large body of research and monitoring indicates that overgrazing by domestic livestock has damaged riparian and stream ecosystems (Armour *et al.* 1994, Mosely 1997) resulting in decreased production of salmonids (Platts 1991).

Impacts to the riparian zone vary. Livestock grazing can affect the riparian environment by changing, reducing, or eliminating vegetation and actually eliminating riparian areas through channel widening, channel aggrading, or lowering of the water table (Platts 1991). Soil compaction by trampling can result in a reduction in water infiltration by 40-90% (Rauzi and Hanson 1966, Berwick 1976). Streams modified by improper livestock grazing are also wider and shallower than normal (Duff 1983) leading to pool loss by elevating sediment delivery (MacDonald and Ritland 1989). In addition, removal of riparian vegetation along rangeland streams can result in increased solar radiation and thus increased summer temperatures (Li *et al.* 1994). Livestock presence in the riparian zone can affect bank stability (Beschta *et al.* 1993), increase sediment transport rates by increasing both surface erosion and mass wasting (Marcus *et al.* 1990), and shift vegetative growth to less productive, often exotic plants when Kentucky bluegrass, timothy, and orchard grass replace the native sedges, rye and bunch grasses. Streamside shrubs and trees are also eliminated as the sprouts are browsed by livestock. Regeneration is prevented and the even-aged stands of aspen, willow, cottonwood, and associates eventually age, die, and disappear (Berwick 1978).

Finally, a major grazing-related historical impact to riparian functions has been (and remains) the clearing of hundreds of thousands of acres of riparian bottoms of willow, mountain maple, cottonwood, and other vegetation which sequestered, pumped, and transpired enormous amounts of water. Ranchers convert meadows to hay pastures of introduced timothy, orchard grass, and clover harvested for winter forage throughout the west, often in close functional relationship to salmonid EFH.

Conservation Measures for Grazing - Grazing management is key to attaining the benefits which a productive riparian offers livestock while maintaining water quality standards and fully functioning riparian ecosystems (Mosely *et al.* 1997). Vegetation in riparian areas responds relatively quickly to changes in grazing management and can usually be restored (Platts 1991). Progressive stockmen and land managers have demonstrated there are no insurmountable technological barriers to restoring and protecting the long-term productivity of western riparian areas and adjacent lands (Chancy *et al.* 1993).

There is great potential for livestock management in the terrestrial and riparian areas of western watersheds to conserve and enhance EFH. Some grazing systems have achieved dramatic successes and others show promise. This is a significant departure from the historically common season-long grazing of summer range riparian zones which resulted in many of the impacts discussed above. Particularly promising are variants

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1/ Riparian ecosystems can best be defined as ". . . those assemblages of plant, animal, and aquatic communities whose presence can be either directly or indirectly attributed to factors that are stream-induced or related" (Kauffman 1982).

of rest-rotation grazing systems. In Idaho, Hayes (1978) found improved forage species composition (i.e., toward pristine deep-rooted perennial climax plants) and a reduction of 65% in bank sloughing with such a system. His data indicate few to no riparian impacts when forage utilization is kept to less than 25%. Bryant (1985 pers. comm.) found that a low/moderate riparian grazing rate promoted more productive, diverse and stable aquatic and riparian systems in the Starkey experimental forest of northeast Oregon. Claire and Storch (in Kauffman 1984) found a rest-rotation system the preferred streamside management if rest is given a pasture for one of every three years. A four-pasture system with summer rest two out of three years increased riparian browse from 78 to 2,616 plants/ha within two years (Davis 1982). Simulated grazing (clippings) after one August had no measurable effects on production or species composition in Wyoming wet meadows (Pond 1961). Late season riparian grazing systems can often increase livestock production, plant vigor and productivity, and minimize wildlife disturbance (Pond 1961, Kauffman 1982). Winter grazing, which considers winter game range use, can effect the same benefits to livestock. Management of stocking rates to reduce damage to wet soils and insure carbohydrate stores for spring growth and vigor is important in these cases (Heady and Child 1994). The above discussion does not address concentrated grazing from dairy cattle which are nowhere near the extent of beef cattle grazing east of the Cascades.

A review of attempts to devise appropriate grazing regimes illustrates the site-specific nature of any conservation measure which would presume to be useful. For grazing systems, it has been repeatedly demonstrated that one size does not fit all. The peculiar mix of browse and herbaceous vegetation, warm and cool season grasses, and site factors, dictate local solutions. At each extreme of the grazing spectrum, it has been found that some sites can benefit from continuous grazing at reduced levels while others need rest. An empirically observed rule of thumb which has been supported by numerous studies (including some cited above) is that consumption of annual growth of woody and herbaceous forage on healthy ranges should be held under 50-60% to provide the nutrients required for initiating new seasonal growth and prevent range degradation (Hedrick 1950, Valentine 1970 *in* Heady and Child 1994).

Following are the types of measures that can be undertaken by the action agency on a site-specific basis to conserve salmon EFH in rangeland area streams and rivers. Lotic systems are intimately associated with their adjacent riparian zones and can be affected by grazing activity or potential grazing-related impact. Not all of these suggested measures are necessarily applicable to any one project or activity that may adversely affect salmon EFH. More specific or different measures based on the best and most current scientific information may be developed prior to, or during, the EFH consultation process, and communicated to the appropriate agency. The options represent a short menu of general types of conservation actions that can contribute to the restoration and maintenance of properly functioning salmon habitat.

- Minimize livestock access to stream reaches containing salmon redds during spawning and incubation periods (McCullough and Espinosa 1996) by utilizing grazing and vegetation management schemes that promote grazing in other areas and by locating water facilities away from the stream channel and riparian zone wherever feasible.

- Utilize special monitoring, management, and grazing regimes or mitigation activities that allow recovery of degraded areas and maintain streams, wetlands, and riparian areas in properly functioning condition.

- Utilize upland grazing management that minimizes surface erosion and disruption of hydrologic processes. Where range is not in properly functioning condition, forage species composition is altered, productivity reduced, and trends are down, select demonstrably restorative grazing regimes or minimize grazing activity until vegetation has recovered. Once conditions have improved, adjust the grazing strategies to account for all herbivory (e.g., including wildlife) at proper use levels to minimize deterioration of range conditions in the future (Spence *et al*. 1996).

- Determine cumulative effects of past and current grazing operations on EFH when designing grazing management strategies.

- Minimize application of chemical treatments within the riparian management zone.

- Utilize innovative grazing practices such as variants of rest-rotation grazing systems, late season riparian grazing systems, winter grazing and management of stocking rates (Heady and Child 1994, Bryant 1985, Davis 1982, Claire and Storch in Kauffman 1982, Hayes 1978, Valentine 1970, and Hedrick *in* Heady and Child 1994, Pond 1961).

3.2.5.11 Habitat Restoration Projects

Although intended to help restore salmon habitat or habitat for other organisms, habitat restoration activities can be detrimental to salmon and their habitats. Inadequate, and often absent, analyses of habitat deficiencies and their causes can result in ineffective restoration efforts or habitat injury (Gregory and Bisson 1997, Kauffman *et al.* 1997, Roper *et al.* 1997). This should not discourage efforts to restore functional aquatic and riparian ecosystems, but efforts should be part of a watershed or basin conservation plan, carefully monitored and evaluated, and revised accordingly. Efforts should initially identify and eliminate the causes of habitat impairment and only then consider active restoration techniques to accelerate habitat recovery (Bisson *et al.* 1997, Lawson 1997).

If restoration efforts are not undertaken with an understanding of the conditions in the watershed, not only may they be unsuccessful, but they may also create additional problems. For example, while stabilizing an eroding bank may improve local water quality, the same treatment may deflect water flow and create erosion elsewhere, thereby decreasing streambank cover, and constricting the natural dynamics of stream channels.

Additionally, habitat restoration activities can be based solely on the needs of an individual species, without consideration of the immediate ecosystem. A single species focus is a concern if the habitat improvement project is designed solely to enhance a particular species, life history stage, or life history pattern. While perhaps being successful in the short term for the limited purpose for which the restoration project was intended, the addition of structure to a channel for specific habitat components in some instances may actually be counterproductive to restoring total ecological functions (Beschta 1997)

Conservation Measures for Habitat Restoration Projects - Various documents are available to help those involved in habitat restoration efforts. For example EPA has produced a watershed assessment primer (EPA 1994a) and the various impact management techniques to be used for habitat protection and restoration approaches used in the region are described by the BPA in their watershed management program (BPA 1997). The California salmonid stream habitat restoration manual (CDFG 1994) provides guidance and forms for assessment, monitoring, and restoration work. Other habitat restoration guidance documents dealing with everything from in-stream projects to road maintenance and beaver management have been briefly summarized. Ordering information for the above is provided by "For The Sake of the Salmon" (FSOS 1998). Each state's fish and wildlife's habitat division also has information and guidance on habitat restoration activities, including the permits needed, as well as specifications as to when in-stream work is allowed in the various systems.

Following are the types of measures that can be undertaken by the action agency on a site-specific basis to conserve salmon EFH and that have the potential to be affected by habitat restoration activities. Not all of these suggested measures are necessarily applicable to any one project or activity that may adversely affect salmon EFH. More specific or different measures based on the best and most current scientific information may be developed prior to, or during, the EFH consultation process and communicated to the appropriate agency. The options represent a short menu of general types of conservation actions that can contribute to the restoration and maintenance of properly functioning salmon habitat. The following suggested measures are adapted from Bisson *et al.* (1997) and Gregory and Bisson (1997).

- Protect a watershed's habitat-forming processes (e.g., riparian community succession, bedload transport, runoff pattern) that maintain the biophysical structure and function of aquatic ecosystems.

- Develop and conduct habitat restoration activities based on a watershed-scale analysis and conservation plan, and where practicable, a sub-basin or basin-scale analysis and plan with restoration of habitat-forming processes as the primary goal.

- Monitor and evaluate all habitat restoration activities for sustained biophysical process and function.

3.2.5.12 Irrigation Water Withdrawal, Storage, and Management

Water is diverted from lakes, streams, and rivers for irrigation, power generation, industrial use, and municipal use. Additionally, water is withdrawn from the ocean by offshore water intake structures in California. Ocean water may be withdrawn for providing sources of cooling water for coastal power generating stations or as a source of potential drinking water as in the case of desalinization plants.

In general, potential effects of freshwater system irrigation withdrawals on salmonid EFH include physical diversion and injury to salmon (see below), as well as impediments to migration, changes in sediment and large woody debris transport and storage, altered flow and temperature regimes, and water level fluctuations. In addition, fish and other aquatic organisms may be affected by the reduced dilution of pollutants in rivers and streams where substantial volumes of water are withdrawn. Alterations in physical and chemical attributes in turn affect many biological components of aquatic systems including riparian vegetation as well as composition, abundance, and distribution of macroinvertebrates and fish (Spence *et al.* 1996). In addition, the volume of fresh water diverted for agriculture can be substantial and can affect both the total volume of water available to salmon as well as the seasonal distribution of flow.

Returned irrigation water to a stream, lake, or estuary project can substantially alter and degrade the habitat (NRC 1989). Generally problems associated with return flows of surface water from irrigation projects include increased water temperature, salinity, pathogens, decreased dissolved oxygen, increased toxicant concentrations from pesticides and fertilizers, and increased sedimentation (NPPC 1986).

Water impoundments can result in raised or lowered summer temperatures and increases in fall and winter temperatures. Increases in fall and winter temperatures can accelerate embryonic development of salmonid emergence, harming their chances of survival. Low dissolved oxygen can also be a problem in irrigation impoundments that have been drawn down, as is freezing which inhibits light penetration and photosynthesis (Ploskey 1983, Guenther and Hubert 1993). Elevated fall water temperatures from impoundments can also result in disease outbreaks in adult salmon that cause high prespawning mortality (Spence *et al.* 1996).

Irrigation withdrawals and impoundments also change sediment transport and storage. Siltation and turbidity in streams generally increase as a result of increased irrigation withdrawals, because of high sediment loads in return waters (Spence *et al.* 1996). In some systems, sediments may accumulate in downstream reaches covering spawning gravels and filling in pools that chinook salmon use for rearing (Spence *et al.* 1996). In other systems, water withdrawals and storage reservoirs can lead to improved water clarity, because they trap sediment. This can lead to aggradation of the stream channel as the capacity of the stream to transport sediment is reduced. The settling of gravel sediments behind impoundments and the reduced sediment transport capacity can cause downstream reaches to become sediment starved. This results in loss of high quality spawning areas as substrate becomes dominated by cobble and other large fractions not suitable for spawning (Spence *et al.* 1996).

Water diversions and impoundments also can change the quantity and timing of streamflow. Changes in flow quantity alters stream velocity which affects the composition and abundance of both insect and fish populations (Spence *et al.* 1996). Changed flow velocities may also delay downstream migration of salmon smolts and result in salmon mortality (Spence *et al.* 1996). Low flows can concentrate fish, rendering juveniles more vulnerable to predation (PFMC 1988).

Water level fluctuations from impoundment releases/storage can de-water eggs, strand juveniles (PFMC 1988), and, by eliminating aquatic plants along stream bank margins and shorelines, decrease fish cover and food supply (Spence et al 1996).

The physical means of withdrawing water may adversely affect salmon. For major irrigation withdrawals, water is either stored in impoundments or diverted directly from the river channel at pumping facilities. Individual irrigators commonly construct smaller "push-up" dams from soil and rock within the stream channel, to divert water into irrigation ditches or to create small storage ponds from which water is pumped. In addition, pumps may be submerged directly into rivers and streams to withdraw water. Effects of these irrigation withdrawals and impoundments on aquatic systems include creating impediments or blockages to migration (for both adults and juveniles), diverting juveniles into irrigation ditches or damage to juveniles as a result of impingement on poorly designed fish exclusion screens (Spence *et al.* 1996).

Groundwater pumping for irrigation, while providing an alternative to surface water diversion, also can cause a reduction in surface flows, especially summer flows which can be derived from groundwater discharges (Spence *et al.* 1996).

Conservation Measures for Irrigation Water Withdrawal, Storage, and Management - Water conservation is one of the most promising sources to meet new and expanding needs for additional water (Gillilan and Brown 1997). For example, Washington State's Water Resources Management Trust Water Rights Program, started in 1991, provides a means of enhancing instream flows using water saved though conservation. Participants in the instream flow protection processes in the states of Washington, Idaho, Oregon, and California include:

California — The state's most potent instream flow protection is a result of administrative activities of the State Water Resources Control Board, which is required to consider the comments of CDFG when making decisions about appropriation and transfer permits. Since 1991, individuals have been authorized to change the purpose of existing rights to instream purposes. Private individuals and organizations have also taken advantage of the opportunity to initiate public trust proceedings.

Idaho — Only the Idaho Water Resources Board is allowed to apply to the Department of Water Resources for an instream water right. State statutes allow "the public" to petition the Board to apply for instream flow rights, but the Board has interpreted this language to mean that it may accept petitions only from state agencies. Applications approved by the Department of Water Resources must be submitted to the Idaho State Legislature for approval.

Oregon — Only the Oregon Water Resources Department may hold instream water rights. The Water Resource Department considers requests from ODFW, Environmental Quality, and Parks and Recreation agencies. Individuals may acquire existing rights and take responsibility for changing the use to instream purposes in an administrative hearing, but then must turn the right over to the Water Resources Department to be held in trust.

Washington — WDOE establishes minimum flows either at its own initiative or after request from the Department of Fisheries and Wildlife. Because minimum flows are established through administrative rule-making procedures, public notice and hearings are involved. Individuals may donate rights to the state and specify that they are to be used for instream purposes under the state's trust water rights program, which is administered by WDOE.

In 1996, the Bureau of Reclamation released policy guidance on the content of water conservation plans for water districts. Recommended water measures include (1) water management and accounting designed to measure and account for the water conveyed through the districts distribution system to water users; (2) a water pricing structure that encourages efficiency and improvements by water users; (3) an information and education program for users designed to promote increased efficiency of water use; and (4) a water conservation coordinator responsible for development and implementation of the water conservation plan (Bureau of Reclamation 1996).

Following are the types of measures that can be undertaken by the action agency on a site-specific basis to conserve salmon EFH in areas that have the potential to be affected by irrigation water withdrawal and storage. Not all of these suggested measures are necessarily applicable to any one project or activity that may adversely affect salmon EFH. More specific or different measures based on the best and most current scientific information may be developed prior to, or during, the EFH consultation process and communicated to the appropriate agency. The options represent a short menu of general types of conservation actions that can contribute to the restoration and maintenance of properly functioning salmon habitat. The following suggested measures are adapted from McCullough and Espinosa, Jr. (1996) and OCSRI (1997).

- Apply conservation and enhancement measures for dams (see dam section) to water management activities and facilities, where applicable.

- Establish adequate instream flow conditions for salmon by using, for example, the Instream Flow Incremental Methodology.

- Undertake efforts to purchase or lease, from willing sellers and lessors, water rights necessary to maintain instream flows in accordance with appropriate state and federal laws.

- Identify and use appropriate water conservation measures in accordance with state law.

- In accordance with state law, install totalizing flow meters at major diversion points. For water withdrawn from reservoirs, install gauges that identify the water surface elevation range from full reservoir elevation to dead pool storage elevation. Additionally, if the reservoir is located in-channel, install gauges upstream and downstream of the reservoir.

- Screen water diversions on all fish-bearing streams.

- Incorporate juvenile and adult salmon passage facilities on all water diversions.

3.2.5.13 Mineral Mining

The effects of mineral mining on salmon EFH depends on the type, extent, and location of the activities. Minerals are extracted by several methods. Surface mining involves suction dredging, hydraulic mining, panning, sluicing, strip mining, and open-pit mining (including heap leach mining). Underground mining utilizes tunnels or shafts to extract minerals by physical or chemical means. Surface mining probably has greater potential to affect aquatic ecosystems, though specific effects will depend on the extraction and processing methods and the degree of disturbance (Spence *et al.* 1996).

Water pollution by heavy metals and acid is also often associated with mineral mining operations, as ores rich in sulfides are commonly mined for gold, silver, copper, iron, zinc, and lead. When stormwater comes in contact with sulfide ores, sulfuric acid is commonly produced (West *et al.* 1995). Abandoned pit mines can also cause severe water pollution problems.

Mining activities can result in substantial increased sediment delivery, although this varies with the type of mining. While mining may not be as geographically pervasive as other sediment-producing activities, surface mining typically increases sediment delivery much more per unit of disturbed area than other activities because of the level of disruption of soils, topography, and vegetation. Erosion from surface mining and spoils may be one of the greatest threats to salmonid habitats in the western United States (Nelson *et al.* 1991).

Hydraulic mining for gold from streams, flood plains, and hillslopes occurred historically in California, Oregon, and Washington in areas affecting salmon EFH. Though hydraulic mining is not common today, past activities have left a legacy of altered stream channels, and abandoned sites and tailings piles can continue to cause serious sediment and chemical contamination problems (Spence *et al.* 1996).

Placer mining for gold and associated suction dredging continues to occur in watersheds supporting salmon. Recreational gold mining with such equipment as pans, motorized or nonmotorized sluice boxes, concentrators, rockerboxes, and dredges can locally disturb streambeds and associated habitat. Additionally, mining activities may involve the withdrawal of water from the stream channel. Commercial mining is likely to involve activities at a larger scale with much disturbance and movement of the channel involved (OWRRI 1995). In some cases, water may be completely diverted from the stream bed while gravel is processed.

Commercial operations may also involve road building, tailings disposal, and the leaching of extraction chemicals, all of which may create serious impacts to salmon EFH. Cyanide, sulfuric acid, arsenic, mercury, heavy metals, and reagents associated with such development are a threat to salmonid habitat. Improper or in-water disposal of tailings may cause toxicity to salmon or their prey downstream. On land placement of tailings in unstable or landslide prone areas can cause large quantities of toxic compounds to be released into streams or to contaminate groundwater (NPFMC 1997). Indirectly, the sodium cyanide solution used in heap leach mining is contained in settling ponds from where they might contaminate groundwater and surface waters (Nelson *et al.* 1991).

Mineral mining can also alter the timing and routing of surface and subsurface flows. Surface mining can increase streamflow and storm runoff as a result of compaction of mine spoils, reduction of vegetated cover, and the loss of organic topsoil, all of which reduce infiltration. Increased flows may result in increased width and depth of the channel.

Mining and placement of gravel spoils in riparian areas can cause the loss of riparian vegetation and changes in heat exchange, leading to higher summer temperatures and lower winter stream temperatures (Spence *et al.* 1996). Bank instability can also lead to altered width-to-depth ratios, which further influences temperature (Spence *et al.* 1996).

Conservation Measures for Mineral Mining - State and federal law (i.e., the Clean Water and Surface Mining Control and Reclamation Acts) contain provisions for regulating mining discharges. State and local governments are taking an increasingly active role in controlling irresponsible mining operations (Nelson *et al.* 1991) and most western states require operators to draw up a mining plan that details potential environmental damage from that operation, and reclamation and performance bonds must be posted (Nelson *et al.* 1991). A challenge still lies in the reclamation of the thousands of abandoned sites that have or may potentially impact salmon EFH.

Following are the types of measures that can be undertaken by the action agency on a site-specific basis to conserve salmon EFH in areas that have the potential to be affected by mining related activities. Not all of these suggested measures are necessarily applicable to any one project or activity that may adversely affect salmon EFH. More specific or different measures based on the best and most current scientific information may be developed prior to, or during, the EFH consultation process and communicated to the appropriate agency. The options represent a short menu of general types of conservation actions that can contribute to the restoration and maintenance of properly functioning salmon habitat. The following suggested measures are adapted from recommendations in Spence *et al.* (1996), NMFS (1996), and WDFW (1998).

- Avoid mineral mining in waters, riparian areas, or flood plains of streams containing or influencing the salmon spawning and rearing habitats.

- Assess the cumulative effects of past and proposed mineral extraction activities and take these into account in planning for mining operations.

- Utilize an integrated environmental assessment, management, and monitoring package in accordance with state and federal law.

- Minimize spillage of dirt, fuel, oil, toxic materials, and other contaminants into the water and riparian areas. Monitor turbidity during operations. Prepare a spill prevention plan and maintain spill containment and water repellent/oil absorbent clean-up materials on hand.

- Treat wastewater (acid neutralization, sulfide precipitation, reverse osmosis, electrochemical, or biological treatments) and recycle on site to minimize discharge to streams. Test wastewater before discharge for compliance with the federal and state clean water standards.

- Minimize mine-generated sediments from entering or affecting EFH. Minimize the aerial extent of ground disturbance (e.g., through phasing of operations), and stabilize disturbed lands to reduce erosion. Employ methods such as contouring, mulching, and construction of settling ponds to control sediment transport.

- Reclaim, rather than bury, mine waste that contains heavy metals, acid materials, or other toxic compounds if leachate can enter EFH through groundwater.

- Restore natural contours and plant native vegetation on site after use to restore habitat function to the extent practicable.

3.2.5.14 Introduction/Spread of Nonnative Species

Introduction of nonnative plant and animal species may be either deliberate (to enhance sport-fishing or control aquatic weeds, for example) or accidental without thought to the consequences (e.g., the dumping of live bait-fish and the seaweeds in which they are packed, aquaculture escapees, the pumping of bilge or ballast water, or releases from aquariums by individuals). Although the impacts are poorly known, the introduction or spread of nonnative species into areas of salmon EFH can potentially alter habitat process and function. Introduced fish can dominate or displace native fish through various mechanisms including competition, predation, inhibition of reproduction, environmental modification, transfer of new parasites, or diseases and hybridization (Spence *et al.* 1996).

In the Columbia Basin, introduced predator species including walleye, channel catfish, and small mouth bass have high predation rates on outmigrating salmon smolts. Boyd (1994) reports that the presence of striped bass in a river system near California's San Francisco Bay region resulted in estimated losses of 11% to 28% of native run of fall chinook. White bass and northern pike introduced into the inland delta of the Sacramento and San Joaquin rivers prey on salmon and other species (Cohen 1997). In Oregon's coastal lakes and reservoirs, introduced fish species such as striped bass, largemouth bass, small mouth bass, crappie, bullheads and yellow perch have become established with obvious predation impacts in some basins and negligible impacts in others. For example, nonendemic Umpqua squawfish are voracious predators of juvenile salmonids in Oregon's Rogue River Basin (Satterwaithe 1998, pers. comm.) and the Coos and Umpqua estuaries contain striped bass that prey on salmonids (OSCRI 1997). Introduced grass carp and common carp can destroy beds of aquatic plants which results in concomitant reductions in cover for juvenile fishes, destruction of substrates supporting diverse invertebrate food chain assemblages, and increases in turbidity (Spence *et al.* 1996).

Many typical warmwater species from other regions, such as small mouth bass, carp, and catfish have been introduced as exotics to the Snake River basin. Displacement of salmonids and other cold water species by native coolwater species (e.g., redside shiners) or by the exotic warmwater species results in a reduced total usable habitat area for spawning and rearing, and thereby a diminished production capability for salmon (McCullough *et al.* 1996).

The introduction of organisms other than fish is also of great concern in estuarine environments. The food webs of San Francisco Bay have been dramatically altered by this invasion, more recently by the arrival of an Asian clam which has multiplied to such abundance that it can filter all the water over a significant portion of the bay in less than a day, removing bacteria, phytoplankton, and zooplankton in the process and leaving little behind for other organisms (The Resources Agency of California [RAC] 1997).

Introduced plants can also have serious detrimental effects on salmon habitat. The exotic aquatic plant, egeria (*Egeria densa*) is known to harm coho rearing in coastal lakes (OCSRI 1997). The spread in estuaries of various species of cordgrass *(Spartina* spp.) and another grass, the common reed (*Phragmites australis),* are of concern. *Spartina* spp. may affect salmon habitat in a number of ways, many of which appear to be detrimental to salmon and their prey. *Spartina* forms dense uniform stands in the upper intertidal area, traps sediment and raises the elevation of the mudflat. The macroinvertebrate population in areas dominated by *Spartina alterniflora* is somewhat different than that in mudflat areas. Nonnative plant invasions may decrease food for some species such as chum salmon that feed on the mudflats, while it may increase resources for chinook salmon that feed on invertebrates in the water column or on the surface, though the interactions are complicated and are still being studied (Luiting *et al.* 1997).

Other effects from *Spartina* invasion (as well as from *Phragmites*) results from the meadows being a good filter of nutrients and sediment washing off the land. While this may be beneficial in terms of reducing pollution, it can also have negative effects by raising the elevation of the high intertidal area and sequestering nutrients from the estuarine system.

Efforts to control *Spartina* and other exotics may cause additional affects to salmon and their habitat. Long term impacts of either the use of mechanical mowing measures or of the use of herbicides (e.g., Rodeo®) and various surfactants have not been well studied. Concerns exist on both the acute and sublethal toxicity to nontarget species and the potential for bioaccumulation. These chemicals are known to adsorb to sediments under certain conditions and some of the surfactants are known to be estrogen disrupters in fish (Felsot 1997). The use of biological control agents is also under study.

Many of the region's riparian habitats have also been extensively altered by invasive species (e.g., blackberries, reed canary grass, and scotch broom), deterring the establishment of native species, and altering the habitat (e.g., shading, stream bank stability) and the nutrient cycling characteristics of the area. The effects of these changes are not fully known.

Conservation Measures for Introduction/Spread of Nonnative Species - Watershed management strategies for enhancement and conservation of salmon EFH in many instances will include restoration of water flows and riparian areas, as well as other habitat conditions. These measures should discourage nonnative species from establishing or expanding their territories (i.e., colder water will favor salmonids over centrarchids).

Following are the types of measures that can be undertaken by the action agency on a site-specific basis to conserve salmon EFH in areas that have the potential to be affected by the introduction of nonnative or nonendemic species. Not all of these suggested measures are necessarily applicable to any one project or activity that may adversely affect salmon EFH. More specific or different measures based on the best and most current scientific information may be developed prior to, or during, the EFH consultation process, and communicated to the appropriate agency. The options represent a short menu of general types of conservation actions that can contribute to the restoration and maintenance of properly functioning salmon habitat. The following suggested measures are adapted from Cohen (1997).

- Provide public awareness materials on the potential impacts resulting from the release of nonnative organisms into the natural environment.

- For the commercial import of plants and animals for aquarium and ornamental plant trades, import those organisms that have been evaluated and determined to be safe for importing.

- Avoid ballast water exchange in nearshore coastal waters. Use shore-based ballast water treatment systems and ship-board ballast treatment systems as alternatives.

- Use native organisms for aquaculture and mariculture operations whenever possible.

- Develop appropriate eradication methods for nonnative plant species and nonnative predatory species.

3.2.5.15 Offshore Oil and Gas Exploration, Drilling, and Transportation

Oil is extracted from offshore platforms in southern California and large amounts of Alaskan crude oil also enter the region on Alaskan tankers bound for refineries. These nearshore oil and gas related activities have the potential to pollute salmon EFH and harm prey resources. Oil exploration/production areas are vulnerable to an assortment of physical, chemical, and biological disturbances resulting from activities used to locate oil and gas deposits such as high energy seismic surveys to actual physical disruptions from anchors, chains, drilling templates, dredging, pipes, platform legs, and the platform jacket. During actual operations, chemical contaminants may also be released into the aquatic environment (NMFS 1997b). Physical alterations in the quality and quantity of local habitats may also occur during the construction and operation of shore-side facilities, tanker terminals, pipelines, and the tankering of oil. These activities may be of concern if they occurred in habitats of special biological importance to salmon stocks or their prey (NPFMC 1997).

Accidents and spills during transport and during oil transfer from ships or pipelines to refineries are the greatest potential threats to salmon EFH. They are likely to affect shallow nearshore areas or sensitive habitats such tidal flats, kelp beds, estuaries, river mouths, and streams.

Although oil is toxic to all marine organisms at high concentrations (parts per million), certain species are more sensitive than others. The type, volume, and properties of the spilled oil (environmental variables such as water density, wave height, currents, wind speed, etc.) and the type of response effort all affect the potential risk to salmon EFH. Oil spills in marine waters probably affect salmon more through their effects on salmon food organisms than on the salmon themselves, because juvenile and adult fish generally are able to avoid oil slicks in open seas. However, if an oil spill reached nearshore areas with productive nursery grounds, such as an estuary, or if a spill occurred at a location where fish were concentrated, a year's production of smolts could be lost (NPFMC 1997).

Injuries to fish and their prey in the surface slick results from both physical coating by oil as well as to the toxicity of the petroleum hydrocarbons and other compounds in the oil. Many low molecular weight aromatic hydrocarbons are soluble in water, increasing the potential for exposure to aquatic resources. Adult fish tolerate much higher concentrations of petroleum hydrocarbons than eggs and larvae. Sublethal effects of oil typically manifested in adult fish are primarily physiological and affect feeding, migration, reproduction, swimming activity, and schooling behaviors (Kennish 1997, Strickland and Chasan 1993).

Clean-up activities for oil residues on beaches, rocky shorelines or sea surface sometimes involve physical or chemical methods such as high pressure hoses, steam, or dispersants. These activities may be more hazardous to plants and animals than the oil itself and may also adversely affect salmon habitat.

Dispersants are also sometimes used to emulsify oil (i.e., reduce the water-oil interfacial tension) so that it can enter the water column rather than remaining on the surface. While reducing the adverse effects on the shoreline, birds, and marine mammals, the dispersants may be toxic themselves to marine organisms and plants as well as make the oil itself more available for uptake by marine organisms and hence more toxic (Falco 1992).

Degradation byproducts of petroleum hydrocarbons have high acute toxicities to fish. Studies of bivalve tissue from beaches heavily oiled by the *Exxon Valdez* incident showed that a complex assemblage of intermediate hydrocarbon oxidation byproducts were bioavailable for uptake in marine organisms for several years post-spill. Thus, oxidation byproducts may be an additional source of chronic exposure and effects on fish populations (NOAA 1996).

Conservation Measures for Offshore Oil and Gas Exploration, Drilling, and Transportation - Following are the types of measures that can be undertaken by the action agency on a site-specific basis to conserve salmon EFH in nearshore and estuarine regions that have the potential to be affected by transportation and onshore support activities associated with oil and gas exploration, drilling, and production. Not all of these suggested measures are necessarily applicable to any one project or activity that may adversely affect salmon EFH. More specific or different measures based on the best and most current scientific information may be developed prior to, or during, the EFH consultation process and communicated to the appropriate agency. The options listed below represent a short menu of general types of conservation actions that can contribute to the protection and restoration of properly functioning salmon habitat. The following suggested measures are adapted from Cameron (1998 pers. comm.), Lollock (1998 pers. comm.), and Logan (1998 pers. comm.).

- Monitor and enforce double hull standards for all oil tankers doing business in U.S. waters, as well as other pollution prevention measures of the Oil Pollution Act of 1990.

- Utilize adequate spill prevention measures such as tug escorts, speed limits, the use of marine pilots, vessel traffic systems, designated areas to be avoided, traffic separation schemes, rescue/salvage tugs, and compliance with international, national, and state spill prevention standards.

- Utilize the agreement between the ten major oil company members of the Western States Petroleum Association as a catalyst to involve other oil carriers and maximize routing of tankers carrying Alaskan North Slope crude to California ports at least 50 miles seaward of the Pacific coast while transiting the coastline after leaving Prince William Sound.

- Route dry cargo vessels and other vessels carrying significant quantities of oil or hazardous cargo at least 50 miles seaward of the Pacific coast while transiting the coast.

- Avoid national marine sanctuaries and areas designated as areas to be avoided and support efforts to re-evaluate and strengthen precautionary and readiness measures in national marine sanctuaries.

- Apply vessel maintenance, inspection programs, and crew training programs, required for oil tank vessels to dry cargo and other vessels carrying significant quantities of oil.

- Monitor and report water and sediment quality around all oil extraction, bunkering, or transfer facilities, and gather other baseline information to assure better natural resource damage assessments after spill events.

3.2.5.16 Road Building and Maintenance

Roads may affect groundwater and surface water by intercepting and re-routing water that might otherwise drain to springs and streams. This increases the density of drainage channels within a watershed and results in water being routed more quickly into the streams (NRC 1996, Spence *et al.* 1996). Altering the connection between surface and groundwater can affect water temperatures, instream flows, and nutrient availability. These factors can affect egg development, the timing of fry emergence, fry survival, aquatic diversity, and salmon growth (NRC 1996).

In urban areas, extensive road and pavement can effectively double the frequency of hydrologic events that are capable of mobilizing stream substrates (NRC 1996) (also see Construction/Urbanization section). This increased scour of gravel and cobble in areas where salmon eggs, alevins, or fry reside can kill salmon directly or indirectly increase mortality by carrying them downstream and away from stream cover.

Urban roads can be a major source of sediment input during construction as can the installation of bridges, culverts, and diversions with coffer dams. However, these project impacts seem to be more temporary and less pervasive on sediment input than forest roads (Waters 1995).

In small forested watersheds, streamflow appears to be directly related to the total area of the watershed composed of roads and other heavily compacted surfaces. In larger watersheds, where roads and impermeable areas represent a relatively small area of the basin, little or no effect is seen (Adams and Ringer 1994). Altered hydrology was noted when roads covered 4% or more of a drainage area (King and Tennyson 1984).

Road culverts can block both adult and juvenile salmon migrations. Blockage can result from the culvert becoming perched above stream bed level, lack of pools that could allow salmon to reach the culvert, or from high water flow velocities in the culvert.

The effect of logging roads on erosion and sedimentation has been well studied. Furniss *et al.* (1991) concluded that forest roads contribute more sediment than all other forest activities combined on a per-unit basis. Road surfaces can break down with repeated heavy wheel loads of hauling trucks, particularly under wet conditions, resulting in a continual source of fine sediment input (Murphy 1995). However, improvements in road-construction and logging methods can reduce erosion rates (NRC 1996). For additional detail, see the “Forestry” section of this document.

Conservation Measures for Road Building and Maintenance - Following are the types of measures that can be undertaken by the action agency on a site-specific basis to conserve salmon EFH habitat in areas that have the potential to be affected by road building and maintenance activities. Not all of these suggested measures are necessarily applicable to any one project or activity that may adversely affect salmon EFH. More specific or different measures based on the best and most current scientific information may be developed prior to, or during, the EFH consultation process and communicated to the appropriate agency. The options represent a short menu of general types of conservation actions that can contribute to the protection and restoration of properly functioning salmon habitat. The following suggested measures are adapted from Murphy (1995), Mirati (1998), ODFW (1989), and NMFS (1996b).

- Revegetate cut banks, road fills, bare shoulders, disturbed streambanks, etc. after construction to prevent erosion. Check and maintain sediment control and retention structures throughout the rainy season.

- Minimize riparian corridor damage during construction of roads (and bridges, culverts, and other crossings) and avoid locating roads in floodplains.

- Rehabilitate roads by upgrading problem culverts or replacing with bridges, outsloping road surfaces to drain properly without maintenance, revegetating bare surfaces, and other measures as necessary for stability.

- Utilize state or federal culvert design guidelines (e.g., NMFS 1996b) for design and installations of culverts.

3.2.5.17 Sand and Gravel Mining

Mining of sand and gravel in the region's watersheds is extensive. Mining occurs by several methods. Sand and gravel extraction from seasonally exposed stream gravel bars occurs through wet-pit mining (i.e., remove material from below the water table) and dry-pit mining on exposed bars and ephemeral streambeds that are excavated by bulldozers, scrapers, and loaders. Bar scalping or skimming operations, which removes the tops of river gravel bars without excavating below the summer water, is one of the most common methods of gravel extraction practiced today. The bars are almost always attached to the stream banks and are frequently located on the inside of bends. Excavation of floodplain and river terrace deposits adjacent to an active or former channel is another common method for gravel extraction. Gravel extraction in these locations may occur to the level of seasonal flow, or may excavate below the level of seasonal flow, and require pumping of seepage water or underwater extraction from a pond. As active channels naturally move, the channel may migrate into the excavated area. The chance of this occurring is increased in the event of a flood.

Extraction of sand and gravel may directly eliminate the amount of gravel available for spawning if the extraction rate exceeds the deposition rate of new gravel in the system. The aerial extent of suitable spawning habitat may be reduced where degradation reduces gravel depth or exposes bedrock (Spence *et al.* 1996). Sand and gravel mining can suspend materials at the sites, resulting in turbidity plumes which may move several kilometers downstream. Sedimentation may be a delayed effect, because gravel removal typically occurs at low flow when the stream has the least capacity to transport the fines out of the system. Mechanical disturbance of spawning beds by mining equipment may also lead to high mortality rates of eggs and alevins. Gravel operations can also interfere with salmon migration past the site if they create physical or thermal changes at the work site or downstream from the site (OWRRI 1995).

Examples of using gravel removal to improve habitat and water quality are limited and isolated (OWRRI 1995). Deep pools created by material removal in streams appears to attract migrating adult salmon for holding. These concentrations of fish may result in high losses as a result of increase predation or recreational fishing pressure. In specific cases, gravel removal can be effectively used to remove stresses on streambanks and streambeds, resulting in greater stabilization and less need for streambank stabilization and greater stability of some spawning beds (OWRRI 1995).

By making the stream channel wider and shallower, the suitability of stream reaches as rearing habitat for juveniles may be decreased, especially during summer low-flow periods when deeper waters are important for survival. Similarly a reduction in pool frequency may adversely affect migrating adults that require holding pools (Spence *et al.* 1996). Changes in the frequency and extent of bedload movement and increased erosion and turbidity can also remove spawning substrates, scour redds (resulting in a direct loss of eggs and young), or reduce their quality by deposition of increased amounts of fine sediments. Other effects that may result from sand and gravel mining include increased temperatures (from reduction in summer base flows and decreases in riparian vegetation), decreased nutrients (from loss of floodplain connection and riparian vegetation), and decreased food production (loss of invertebrates) (Spence *et al.* 1996).

Conservation Measures for Sand and Gravel Mining - Following are the types of measures that can be undertaken by the action agency on a site-specific basis to conserve salmon EFH in areas that have the potential to be affected by sand and gravel mining activities. Not all of these suggested measures are necessarily applicable to any one project or activity that may adversely affect salmon EFH. More specific or different measures based on the best and most current scientific information may be developed prior to, or during, the EFH consultation process and communicated to the appropriate agency. The options represent a short menu of general types of conservation actions that can contribute to the protection and restoration of properly functioning salmon habitat. The following suggested measures are adapted from NMFS (1996) and OWRRI (1995).

- Avoid gravel mining within or proximal to spawning reaches.
- Where possible, identify upland or off-channel (where channel will not be captured) gravel extraction sites as alternatives to gravel mining in salmon EFH.
- Design, manage, and monitor gravel operations to minimize potential impacts to migrating salmon and stream/river banks, riparian, and habitat, etc.
- Minimize the areal extent and depth of extraction.
- Include restoration, mitigation, and monitoring plans in gravel extraction plans.

3.2.5.18 Vessel Operations

The discharge of contaminated ballast or bilge water and trash has the potential to adversely affect salmon EFH. Ship wakes can also cause increased bank erosion, increasing turbidity and sedimentation effects. Depending on the size of waves generated by ships, wash caused by ship wakes can result in the stranding of juvenile salmonids along the shoreline. Fish stranding, a function of fish size and swimming performance, tends to be a problem for smolts less than 60-70 mm and can be a significant source of juvenile mortality (Bauersfeld 1977).

Onshore, the discharge of solvents, grease, or paints from ship yard maintenance activities (see sections on "Waste Water…," "Oil Exploration…," and "Introduction of Nonnative Plants and Animals") also has the potential to adversely affect salmon EFH.

Conservation Measures for Vessel Operations - Following are the types of measures that can be undertaken by the action agency on a site-specific basis to conserve salmon EFH in areas that have the potential to be affected by vessel operations. Not all of these suggested measures are necessarily applicable to any one project or activity that may adversely affect salmon EFH. More specific or different measures based on the best and most current scientific information may be developed prior to, or during, the EFH consultation process and communicated to the appropriate agency. The options represent a short menu of general types of conservation actions that can contribute to the protection and restoration of properly functioning salmon habitat. Also refer to sections on "Waste Water…," "Oil Exploration…," and "Introduction and Spread of Nonnative Species." The following suggested measures are adapted from Bauersfeld (1977), Cohen (1997), and EPA (1993).

- Avoid ballast water exchange in nearshore coastal waters. Use shore-based ballast water treatment systems and ship-board ballast treatment systems as alternatives.
- Minimize ship speeds on rivers to those that do not create ship wakes.
- Utilize appropriate methods for containment of waste water, surface water collection, and recycling to avoid the discharge of pollution from boat yards, shipyards, and marinas or during the maintenance and operation of vessels.

3.2.5.19 Wastewater/Pollutant Discharge

Water quality essential to salmon and their habitat can be altered when pollutants are introduced through surface runoff, through direct discharges of pollutants into the water, when deposited pollutants are resuspended (e.g., dredging), and when flow is altered (e.g., nitrogen supersaturation at dams).

Atmospheric discharges of pollutants from power plants or industrial facilities can deposit metals, complex hydrocarbons, and synthetic chemicals into salmon EFH. These pollutants can be carried directly into salmon EFH or can settle on land and be carried into the water through rain run-off or snow-melt.

Similarly, wastewater or pollutants can be directly or indirectly discharged into ocean, estuarine, or fresh water environments. Examples of direct input of pollutants include the wastewater discharges of municipal sewage or stormwater treatment plants, power generating stations, industrial facilities (e.g., pulp mills, desalination plants, fish processing facilities), spills or seepage from oil and gas platforms, marine fueling facilities, hatcheries, boats (e.g., sewage, bilge water), the dumping of dredged materials or sewage sludge, or even from vessel maintenance, if it occurs over the water. These sources can result in the introduction of heavy metals, nutrients, hydrocarbons, synthetic compounds, organic materials, salt, warm water, disease organisms, or other pollutants into the environment.

Indirect sources of water pollution in salmon habitat results from run-off from streets, yards, construction sites, gravel or rock crushing operations, or agricultural and forestry lands. This run-off can carry oil and other hydrocarbons, lead and other heavy metals, pesticides, herbicides, sediment, nutrients, bacteria, and pathogens into salmon habitat. Water pollution can also result from the resuspension of buried contaminated sediments (e.g., from dredging operations). (See sections on "Dredging.....;" "Grazing;" "Mineral Mining;" "Agriculture;" "Construction/Urbanization;" and "Forestry").

The introduction of pollutants into EFH can create both lethal and sublethal habitat conditions to salmon and their prey. For example, fish kills may result from a pesticide run-off event, high water temperatures, or when algae blooms caused by excess nutrients deplete the water of oxygen.

Pollutant and water quality impacts to EFH can also have more chronic effects detrimental to fish survival. Contaminants can be assimilated into fish tissues by absorption across the gills or through bio-accumulation as a result of consuming contaminated prey. Pollutants either suspended in the water column (e.g., nitrogen, contaminants, fine sediments) or settled on the bottom (through food chain effects) can affect salmon. Many heavy metals and persistent organic compounds such as pesticides and polychlorinated biphenyls tend to adhere to solid particles. As the particles are deposited these compounds or their degradation products (which may be equally or more toxic than the parent compounds) can bioaccumulate in benthic organisms at much higher concentrations than in the surrounding waters (Oregon Territorial Sea Management Study [OTSMS] 1987, Stein *et al.* 1995).

Conservation Measures for Wastewater/Pollutant Discharge - Numerous federal and state programs have been established to improve and protect water quality. One of the most important programs relating to salmon EFH is the Clean Water Act's Section 319 program administered by the EPA. Under this section, states are required to submit to EPA for approval of an assessment of waters within the state that, without additional action to control nonpoint sources of pollution, cannot be expected to attain or maintain applicable water quality standards. In addition, states are to submit to EPA their management programs that identify measures to reduce pollutant loadings, including best management practices and monitoring programs. It is, therefore, critical that actions aimed at improving EFH water quality, especially in streams and rivers, are taken in concert with state agencies (e.g., Oregon Department of Environmental Quality, WDOE California Water Resources Control Board; Idaho Department of Health and Welfare) responsible for water quality management.

Some pollutant discharges are regulated through discharge permits which set effluent discharge limitations and/or specify operation procedures, performance standards, or best management practices. Additional effort to improve water quality is also being fostered by states under the guidance of the Coastal Zone Management Reauthorization Act. These efforts rely on the implementation of best management practices to control polluted run-off (EPA 1993). Although not yet a consistently applied mechanism to improve water quality, vegetated buffers along streams have been shown to be effective in providing such functions as sediment trapping, removal of nutrients and metals, moderation of water temperatures, increasing stream and channel stability and allowing recruitment of woody debris.

Following are the types of measures that can be undertaken by the action agency on a site-specific basis to conserve salmon EFH in areas that have the potential to be affected by both point and nonpoint sources of pollution. Not all of these suggested measures are necessarily applicable to any one project or activity that may adversely affect salmon EFH. More specific or different measures based on the best and most current scientific information may be developed prior to, or during, the EFH consultation process, and communicated to the appropriate agency. The options represent a short menu of general types of conservation actions that can contribute to the protection and restoration of properly functioning salmon habitat. The following suggested measures are adapted from Gauvin (1997), Washington Fish and Wildlife Commission (WFWC) (1997), OCSRI (1997), NMFS (1997b), The Resources Agency of California (RAC) (1997) and EPA (1993).

- Monitor water quality discharges following National Pollutant Discharge Elimination System requirements from all discharge points (including municipal storm water systems, and desalinization plants).

- Apply the management measures developed for controlling pollution from run-off in coastal areas to all watersheds affecting salmon EFH.

- For those water bodies that are defined as water quality limited in salmon EFH (303(d) list), establish total maximum daily loads and develop appropriate management plans to attain management goals.

- Where in-stream flows are insufficient for water quality maintenance, establish conservation guidelines for water use permits, encourage the purchase or lease of water rights and the use of water to conserve or augment instream flows in accordance with state and federal water law.

- Establish and update, as necessary, pollution prevention plans, spill control practices, and spill control equipment for the handling or transporting toxic substances in salmon EFH. Consider bonds or other damage compensation mechanisms to cover clean-up, restoration, and mitigation costs.

3.2.5.20 Wetland and Floodplain Alteration

Many river valleys in the west were once marshy and well vegetated, filled with mazes of floodplain sloughs, beaver ponds, and wetlands. Salmon evolved within these systems. Juvenile salmon, especially coho, can spend large portions of their fresh water residence rearing and over-wintering in floodplain environments and riverine wetlands. Salmon survival and growth are often better in floodplain channels, oxbow lakes, and other river-adjacent waters than in mainstream systems (NRC 1996). Additionally wetlands provide other ecosystem functions important to salmonids such as regulation of stream flow, stormwater storage and filtration, and often provide key habitat for beavers (that in turn may provide instream habitat benefits to coho from their active and continual placement of wood in streams) (OCSRI 1997). Floodplains (even those that are not wetlands) also help store water, filter nutrients, and cycle nutrients into the aquatic ecosystem.

Wetlands and side channels throughout the region have been converted through diking, draining and filling to create agricultural fields, livestock pasture, areas for ports, cities, and industrial lands. Wetlands were further altered to improve navigation along rivers. These changes have transformed the complex river valley habitat, with many backwater areas, into a simplified drainage systems most of whose flow is confined to the mainstream (Sedell and Luchessa 1982). As a result of these alterations, these areas became less capable of absorbing flood waters. Further habitat alteration often occurs as flood control projects are then undertaken. These projects include such things as water storage dams, dredging to increase channel capacity, or the building of dikes and levees to prevent rivers from over-topping their banks.

The construction of dikes, levees, and roads in the floodplain have further effects on salmon habitat. These structures prevent the connections between the rivers and floodplain, depriving the rivers of supplies of large woody debris as well as decreasing the input of fine organic matter and dissolved nutrients which support the food web for salmon (NRC 1996). These structures also deprive the river of a place to deposit sediment, so more sediment moves downstream, causing stream channel aggradation, the scouring of spawning redds, and estuary filling.

Conservation Measures for Wetland and Floodplain Alteration - Following are the types of measures that can be undertaken by the action agency on a site-specific basis to conserve salmon EFH in areas that have the potential to be affected by wetland and floodplain alterations. Not all of these suggested measures are necessarily applicable to any one project or activity that may adversely affect salmon EFH. More specific or different measures based on the best and most current scientific information may be developed prior to, or during, the EFH consultation process, and communicated to the appropriate agency. The options represent a short menu of general types of conservation actions that can contribute to the protection and restoration of properly functioning salmon habitat. The following suggested measures are adapted from NMFS (1997b), Metro (1997) and Streif (1996).

In addition to applicable measures described in the estuarine alteration section, the following general measures may apply:

- Minimize alteration of wetlands for nonwater-dependent uses in areas of salmon EFH.
- Minimize adverse effects on wetlands from water-dependent uses.
- Where ever possible avoid floodplain development, and mitigate for unavoidable floodplain losses to maintain water storage capacity.
- Complete compensation mitigation for unavoidable wetland loss prior to conducting activities that may adversely affect wetlands wherever possible, and perform such mitigation only in areas which have been prioritized as to long term viability and functionality.
- Design wetland mitigation to meet specific performance objectives for function and value and monitored to assure achievement of these objectives. Use wetland mitigation and enhancement ratios that are sufficient to attain a net gain in acreage as well as function and value.
- Determine cumulative effects of all past and current wetland and floodplain alterations before planning activities that further alter wetlands and floodplains.
- Promote awareness and use of the USDA's wetland and conservation reserve programs to conserve and restore wetland and floodplain habitat.
- Promote restoration of degraded wetlands.

3.2.5.21 Woody Debris/Structure Removal From Rivers and Estuaries

The functional importance of large woody debris and structure (e.g.,, large rocks and boulders) has been well documented in stream environments. Large woody debris is also important in riverine and estuarine environments.

Large woody debris provides structure to stream channels which promotes habitat complexity that allows multiple salmon species to coexist. For example, depending on the size of the woody debris and the stream, the debris may create plunge, lateral, scour and backwater pools, short riffles, undercut banks, side channels and backwaters, and create different water depths (Spence *et al.* 1996). Large woody debris in the stream also helps retain gravel for spawning habitat, provides long-term nutrient storage and substrate for aquatic invertebrates that are salmon prey, and provides refuge for fish and prey during high and low-flow periods (Spence *et al.* 1996). Additionally, large woody debris provides cover for salmon, influences water flow, allows for the storage and transport of sediment and fine organic debris (as well as salmon carcasses), and influences the physical structure and stability of important habitat features such as pools (Ralph *et al.* 1994, Spence *et al.* 1996).

The pools that are associated with large woody debris are preferred habitats for various age classes of juvenile coho salmon (as well as cutthroat trout and steelhead) (Bisson *et al.* 1987). Additionally, pools are important as resting and holding habitat for upstream migrating adult salmon and are necessary for attaining the swimming speed needed to jump obstacles (Spence *et al.* 1996).

The ecological functions of large woody debris in lower river and estuarine environments is similar, but has not been as widely acknowledged. Large woody debris in the tidal river segment of coastal stream systems create riffles and provide shelter from predators for salmonids and other aquatic organisms. The woody debris can also affect local water flow by creating turbulence and thereby affecting the sedimentation pattern and the formation of gravel bars or mud banks. Large woody debris influences the estuarine portion of the ecosystem, mainly through their physical properties as large masses and by creating substrate in an environment where the bottom consists mainly of fine sediment (Maser and Sedell 1994). Fallen trees that reach the upper and lower estuary system are degraded by various species of woodborers, providing important sources of nutrients for the detritus based food webs of the estuary. Downed trees also play roles in creating important habitat in salt marshes by catching sediment and organic material, elevating the general area of the ground around them. When these trees refloat during high tides, floods, or storm surges, the shallow depressions that remain in the marsh increase habitat diversity; at low tide, these depressions are filled with juvenile fishes (Gonor *et al.* 1988). The depletion of woody debris has diminished these channel formation, predator avoidance, and nutrient/prey functions. Additionally, the important structure that tree branches once provided in estuaries as spawning substrate for herring is lacking, resulting in overcrowding on the remaining spawning substrates (Phillips 1984).

The removal of large woody debris from streams, rivers, and estuaries is not encouraged, though it continues in attempts to control riverbank erosion or to protect structures (e.g., bridges). Additionally, recreational boaters, kayakers, and rafters may remove snags from rivers and lakes. This is done for reasons of aesthetics and safety, leaving popular white water rivers and many recreational lakes nearly devoid of snags (Gonor *et al.* 1988). Additionally, streams in urban and urbanizing areas are devoid of wood due in part to the removal of wood by river-side property owners for aesthetic reasons, concerns about flooding, and for firewood. Additionally, property owners cut trees along riparian areas and replace these areas with lawns, thus depriving the stream of a replacement supply of large wood (May *et al.* 1997).

Removal of large rocks and boulders is also of concern since these structures also create hydrologic and stream channel complexity important to salmon.

Conservation Measures for Woody Debris/Structure Removal From Rivers and Estuaries - Following are the types of measures that can be undertaken by the action agency on a site-specific basis to conserve salmon EFH in areas that have the potential to be affected by the removal of large woody debris. Not all of these suggested measures are necessarily applicable to any one project or activity that may adversely affect salmon EFH. More specific or different measures based on the best and most current scientific information may be developed prior to, or during, the EFH consultation process, and communicated to the appropriate agency. The options represent a short menu of general types of conservation actions that can contribute to the protection and restoration of properly functioning salmon habitat.

- Avoid removing woody debris and large rocks and boulders in salmon EFH.

- Educate landowners and boaters about the benefits of maintaining large woody debris in streams to enhance properly functioning salmon habitat conditions.

4.0 ADDITIONAL INFORMATION AND RESEARCH NEEDS

While far more research has been conducted on Pacific salmon life history and habitat requirements than most other marine fishes, significant research gaps exist on distribution and marine life history and habitat requirements. The lack of specific and comprehensive information on distribution prevented detailed delineation and fine-scale mappings of EFH. The process of identifying Pacific salmon EFH emphasized the need for accurate, fine-scale GIS data on freshwater and marine distribution, habitat conditions, and the need for compilation of uniform and compatible datasets. Future efforts should focus on developing accurate, seasonal salmon distribution data at a 1:24,000 or finer scale (particularly in freshwater) to aid in more accurate and precise delineation of EFH and in the EFH consultation process. It should be noted, however, that more detailed and precise freshwater distribution data will not eliminate the need for a watershed-based approach for recovery and protection of Pacific salmon EFH.

Defining salmon EFH using USGS fourth-field hydrologic units resulted in entire watersheds being defined as EFH even when large portions of the watershed were not historically used by Pacific salmon. For example, a large impassible waterfall historically and currently precludes salmon from approximately 50% of Snoqualmie hydrologic unit (USGS No. 17110010). The waters above this natural barrier are not considered EFH, though activities that may impact the quality and quantity of downstream EFH could be subject to the provisions of EFH. Classification by subwatersheds, defined by the USGS as fifth-field hydrologic units would allow more restrictive and precise delineation of EFH. These subwatershed boundaries and codes are in development for some areas, but were not available for initial EFH delineation. Detailed, fine-scale information on seasonal salmon distribution would allow accurate delineation of freshwater EFH using fifth- or even sixth-field hydrologic units. Furthermore, it would help provide the basis for more accurate descriptions of EFH and habitats areas of particular concern. Additional physical variables such as water quality, riparian vegetation, land-use, and other physical features could be incorporated into this watershed framework to determine the most productive watersheds, those in need of restoration, and to develop priorities for restoration. Ultimately, a detailed analysis of salmon production and watershed condition throughout the Pacific Northwest is needed to determine the characteristics of productive watersheds and stream reaches for Pacific salmon.

Few studies exist on Pacific salmon oceanic and coastal distributions and EFH descriptions for Pacific salmon relied heavily upon a few key studies on juvenile salmon (e.g. Pearcy 1992, Hartt and Dell 1986, etc.) and anecdotal information from commercial fishermen. Fine (large) scale seasonal information on salmon marine distribution is needed to more accurately depict the distribution of juvenile, maturing, and adult Pacific salmon, which is thought to be dynamic, changing with ocean conditions. Moreover, early ocean residence is believed to be a critical period for salmon survival (Pearcy 1992) and little information exists on habitat utilization, feeding, and survival during this period. Similarly, there is a paucity of data on estuarine habitat utilization and survival and marine and oceanic distribution during winter months.

In contrast to the marine environment, considerable information exists on the freshwater life history requirements of Pacific salmon. However, little habitat- and season-specific survival information exists for most life stages. Furthermore, models are needed to predict juvenile and adult production in relation to habitat quality, ocean conditions, and the effects of anthropogenic activities such as forest practices, agriculture, grazing, and urbanization. Finally, the development of models and research on habitat impacts and salmon production will prove critical for effective consultation and for refining Pacific salmon EFH descriptions.

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APPENDIX B

DESCRIPTION OF THE OCEAN SALMON FISHERY AND ITS SOCIAL AND ECONOMIC CHARACTERISTICS

AMENDMENT 14 TO THE PACIFIC COAST SALMON PLAN

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TABLE OF CONTENTS

Page

LIST OF ACRONYMS AND ABBREVIATIONS

BIA	Bureau of Indian Affairs
CDFG	California Department of Fish and Game
CPFV	Commercial Passenger Fishing Vessel
CRITFC	Columbia River Inter-Tribal Fish Commission
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FMP	fishery management plan
KFMC	Klamath Fishery Management Council
KMZ	Klamath Management Zone
NOAA	National Oceanic and Atmospheric Administration
NRC	Natural Resource Consultants
NWIFC	Northwest Indian Fisheries Commission
ODFW	Oregon Department of Fish and Wildlife
PacFIN	Pacific Fishery Information Network
PFMC	Pacific Fishery Management Council
PSC	Pacific Salmon Commission
STT	Salmon Technical Team
USCG	U.S. Coast Guard
WDFW	Washington Department of Fish and Wildlife

INTRODUCTION

This appendix provides an economic and social description of the West Coast ocean salmon fishery in the context of local and world markets, the West Coast fishing industries and communities, and the larger management regime of which the West Coast ocean salmon fishery is only one part. It serves as a description of the fishery for the salmon fishery management plan (FMP) and a description of the human environment for the environmental impact statement (EIS).

Chinook, or king salmon (*Oncorhynchus tshawytscha*), and coho, or silver salmon (*O. kisutch*), are the main species caught in PFMC-managed ocean salmon fisheries. In odd-numbered years, catches of pink salmon (*O. gorbuscha*) can also be significant, primarily off Washington and Oregon (Salmon Technical Team [STT] 1998a). Therefore, while all species of salmon fall under PFMC's jurisdiction, the primary focus of management is on chinook, coho, pink (odd-numbered years only), and any salmon species listed under the Endangered Species Act (ESA) that is measurably impacted by PFMC fisheries. To the extent practicable, PFMC has partitioned this coastwide aggregate of chinook, coho, and pink salmon into various stock components with specific conservation objectives. A detailed listing of the individual stocks or stock complexes managed by PFMC, along with pertinent stock information and conservation objectives, is provided in Chapter 3.

In this appendix, where inflation-adjusted economic information is provided, the gross domestic product implicit price deflator, developed by the Bureau of Economic Analysis, has been used to adjust nominal to real values (Table B-1).

1.0 MARKETS

1.1 COMMERCIAL

1.1.1 The World Market and Production

West Coast salmon products compete in a global salmon market. Chinook and coho off the West Coast compete not only with the same species produced in other regions of the world, but also with other salmon species such as sockeye, chum, pink, and Atlantic. Nonsalmon fish species and other meat protein sources also compete with salmon and act as substitutes in the market place. One such example particularly relevant to the West Coast is sablefish. Studies have shown a relationship between sablefish prices and salmon prices in the Tokyo central wholesale market (Hastie, 1989 and Jacobson 1982 as cited by Hastie 1989). Japan is the world's largest importer of fish, and Japanese demand for salmon drives much of the trade patterns in the world salmon market (Wessells and Wilen, 1992). Rainbow trout (*Oncorhynchus mykiss)* might be considered another example (Anon., 1998). This fish is not included in most of the quantitative information below on world salmon production, though it has recently been reclassified as a salmon species.

With the introduction of farm-raised salmon, and most recently trout, world salmon markets have undergone rapid changes in recent years. World salmon supply has tripled since 1980 (based on estimated production for 1997, Figure B-1a). The estimated 1997 world harvest of salmon from commercial fisheries is near the 1980-1997 average while farmed production continues to increase. The farmed salmon share of the market has gone from one percent in 1980 to 59% in 1997 (Figure B-1b). Increasing production of farmed salmon has had major impacts on salmon prices and is likely responsible for a continuing slump in West Coast chinook and coho prices (Figure B-2). Rainbow trout pen culture has been slower to take off than the culture of other salmon species though recent growth in this activity has been rapid. In 1997, farmed rainbow trout production was about one fifth the size of farmed salmon production (Anon., 1998).

The West Coast ocean salmon fisheries contribute chinook, coho, and pink salmon to North American salmon production. The West Coast chinook harvest is comparable to Alaskan and Canadian production (Table B-2). West Coast coho and pink salmon harvests are less than Canadas and minor compared to Alaska (Table B-3 and Table B-4).

In fisheries such as the salmon fishery, where there is a brief harvest period followed by a longer marketing period during which product is sold out of inventories, there are two types of markets operating. One market distributes all its product during or shortly after the harvest period and determines what product form the raw fish will go to (e.g., fresh, frozen, canned, or cured). It is this market that also establishes the exvessel price that fishers will receive. The other market operates during the remainder of the year and determines the rate at which product flow into wholesale and retail markets over time (Wessels and Wilen, 1992). Salmon cannot be held in cold storage for much longer than a year, thus U.S. cold storage holdings fluctuate widely (Figure B-3). Since the mid-1990s peak inventories of salmon have been generally been higher than what was observed in the late 1980s and early 1990s. The generally higher U.S. cold storage holdings correlate with a period of increased world supply, increased U.S. salmon consumption rates, and decreased exvessel prices.

1.1.2 Trade

In 1997, the U.S. went from being a net exporter of fresh and frozen salmon to being a net importer on a dollar-value basis (Table B-5). This was primarily the result of a decline in sockeye exports and a corresponding increase in Atlantic salmon imports. The U.S. is a net exporter of fresh and frozen coho and a net importer of fresh and frozen chinook.

1.1.2.1 Imports

Fresh and frozen salmon comprise about 95% of the U.S. salmon imports as measured by value (Table B-5). U.S. imports of fresh and frozen chinook and coho declined from 17% of all fresh and frozen salmon imports by value in 1993 to between 10% and 13% from 1994 to 1996, and then down to about five percent in 1997.

The decline is due primarily to an increase in the volume of imports of other species of salmon and some reduction in chinook imports (Figure B-4 and Figure B-5). The value and volume of fresh and frozen chinook imports is generally substantially greater than the value and volume of fresh and frozen coho imports. The Atlantic salmon proportion of the total value of fresh and frozen salmon imports has risen steadily from 69% in 1993 to 86% in 1997. The U.S. has imported salmon products of all types from 65 different countries over the last five years. Many of the countries from which the U.S. imports small amount of salmon are locations for intermediate handlers of the salmon. In these intermediary countries, salmon may undergo additional processing before being re-exported to the U.S. From 1993 to 1997, Canada, Chile, Norway, and the United Kingdom, accounted for 96% of the value of U.S. salmon imports (Table B-6).

1.1.2.2 Exports

About 65% of the U.S. salmon exports are fresh and frozen (on a dollar value basis), though that ratio declined to 60% in 1997 (Table B-5). From 1993 to 1997, U.S. exports of chinook and coho accounted for between 8% and 13% of the value of all exports of fresh and frozen exports (Figure B-6 and B-7). The value of the coho exports has been generally greater than the value of chinook exports though the ratios have evened out more in recent years. In 1993, sockeye accounted for 75% of the value of U.S. fresh and frozen salmon exports. The sockeye contribution to export values has been on a downward trend, and in 1997 sockeye contributed only 65% of the value of U.S. fresh and frozen salmon exports. The U.S. has exported salmon products of all types to 93 different countries over the last five years. From 1993-1997, Japan, Canada, the United Kingdom, and France received 90% of the value of U.S. salmon imports (Table B-7).

In 1997, even with the drop in sockeye production and exports, the U.S. supplied nearly one-third of the dollar value of Japan's salmon imports. Of that one-third, 88% of the U.S. supply to Japan was fresh and frozen sockeye (Table B-8). The U.S. export of all other salmon species combined amounts to only four percent of the Japanese imports of all salmon. The main market for West Coast salmon has been domestic with some chinook going to the smoking market in Europe (Radtke and Jensen, 1991).

1.1.3 Domestic Demand

From 1910 through the early 1970s, per-capita fish consumption in the U.S. generally ran between 10 and 12 pounds, except during the depression and World War II, at which times consumption dropped. In the early 1970s, per-capita consumption increased to a 12 to 13 pound range. In the mid 1980s, it shifted upward again to the 15 to 16 pound range it has been in since 1985 (U.S. Department of Commerce, 1996). Consumption of salmon has steadily increased over the last 18 years. Per-capita consumption of salmon in 1996 is 3.65 times what it was in 1979, while the U.S. population has increased 18% (Figure B-8 and Table B-9). Most of the increased demand is for fresh and frozen salmon as opposed to canned salmon.

1.1.4 Exvessel Prices

Exvessel prices for West Coast ocean-caught non-Indian chinook and coho have been on a steady downward trend in the 1990s (Figure B-2). In real terms, 1996-1997 chinook and coho prices are less than half what they were at the start of the decade. Within the year, West Coast exvessel prices appear to dip when harvest increases (Figures B-9 and B-10). West Coast exvessel prices are generally lowest in July and August. Given the small size of the West Coast harvest relative to world production, the cause of this correlation between West Coast harvest and exvessel prices is uncertain. It might be a function of localized markets or a correlation of West Coast harvest with harvest in other parts of the world.

1.1.5 Exprocessor and Wholesale Prices

Information on the exprocessor values of salmon products is very limited. A Natural Resource Consultants (NRC) report from 1986 estimated that the wholesale value of salmon products in Washington was twice the exvessel value (NRC, 1986). Some more recent information for a broader geographic area is available from the NMFS processed products survey and Urner Barry Publications, Inc.

Usefulness of the processed product survey information for purposes here is limited, because response to the survey by processors is relatively low; the processed products covered include fish from Canada, Alaska, and other nonWest Coast sources; and the product forms for which there are the best response rates in the survey tend to be in general categories (e.g., "salmon chinook dressed") as opposed to more specific categories (e.g., "salmon chinook dressed head-on"). This makes it difficult to interpret price trends and difficult to compare exprocessor and exvessel prices. Table B-10 shows exprocessor prices for products for which the number of processors and pounds on which prices are reported in the processed product survey are substantial. Prices appear to be lower in recent years, though there are exceptions.

Urner Barry Publications, Inc. reports wholesale market prices for certain categories of salmon. The only wild salmon for which Urner Barry reports prices are chum. However, price trends for farm raised salmon may be indicative of the market situation for wild salmon as well. In general, Urner Barry wholesale prices indicate a downward trend in recent years for wild chums and farmed Atlantic salmon (Table B-11). While prices for Canadian farmed chinook prices also exhibit a downward trend they appear to be a little more stable in recent years. This relative price stability may reflect decreased supply due to falling production since Canadian farmed chinook production reached a peak in 1991.

CanadaFarmed Chinook Production (mt)

1990	1991	1992	1993	1994	1995	1996
10,396	14,245	13,409	8,295	7,148	8,068	7,194

(Salmon Market Information Service, 1998)

1.2 RECREATIONAL

Just as the West Coast supply of salmon for food markets is only one segment of a broader food market, the supply of salmon for recreational harvest opportunities is only one segment of a broader recreational market. The substitutes for marine recreational ocean salmon fishing experiences are not as accessible and of greater difference in quality than substitutes in the food markets. For example, substituting an alternative ocean salmon harvest experience for a West Coast experience (e.g., traveling to Alaska or Canada for such an experience) involves a much greater increase in time and money expenditures than substituting an Alaska caught salmon for a West Coast caught salmon at the supermarket. At the same time, for northern areas of the coast in particular, newspaper advertising reveals that there is a real competition with the British Columbia recreational industry for the dollars of West Coast (U.S.) marine recreational anglers. Alaska and British Columbia tend to offer longer more stable ocean seasons than have been offered north of Horse Mountain California under the restrictive seasons of recent years, (Tables B-12 and B-13).

Other types of marine recreational angler trips, fresh water angling, and other recreational activities are, to varying degrees, potential substitutes in the market place for ocean salmon fishing. West Coast salmon angling opportunities, including those in marine fisheries such as Puget Sound and the Columbia River Buoy-10 fishery are discussed in more detail in Section 3.4.

Demand for recreational trips and measures of the breadth of social and economic impacts related to the salmon fishery are related to numbers of anglers. Data is not available on the number of salmon anglers on the West Coast. However, data is available on the number of saltwater anglers. In the U.S., 9.4 million anglers took part in 86.5 million saltwater fishing trips in 1996. The following are the numbers of marine anglers by West Coast state and number of marine angling trips (USFWS, 1997).

1996	Marine Anglers (Thousands)				Marine Trips (Thousands)			
	Total	Resident	NonResident	Percent NonResident	Total	Resident	NonResident	Percent NonResident
Washington	378	316	62	16	2,134	1,773	361	17
Oregon	162	129	33	20	870	818	53	6
California	1,049	937	112	11	7,302	6,992	310	4

2.0 THE SALMON FISHERIES MANAGEMENT SYSTEM

PFMC is responsible only for the West Coast ocean area commercial and recreational salmon harvests. Non-Indian commercial salmon fisheries also occur in Puget Sound, Grays Harbor, Willapa Bay, and the Columbia River. Nonocean Indian commercial salmon fisheries occur in the same areas (except Willapa Bay) as well as the Klamath River, Quinault River, Queets River, Hoh River, and Quillayute River. Nonocean recreational salmon fisheries occur in Puget Sound and other coastal and inland rivers, streams and estuaries including the Columbia River and Klamath River Basins. PFMC manages the ocean fisheries for ocean and expected spawning escapement, taking into account expected abundances and inside harvests. Expected abundances for north migrating fish are affected by harvests in Alaska and Canadian waters, which in some years have been negotiated under the Pacific Salmon Treaty.

2.1 HARVEST MANAGERS AND MANAGEMENT FORUMS

Because of the transboundary migratory nature of salmon, numerous U.S. management agencies take part in a number of different forums for the coordinated management of West Coast salmon stocks.

2.1.1 The Harvest Managers

The parties that implement management regulations affecting the West Coast ocean salmon fisheries include California, Oregon, Washington, Idaho, Alaska, Canada, NMFS, and the tribes. The California tribes involved in management and harvest of salmon are the Hoopa and Yurok. The Columbia River tribes involved in management and harvest of salmon are the Yakima, Warm Springs, Umatilla, Nez Perce, and Shoshone-Bannock tribes. The states of Oregon, Washington, and the Columbia River tribes manage according to court orders and plans arising from U.S. v. Oregon. The western Washington tribes involved in management and harvest of salmon are the Hoh, Jamestown S'Klallam, Lower Elwha Klallam, Port Gamble S'Klallam, Lummi, Makah, Muckleshoot, Nisqually, Nooksack, Puyallup, Quileute, Quinault, Sauk-Suiattle, Skokomish, Squaxin Island, Stillaquamish, Suquamish, Swinomish, Tulalip, and Upper Skagit. In Western Washington, the State of Washington and tribes are co-managers according to court orders arising from U.S. v. Washington and Hoh v. Baldrige utilizing the Puget Sound Salmon Management Plan and the Hoh v. Baldrige Framework Management Plan to guide annual management planning activities. Other tribes in the northwest also fish for salmon, but do not have fishery rights adjudicated under a treaty.

2.1.2 Northwest Tribal Management Organizations

The treaty tribes of the northwest utilize the services of two technical service organizations. These are the Columbia River Inter-Tribal Fish Commission (CRITFC) and the Northwest Indian Fisheries Commission (NWIFC).

2.1.2.1 Columbia River Inter-Tribal Fish Commission

The CRITFC was formed in 1977 by resolutions of the Yakama, Warm Springs, Umatilla, and Nez Perce tribes-Columbia Basin Indian tribes that signed treaties in 1855 securing to them certain reserved rights to take fish in the Columbia River and its tributaries. The CRITFC is composed of the fish and wildlife committees of its member tribes and supplies technical expertise and enforcement resources. CRITFC provides support to the tribal governments during their negotiation on fish issues with the relevant state governments.[1/]

1/ The Shoshone-Bannock tribe has fishery rights established under a separate treaty and is not a member of the CRITFC.

2.1.2.2 Northwest Indian Fisheries Commission

The NWIFC was established to coordinate the activities of the tribes for implementation of orders arising from U.S. v. Washington. It is composed of 19 of the tribes in western Washington that are party to the U.S. v. Washington litigation: Jamestown S'Klallam, Lower Elwha S'Klallam, Port Gamble S'Klallam, Lummi Makah, Muckleshoot, Nisqually, Nooksack, Puyallup, Quileute, Quinault, Sauk-Suiattle, Skokomish, Squaxin Island, Stillaquamish, Suquamish, Swinomish, Tulalip, and Upper Skagit. Members' tribes manage their own fisheries and negotiate directly with the state. The NWIFC provides technical support to Puget Sound and coastal tribes and assists in intertribal coordination on harvest policy.

2.1.3 Pacific Salmon Treaty and Pacific Salmon Commission

Allowable impact levels established under agreements made within the Pacific Salmon Commission (PSC) or, in the absence of such agreements, independently by Canada affect the amount of fish available for harvest and spawning in U.S. waters. The PSC was established under the Pacific Salmon Treaty.

Canada and the U.S. signed the Pacific Salmon Treaty in 1985, after 15 years of negotiation. The Treaty was negotiated to ensure conservation and an equitable harvest of salmon stocks. It covers five species of Pacific salmon and steelhead; and applies to fisheries in southeast Alaska, British Columbia, Washington, and Oregon.

The treaty recognizes that each country is most interested in the conservation and harvest of salmon stocks that originate in its own waters. However, it also recognizes that salmon migrate through the waters of both countries and are inevitably intercepted in large numbers by each country's fisheries. The treaty was designed, therefore, to establish a forum for consultation and negotiation between Canada and the U.S. on Pacific salmon issues and to facilitate co-operation on research and enhancement of Pacific salmon stocks.

The two principles on which the treaty rests are conservation and equity.

- The conservation principle obliges the two parties to prevent overfishing and provide for optimum production.
- The equity principle provides for each country to receive benefits equivalent to the production of salmon from its own rivers.

Representatives from the two countries meet annually to review the past year's fishery and to negotiate fishing regimes for future years. Negotiations on implementation of the equity principle within the Pacific Salmon Commission as well as U.S.-government-to-Canadian-government negotiations on the issue have been unsuccessful. Since 1994, U.S. and Canadian negotiators have been unable to agree on catch limits.

2.1.4 Pacific Fishery Management Council

Each year PFMC[2/] follows a specified preseason management process to develop the annual salmon management recommendations. Public involvement in the process begins in late February with the release of reports documenting the previous ocean salmon fishing season and providing estimates of the expected salmon abundance for the coming season. The reports are followed by a Council meeting in early March to propose season options for public comment, public hearings on the options in late March, and an early April Council meeting to adopt the final recommendations on time for implementation on May 1.

2.1.5 Columbia River Compact

The U.S. congress ratified a compact agreement between Oregon and Washington in 1918 (the Compact). The Compact's charge is to manage commercial fishing seasons for salmon, sturgeon and other commercial food fish caught in the Columbia River. The Columbia River Compact is made up of delegates from the Oregon and Washington fish and wildlife commissions. The Columbia River treaty tribes have authority to regulate Treaty-Indian ceremonial and subsistence fisheries. All commercial fisheries regulations are established by the Compact. In developing commercial seasons, the Compact considers the effect of the commercial fishery on escapement, treaty rights and sports fisheries for species such as salmon, steehead and shad. Options for management of the commercial Treaty fisheries are developed in consultation with the tribes in a co-management process. While the Compact has no authority to adopt sport regulations, allocation between sport, commercial and tribal users is considered an inherent part of the Compact's responsibility. Additionally, particular attention is paid to conservation of species listed under the ESA. Hearings are held periodically to adopt or review seasonal commercial regulation (Columbia River Compact, 1997 and 1998).

2.1.6 North of Cape Falcon Forum

The North of Cape Falcon Forum provides an opportunity for co-managers of the ocean and inside fisheries and representatives of commercial and recreational harvesting groups to resolve complex management issues which constrain management of the ocean and inside salmon fisheries north of Cape Falcon, Oregon. Co-managers participating in the forum include the states of Oregon and Washington, the Columbia River tribes, the Puget Sound and Washington coastal tribes and NMFS. The fishing groups represented include Oregon and Washington inside and ocean recreational fishers, Oregon and Washington non-Indian Columbia River, Willapa Bay and Grays Harbor gillnetters, Oregon and Washington non-Indian trollers, and Puget Sound non-Indian commercial fishers. In this forum, participants try to reach harvest agreements taking into account conservation needs, anticipated impacts from fish passing through Alaska and Canadian fisheries, court orders and harvest sharing between Indian and non-Indian users, harvest sharing between inside and outside fisheries, and harvest sharing and formal allocations between non-Indian commercial and recreational fishers.

In the Puget Sound and the Washington coastal areas, the entire package of pre-terminal and terminal fishing agreements are not always fully completed in the North of Cape Falcon Forum. In the event this occurs, the affected co-managers continue negotiations utilizing court orders and plans arising from the U.S.

2/ PFMC is one of eight regional fishery management councils in the nation, all with similar missions, but covering different areas. Congress created councils when it passed the Magnuson-Stevens Fishery Conservation and Management Act in 1976. Fish and fishers often move between the waters of different states and between federal and state waters. Consequently, a regional management body can more easily control harvests of all fishers throughout the range of the fish. Councils prepare, monitor, and revise FMPs for fisheries requiring conservation and management, such as this salmon FMP. Councils are not federal agencies, but a combination of federal, state, and private interests. Councils are planning bodies that make recommendations, but have no rule making authority. The U.S. Secretary of Commerce is the federal rule making authority for fishery management. The Secretary approves/disapproves and implements PFMC plans and regulations.

v. Washington and Hoh v. Baldrige litigation including the Puget Sound Salmon Management Plan and the Hoh v. Baldrige Framework Management Plan.

2.1.7 Klamath River Fishery Management Council

The Klamath Fishery Management Council (KFMC) was created by Congress under the Klamath Basin Restoration Act in October 1986 (PL 99-552, 1986). The Klamath Basin Restoration Act created an 11 member KFMC to supercede a management group originally convened under the auspices of PFMC. The KFMC is comprised of representatives of California Department of Fish and Game (CDFG), Oregon Department of Fish and Wildlife (ODFW), PFMC, NMFS, the Department of Interior, the Yurok and Hoopa Tribes, California and Oregon commercial fishers, California ocean recreational fishers, and inland recreational fishers. The KFMC's advisory function is to make harvest management recommendations to the various management agencies including PFMC. All recommendations passed forward to agencies or to PFMC must be with the consensus of all members.

2.2 ACCESS TO THE COMMERCIAL AND RECREATIONAL SALMON FISHERIES

How our society determines who should be allowed access to the salmon fishery reflects social, political, and economic attitudes about the salmon resource. For example, the license limitation programs for the commercial fishery firmly establishes the resource is publicly owned, while at the same time establishing what is often construed as a private (tradable) right to access. The characteristics of this system and how it was established reflect attitudes about the fishery and fish resource and our relationship to it. License requirements and fees for recreational angling also reflect values placed on the opportunity to participate in the fishery, as do rules that provide exemptions for veterans, handicapped individuals, and senior citizens.

This section documents the commercial license limitation programs established by the states, including how they were established, and licensing requirements for recreational fisheries. The emphasis on the license limitation programs is particularly relevant given the recent federal funding of salmon license buyback programs in Washington and the potential for future buyback programs as a response to diminishing harvest opportunities. Information included on license fees may become out-dated over a relatively short period of time. It is included here to document and provide a baseline for the costs of access as of this moment in time. This section does not cover tribal rules for member access to tribal fisheries.

2.2.1 Commercial and Charter Vessels

State license limitation programs are used to control participation in the West Coast salmon fisheries. The non-Indian commercial salmon fisheries in all three states are operated under license limitation programs, and there is a license limitation program in effect in Washington for salmon recreational charter operations.

In August 1978, PFMC adopted a resolution encouraging the coastal states to implement moratoria on new participation in the ocean salmon troll and charter boat fleets. This action was taken in lieu of establishing a Federal permit, in recognition that the coastal states had existing vessel licensing programs and could most efficiently implement their own moratoria, responsive to the needs of the states and industry. The following are the general principles the states were encouraged to follow (1) cap not only participation, but also total effort; (2) use 1974-1977 as a base period for qualifying; (3) adhere as closely as possible to definitions of "active vessel participation," "contracted for construction," etc., as adopted and publicized by PFMC; (4) establish appeals boards; (5) recognize the regional nature of fisheries, but do not discriminate among fishers of the states within the region; (6) seek to ultimately maintain approximately the number of vessels in the 1977 fishery (or less) recognizing that the qualifying period may result in an initial increase in number of participants.

2.2.1.1 California

Ocean Commercial Troll

In California, ocean troll salmon vessel limited entry permits were first required for participation in the ocean troll salmon fishery beginning in 1982. There is no recipricol recognition of the salmon limited entry permits of other states.

Initial Qualification

California implemented its first moratorium on new entry to the salmon fishery in 1980 (SB 755, 1979). California's first moratorium was based on the individual rather than the vessel. The two-year moratorium required licensed fishers hold a personal salmon permit when fishing commercially for salmon. The permit was in the form of a stamp to be affixed to the commercial fishing license. A person with a salmon stamp could fish for salmon from any commercially licensed vessel. To acquire a stamp, the person (1) needed a commercial fish dealer receipt showing that he or she had sold at last one salmon in at least one year from 1974 through 1979; or (2) needed to show that he or she had a commercial license and while acting under that license had assisted in the capture and sale of at least one salmon from 1974 through 1979; or (3) needed to show proof of investment in becoming a commercial salmon fisherman such as by having a vessel under construction or contract for purchase prior to December 16, 1977. A notarized statement signed by the applicant and providing the registration number of the vessel delivering the fish was sufficient demonstration that the second of the listed requirements was met. To qualify based on investment, applications had to be reviewed by an appeals board dominated by commercial salmon fishers. Fishers in Oregon and Washington that qualified under the limited entry laws in those states were qualified to purchase a commercial license and salmon stamp in California. Because the limited entry programs in other states were vessel based rather than crew based, out of state vessels were allowed to use out of state crew without having commercial licenses for those crew. The initial moratorium permits were nontransferable except that they could be transferred to a different individual for one 15-day period during the calendar year. The fees for the stamp and salmon validation fee were $15. The initial moratorium was in place through the end of 1981.

In 1982, the fisher based moratorium was modified to a vessel owner based license limitation system. Permits were issued to (1) owners of vessels that had been used to take salmon commercially from 1980 through August 11, 1982, (2) to natural persons with personal salmon permits under the moratorium who had constructed or purchased a vessel prior to August 11, 1982 in anticipation of entering the salmon fishery, (3) natural persons owning a commercial vessel with salmon landings who due to a personal illness, disability, or other circumstance outside their control were unable to fish from 1980-1982, (4) individuals licensed to fish commercially for at least 20 years who had participated in the salmon fishery in at least one of those 20 years (Senate Bill 1917, 1982).[3/] New permits could only go to natural persons who did not already own a commercial salmon fishing permit.[4/] The vessel based moratorium did not provide recipricol recognition for Oregon and Washington salmon limited entry permits. This moratorium was initially set to expire at the end of 1986, unless renewed (SB 1917). After a series of renewals, the moratoreum became a permanent license limitation system in 1988 (Assembly Bill 2366).

Numbers of Permits and Provisions for Expanding the Number of Permits

The California legislation establishing a permanent salmon license limitation program authorized the issuance of new permits only when the total number of permits falls below 2,500. When the total number of permits falls below 2,500, CDFG is to consult with the review board to determine the number and vessel

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3/ If new permits were to be issued, they were first issued as interim permits. Interim permits had to be used in two consecutive seasons before a permanent permit could be issued.

4/ Permits were transferable with, but not separable from, the vessel except in the case of a lost, destroyed, or retired vessel. An owner could replace a lost, destroyed, or retired vessel within one year with a vessel found by the review board to be of equal or lessor capacity.

classification for the new permits to be issued. New permits would be issued by a drawing. There have been fewer than 2,500 California permits since 1994; however, because of the depressed condition of the resource, to date, no additional permits have been issued. The number of permits issued was highest in 1984 at 5,964. In 1997, there were 2,069 vessels with California permits.

Permit Transferability and Vessel Capacity Limitation

Permits are issued to the vessel owner and may only be transferred to a new owner with the vessel. The owner may transfer the permit to a replacement vessel that has the same or less fishing potential than the vessel being replaced, however, the owner must own the permitted boat at least 18 months before the permit can be transferred to a new vessel. Permits may be transferred to new vessels if the vessel was accidentally lost and the necessary steps to secure a replacement are taken within one year of the loss. There is a $200 fee for transferring a permit to a different vessel. If a permitted vessel has a lien holder or mortgage holder, the lien or mortgage holder must approve the transfer of the permit to a different vessel.

Fishing vessel potential is evaluated by a commercial salmon review board. In considering the capacity of permits, the review board first groups vessels into two groups: vessels less than 25 feet, and vessels more than 25 feet. The following seven factors are evaluated by the board in determining vessel capacity (they are listed here in order of importance), (1) the vessel's size in terms of length, beam, and depth; (2) the vessel's "seakeeping ability" as determined by the size and design of the hull; (3) the new vessel's ability to function as a salmon troller in comparison to the vessel being replaced; (4) previous use of the vessel; (5) fish holding capacity; (6) hull shape (open deck, closed deck, displacement, semidisplacement, and planing) and materials (wood, fiberglass, aluminum, steel, other); (7) propulsion. Seakeeping ability is the board's assessment of the ability of the vessel to stay at sea and continue to fish during inclement weather. Amounts of salmon landed may be considered as part of the boards evaluation of the vessel's capacity. The boards final determination is based on its aggregate assessment of these factors. For vessels less than 25 feet in length the size of the vessels is not compared. Where one or both vessels involved in the transfer are greater than 25 feet all seven factors are considered. (CDFG, Guidelines for Commercial Salmon Vessel Permit Transfers, March 18, 1997).

Permit Renewal and Revocation

Salmon permits must be renewed prior to April 1 each year and will become void if not renewed. The fee for renewing the salmon permit is $30 (Bennett, 1998). Permits not renewed by April 1, may be renewed prior to the end of April with payment of a $100 late fee. Salmon landings are not required for renewal of the permit. The permits can only be reinstated if an extenuating circumstance prevented renewal and there was not a reasonable opportunity for an agent to renew the permit on behalf of the owner. Permits will be voided if a vessel is purposefully sunk prior to the transfer of the permit from the vessel or if a vessel was accidentally lost but not replaced within one year (Fish and Game Code, Article 4.5).

Other State Permits Required for Participation in the Commercial Salmon Fishery

In California, all commercial fishing vessels are required to have a commercial fishing vessel registration. Additionally, salmon conservation stamps are required for anyone on the vessel assisting in the salmon harvest. As of 1998, the fee for the vessel registration was $200 for residents and $400 for nonresidents. Everyone working on board the vessel must hold a commercial license to which the salmon conservation stamps are affixed. The 1998 fees for the commercial licenses were $50 for crew members, $90 for operators, and $400 for nonresidents. The vessel may hold a permit for one crew member that may be assigned to any crew member working on the vessel. The fee for the salmon conservation stamps fluctuate between $85 and $285 on an annual basis, depending on the total tonnage of salmon landed in the state in the previous year. For 1998 the fee was $260 (Bennett,1998).

Commercial fishers who wish to sell to the public or directly to restaurants and retail outlets must acquire special licenses. To sell to restaurants and retail outlets a commercial fish receivers license is required, the fee for which is $400 for 1998. To sell directly to the public a commercial fish retailers license is required, the fee for which is $50 for 1998 (CDFG, 1998b).

Recreational Charter Vessels

There is no license limitation system for California commercial passenger fishing vessels charter vessels. Such vessels are required to obtain commercial passenger fishing vessel licenses from CDFG for $200 ($150 if the vessel has a commercial salmon vessel permit). These vessels must also hold commercial boat registrations from the California Department of Motor Vehicles. In addition, north of Point Arguello, charter vessels participating in the salmon fishery must hold commercial fishing salmon stamps for the operator and an additional salmon stamp for each crew member required to be on board under USCG rules (CDFG, 1998).

Limited Entry Permit Buyback Programs

There have been no buyback programs for California ocean troll permits.

2.2.1.2 Oregon

Ocean Commercial Troll

Ocean troll salmon limited entry permits were first required for participation in the ocean troll salmon fishery beginning in 1980 (ORS 508.801). In an emergency and with the approval of ODFW, ocean troll salmon may be landed by vessels without limited entry permits if a single delivery license is purchased for the vessel. Vessels operating under the California salmon license limitation program may land in Oregon using such a single delivery permit.

Initial Qualification

Initial issuance of the ocean troll salmon limited entry permits was based on vessel history. In order to qualify, a vessel must have been commercially licensed and have landed in Oregon at least one ocean troll caught salmon from 1974-1978, or, during 1974-1978 must have been under construction or a contract for construction as a commercial fishing vessel designed to be used in the ocean troll salmon fishery. No applications for new permits were accepted after May 15, 1989.

Numbers of Permits and Provisions for Expanding the Number of Permits

ODFW is required to issue a minimum of 1,200 limited entry ocean troll salmon permits. If the number of renewed permits falls below this level then a lottery may be used to achieve the minimum. The Oregon Fish and Wildlife Commission is allowed to suspend the lottery for up to two years if it determines the action appropriate in consideration of the condition of the resource. When the program was first established the minimum was set at the number of vessels participating in the ocean troll salmon fishery during the calendar year 1978 (3,158 vessels). Since initially establishing the program, the state legislature has reduced this minimum on several occasions. A lottery has never been held to issue more permits. The greatest number of permits issued was 4,314 in 1980. In 1997 there were 1,286 permits issued.

Permit Transferability and Vessel Capacity Limitation

Limited entry troll permits may be transferred to new owners with the transfer of the vessel. Such permits may also be transferred to a replacement vessel of the holder of the permit or, if authorized by ODFW, to a different vessel owned by a different individual. The language of the initial legislation placed some limits on the transfers based on vessel "capability".[5] [6] The replacement vessels could not be of greater capability than the vessel from which the permit was being transferred with three exceptions. The permit could go to a greater capability vessel if (1) prior to August 8, 1983 the person owning the vessel to which the permit was being transferred also owned a limited entry troll permit; (2) prior to August 8, 1983 there was a limited entry troll permit issued for the vessel to which the permit was being transferred; or (3) the vessel was newly constructed and had never been used in any commercial fishery. The agency issued rules giving this legislation the following interpretation: all vessels less than or equal to 30 feet in length were considered to have the same capability; and the limit on transfer to vessels of "greater capability" was interpreted as a limit on transferring a permit to a vessel more than 5 feet longer than the vessel from which the permit was being transferred (where the vessel to which the permit was being transferred was longer than 30 feet). Through a series of transfers, permits could be moved to progressively longer vessels without limit, except permits could be transferred only once per year. In 1995, legislation abandoned the "capability" language and specified transfer restrictions in terms of length. The rules were liberalized to remove all capability limitations for permit transfers where both vessels involved were in the same length class. Three length classes were established, (1) less than 30 feet,[7] (2) greater than 30 feet and less than or equal to 42 feet, and (3) greater than 42 feet. Additionally, permits could be moved between vessels in different categories so long as the change in length was no greater than 5 feet.

A vessel operating under a permit must land more than 100 pounds of salmon in the year prior to a transfer if the permit is to be transferred to a vessel longer than 30 feet owned by a different person. The required salmon landings may be made in any West Coast or Alaska ocean troll fishery. This requirement to land 100 pounds in order to transfer the permit will not be effective in a calendar year in which the number of permits issued is less than 1,200.

Permits may be transferred only once per year unless the Commercial Fishery Permit Review Board finds that such a restriction would create undue hardship. In response to an appeal, the board may waive eligibility requirements for transfer of permits if the board finds the individual fails to meet the requirements as the result of illness, accident, or other circumstances beyond the individual's control.

There are no fees for the transfer of a permit.

Permit Renewal and Revocation

Limited entry permits must be renewed each year prior to the end of the year. A limited entry permit will expire and not be renewed if the permit holder fails to apply and pay the required fees for the limited entry permit prior to the end of the calendar year or fails to acquire the state's general boat license for commercial harvest prior to the end of the calendar year, except in the following situations:

- A person who permanently loses a vessel through capsizing, fire, or collision has a period of two years from the date of the loss to replace the vessel without losing eligibility to renew the limited entry permit.
- Renewal requirements are waived if in the year prior to the renewal application there was no federally established salmon season of 20 or more days in length between May 1 and July 31 off the Oregon port in which the vessel lands; and if, during the three most recent years in which there was a season of 20 or more days off that Oregon port, the vessel has landed troll-caught salmon in at least one of those years and did not land salmon in any other port during those three years.

5/ Oregon regulations use the word "capability" rather than "capacity".

6/ During the early phase of the program, legislation authorized consideration of the following factors in determining vessel capability. Vessel size, horsepower, ability to operate under adverse weather, electronic and other gear with which the vessel is equipped, and fish hold capacity.

7/ Based on the previous rules and the pattern established by the remaining categories, it was probably intended that the bottom category be vessels less than **or equal to** 30 feet.

As of 1998, the renewal fee for a salmon troll permit was $75 (including a $65 surcharge in place for 1998 through 2003). Permit fees may be refunded for vessels qualifying for the exemption from renewal specified in the second bullet. When the program was first established, in addition to keeping the permit up-to-date (renewed prior to the end of the calendar year) sometime during the year the vessel had to have landed salmon in Alaska, Washington, Oregon, or California in order to be eligible to have its permit renewed in a subsequent year. This provision was eliminated, effective in 1988.

If issuance of a permit is denied because of failure to renew, the denial may be appealed to the Commercial Fishery Permit Review Board. The board may waive eligibility requirements for renewal of permits if the board finds the individual fails to meet the requirements as the result of illness, accident, or other circumstances beyond the individual's control.

Permits may be revoked by the Commercial Fishery Permit Review Board on conviction of violation of the state's commercial fishing or game fishing laws or rules or on forfeiture of bail on account of such an offense. Additionally, permits may be revoked based on convictions in the State of Washington on an offense in violation of Columbia River commercial fishing rules adopted pursuant to the Columbia River Compact, provided the action on which the conviction was based would have also been considered an offense subject to permit revocation in the State of Oregon. After a first revocation, a permit may be revoked for up to two years for the commission of a second offense.

Columbia River Commercial Gill Net

Columbia River commercial gill net permits are required to participate in the Columbia River troll gill net fishery and land fish in Oregon (ORS 508.775). Vessels with permits for this fishery licensed by Washington are also allowed to make landings in Oregon.

Initial Qualification

The initial qualifying requirements for the Columbia River gill net permits (landings and construction) were similar to those for the troll fishery except with respect to the fishery in which participation was required (the Columbia River gill net fishery) and the years of the qualifying period (1977-1978).

Numbers of Permits and Provisions for Expanding the Number of Permits

Similar to the troll permit system, there is a minimum number of gill net permits that ODFW is required to issue and if necessary, that minimum number may be maintained through a lottery. However, the lottery may be delayed for two years for resource conservation reasons. Since 1995, the minimum number has been 200.

Permit Transferability and Vessel Capacity Limitation

Limited entry gill net permits may be transferred to new owners with the transfer of the vessel. Such permits may also be transferred to a replacement vessel of the holder of the permit or, if authorized by ODFW, to a different vessel owned by a different individual. There are no vessel capacity restrictions on the transfer of Columbia River gill net permits. Until 1995, there was a provision specifying that if a permit was not used during a calendar year and a waiver of renewal requirements was issued (see below), it could not be transferred for two years.

Permit Renewal and Revocation

Permit renewal requirements and revocation provisions are similar to those described for the troll permit system. Through mid-1995, in addition to keeping the permit up-to-date (renewed prior to the end of the calendar year) the vessel operating under the permit must have made at least one landing in the Columbia River gill net fishery during the calendar year. The renewal requirement can be waived if the Commercial

Fishery Permit Board finds that (1) the individual, for personal or economic reasons, chose to actively commercially fish in some other fishery during the Columbia River gill net salmon seasons, or (2) the individual failed to meet the requirements as a result of illness, accident, or other circumstances beyond the individuals control. These exceptions also applied to the use requirement when it was in place.

As of 1998, the renewal fee for the permits was $75 (including a $74 surcharge in place for 1998 through 2003).

Commercial Fishery Permit Board

The Commercial Fishery Permit Board is comprised of representatives of the fishing industry. Additionally, two members are appointed to represent the public. Members of the board serve without compensation (with the exception of travel and other expenses incurred as part of their official duties).

Other State Permits Required for Participation in the Commercial Salmon Fishery

The owner or operator of any boat harvesting fish or shellfish for commercial use must hold a boat license for the vessel (ORS 507.260). These licenses constitute registration for the purpose of Section 306(a) of the Magnuson-Stevens Fishery Conservation and Management Act. Such registration gives the state authority to regulate the fishing vessel outside the boundaries of the state so long as there is no FMP or other applicable federal fishing regulations, or so long as the state's laws and regulations are consistent with such FMPs or other federal fishing regulations. Vessel licenses cost $200 for residents and $400 for nonresidents.

Crew members assisting in the fish harvest must hold licenses. The crewmember fees are $50 for residents over 18, $25 for residents 18 and younger, and $100 for nonresidents. The vessel may purchase "Commercial Crewmember Fishing Licenses" for $85 and assign such licenses to the individuals working on the vessel.

Recreational Charter Vessels

There is no license limitation system for Oregon recreational charter vessels. Such vessels are required to obtain permits from the state Marine Board. The current permit fees for residents are $50 for an Oregon titled vessel and $100 for a United States Coast Guard (USCG) documented vessel. For nonresidents the fees are $50 for Alaska residents, $250 for California residents, $550 for Washington residents, and $100 for residents of other states. In addition to the vessel licensing requirements, the vessel operator must have a vessel operators license from the USCG. Outfitter guides may also take recreational fishers out for hire, however, they may not go further than three miles out without a charter vessel license (Oregon State Marine Board, 1998).

Limited Entry Permit Buyback Programs

There has not been a buyback program for Oregon troll vessel permits, however, there has been such a program for Columbia River gill net vessels. The Salmon and Steelhead Conservation Act of 1980 provided guidance on fleet reduction in the Washington conservation area, including the Columbia River gill net salmon fishery. A separate public law authorized a National Oceanic and Atmospheric Administration (NOAA) grant to the Washington Department of Fisheries in 1981 for fleet reduction in the Washington conservation area. This appropriation included a provision for funding an Oregon Columbia River fleet reduction program. The Oregon program began in April 1983, operating with federal grant funds made available through a cooperative agreement with Washington. The program ended with the end of federal funding in December of 1986. Permits were purchased in four rounds under a reverse auction bidding procedure. In each round, offers to sell were solicited from permit holders. The offers were placed in order from lowest to highest, and the Oregon Fish and Wildlife Commission determined how many of the permits they would buy, buying the lowest offers first (Carter, 1998). During the program, 133 gill net permits were purchased for $645,000. Between attrition and the buyback program, the number of permits declined from 572 in 1980 to 355 in 1986. The administrative costs of the program were $71,000.

2.2.1.3 Washington

Ocean Commercial Troll and Other Washington Commercial Salmon Fisheries

The ocean troll salmon limited entry program was created as part of a program that created commercial licenses for all of Washington's commercial salmon fisheries. The first legislation creating this system was passed in 1974. Washington recognizes Oregon Columbia River gill net permits, but does not provide recipricol recognition for the troll limited entry licenses issued by other states.

Initial Qualification

Initial issuance of the ocean troll salmon limited entry licenses and delivery permits was based on vessel history. In order to qualify, a vessel must have been commercially licensed for salmon and landed at least one ocean troll caught salmon between January 1, 1970 and May 6, 1974. The licenses issued were specific to the gear type and area in which the vessel fished.[8/] Additionally, commercial fishing vessels under construction or purchased in good faith between April 16, 1973 and May 6, 1974 were eligible for licenses. A provision in the law would have allowed recreational charter vessels to be licensed for commercial trolling if it were found that the charter industry was suffering economic hardship due to the national fuel crisis. However, the fuel crisis provision was never invoked (Edie, 1998). As a result of the consideration of the moratorium law, many individuals applied for licenses early in 1974. However, because most fishing seasons did not start until after May 6, 1974 and landings were required prior to that date, these permits were not eligible for renewal in 1975. Extenuating hardship circumstances did not play a role in the initial permit issuance criteria.

An advisory review board was convened to hear disputes on the issuance of permits. The board was comprised of three members nominated by the commercial salmon fishing industry.

The initial program was set to expire at the end of 1977. In 1977 the commercial troll program was extended through 1980 and in 1979 it was made permanent.

Numbers of Permits and Provisions for Expanding the Number of Permits

Unlike Oregon and California, there was no minimum set on the number of permits to be issued. A committee, convened to evaluate the moratorium, was in consensus agreement the number of vessels in the fishery should not be increased, but there was not an agreement on whether or not a decrease was warranted (Benson and Longman, 1980). In 1978, 3,291 permits were issued. The number of permits issued declined to 323 in 1997.

Permit Transferability and Vessel Capacity Limitation

Washington commercial salmon limited entry permits are transferable between vessels. There has never been a limit on the size or capacity of the vessels to which the permits can be transferred. There is nothing in the program that restricts the transfer of permits from lost vessels. The fee to transfer a permit is $50.

The permit off any vessel which is subject to a government confiscation may be transferred to the individual named on the permit with the approval of the director of Washington Department of Fish and Wildlife (WDFW).

8/ The fishing area/gear type combinations for which permits were issued were Puget Sound purse seine, Puget Sound gill net, Willapa Bay gill net, Grays Harbor gill net, Columbia River gill net, Ocean troll, and Puget Sound reef net.

Permit Renewal and Revocation

The annual fee for renewing a salmon troll license is $380 for Washington residents and $685 for nonresidents. There is an additional $100 enhancement surcharge which must be paid. The WDFW directory may wave renewal requirements or refund permit renewal fees if there is no salmon season in a particular year (Edie, 1998).

Beginning in 1979, salmon limited entry permits could be renewed so long as the permit had been renewed in the previous year, and the vessel with which the permit had been registered was used to take food fish. Previous to 1979, permit renewal was contingent only on a vessel having met the original qualifying requirements. Some vessels did not renew their permit every year or had not applied for a permit. The requirement a permit be held in the previous year in order to acquire a permit in a subsequent year resulted in an increase in the number of permits issued in 1978. Beginning in 1994, the provision was dropped that required the vessel to have been used to take food fish in order to renew. Beginning in April 1997, a provision was created that allowed permit holder's to declare an intent not to renew their permit for the year, but reserve the right to renew the permit in a future year. Such declarations must be made by May 1, and the standard enhancement surcharge must be paid along with a $15 handling fee (RCW 75.28.110, Edie, 1998). Extenuating circumstances beyond the control of the vessel owner may be considered by an administrative hearings officer if someone fails to renew their permit. However, because permit holders have until the end of the year to renew a permit, the circumstances under which hardship exceptions are granted have been quite limited.

The director may revoke a permit for up to one year for violation of state fishing laws. Such revocation is allowed in response to two or more gross misdemeanors within a 5-year period or one Class C felony (RCW 75.10.120).

Other State Permits Required for Participation in the Commercial Salmon Fishery

In Washington, licenses for all commercial fisheries are species and gear specific. No vessel licenses are required from the state other than a salmon limited entry or delivery permit. Each permit allows the designation of one of the vessel owners as a primary vessel operator. If someone else is to operate the vessel, they must acquire an alternative operator license for $35. The operator license is a one-time license assigned to the individual that may be used by that person on any vessel. Licenses are not required for crew members.

Recreational Charter Vessels

A moratorium on the entry of new recreational salmon charter vessels was imposed on May 28, 1977. Oregon permits are recognized for Oregon charter vessels fishing as far north as Point Leadbetter Washington, so long as Oregon extends similar reciprocity to Washington charter vessels.

Initial Qualification

To qualify under the initial moratorium, a charter vessel had to have been licensed in at least one year from 1974 to 1976 (RCW 75.28.095, 1975). The charter licenses required were not specific to salmon. In addition, licenses were issued to any vessel under construction or purchased in good faith between April 15, 1976 and May 28, 1977. The initial moratorium was set to expire at the end of 1980 (SB 2104). Recreational charter vessel licenses are not area specific (vessels may make trips in the ocean as well as interior marine waters such as Puget Sound [Edie, 1998]). Extenuating hardship circumstances did not play a role in the initial permit issuance criteria.

In 1979, the moratorium was revised and renewed through the end of 1981, and it was established as a permanent program in 1981. The 1979 revisions included the addition of a requirement for "yearly angler permits," in addition to the charter vessel permit. The yearly angler permit specified the maximum number of anglers that may fish from a charter vessel at any one time. The maximum number of anglers that could be carried was based on vessel size as specified in a USCG certificate of inspection. The schedule for number of anglers started out at 8 for a 31.5' vessel and ended at 34 for a 64.5' vessel. Vessels without USCG inspection documents were issued permits for 6 passengers. Vessels with hulls substantially wider than conventional hulls were issued permits to carry up to 25 anglers (Benson and Longman, 1979; RCW 75.30, 1980).

An advisory review board was convened to hear disputes on the issuance of permits. The board was comprised of three members nominated by the charter industry.

Numbers of Permits and Provisions for Expanding the Number of Permits

No provisions have been made to allow an expansion in the number of permits or yearly angler permits issued if the fleet size or number of yearly angler permits falls below a certain threshold.

Permit Transferability and Vessel Capacity Limitation

All charter vessel licenses are transferrable between owners and among vessels. There is a $50 fee for the transfer of a license. Angler permits are also transferable and may be transferred in single angler units, so the authorized carrying capacity of any vessel may be increased or decreased with the purchase or sale of additional angler permits. There is a $10 fee for the transfer of angler permits. The fee is paid by all parties in the transfer (both "sellers" and "buyers"). There must be at least one angler permit left with the vessel license. If all angler permits are transferred from the vessel license then the vessel license expires.

Permit Renewal and Revocation

A license for which no application was made or which is not renewed in any given year is considered to have expired. Angler permits expire if the charter permits are not renewed. The permit renewal fee is $380 for residents and $685 for nonresidents. There is an additional $100 enhancement surcharge which must be paid. The WDFW directory may wave renewal requirements or refund permit renewal fees if there is no salmon season in a particular year (Edie, 1998). The rules for considering hardship and permit revocation are similar to those discussed above for the commercial fishery.

Other State Permits Required for Participation in the Commercial Salmon Fishery

There are no state permits required for charter vessel operations, other than the limited entry license. Vessel operators are required to have the proper USCG certification, no additional state licenses are required. There are no licensing requirements for crew members.

Limited Entry Permit Buyback Programs

Laws creating a buyback program for the Washington fleet were implemented in 1975. The funds for the program were federal, and the initial funds were used for the purchase of Puget Sound commercial permits and vessels. Vessels bought out were not allowed to participate in any Washington fisheries. The buyback program was changed in 1979 to include recreational charter, ocean troll vessels, and gill net vessels in Grays Harbor, Willapa Bay, and the Columbia River. First priority was given to those who wanted to sell their permit only and second priority to those willing to sell both their permits and vessels. Within these two categories a ranking system was developed based on length of time in the fishery, with higher priority going to those with a longer history. A random drawing was held among those within a similar category for length of participation. In 1980 the program was modified to allow only the purchase of licenses (not vessels). In October 1981, the program was modified to allow the purchase of the license or the license and a promise not to participate in Washington fisheries for ten years (WDFW, 1991) . Prices were based on a set offer from the state.

In 1978, there were 3,291 ocean troll permits and 535 recreational charter permits. The number of troll and charter vessels purchased under the buyback program were as follows:

Number of permits bought back.

	1975-1978	1979	1980	1981	1982	1983	1984	1985	1986	Total
Troll	0	213	215	15	44	39	162	324	143	1,155
Charter	0	0	16	3	25	19	21	19	15	118

Since 1986 no funds have been available for this program. In 1987, due to the buyback program and attrition, there were 1,401 troll permits and 280 charter permits.

In 1994, the federal government declared a fishery disaster for West Coast salmon fisheries off northern California, Oregon, and Washington. Disaster relief funds were used to fund a buyback program in 1995 and 1996. In 1995, the lowest bids were purchased first and program rules prohibited acceptance of bids over $100,000. In 1996, offers to sell permits were ranked based on the salmon decline impact ratio. The salmon decline impact was calculated as the vessel's best year of salmon-related revenue from 1986 through 1991 minus the vessel's worst year of salmon related revenue from 1991 through 1995 multiplied by 2.5. The ratio was the permit holders offering price divided by the salmon decline impact. Maximum payments were limited to the lessor of the salmon decline impact and $75,000 in 1996. Those selling their permits had to agree not to purchase or operate a commercially licensed vessel in any of the fisheries under the buyback program for ten years beginning January 1, 1997. Over the two years of the program, $4.0 million was spent buying troll permits and $800,000 on recreational charter permits (WDFW, 1997). Washington gill net permits for Grays Harbor, Willapa Bay, and the Columbia River were also purchased. The following are the number of permits purchased in 1995 and 1996.

Number of permits bought back.

	1995	1996	Total
Ocean Troll	190	72	262
Charter	23	18	41

Following on the buyback program funded under the fishery disaster declaration, a second program was funded using a federal appropriation of disaster relief funds made in response to the 1996-1997 winter floods. The second program required state matching funds. In 1998, the Washington legislature appropriated $1.7 million as 25% matching funds. This most recent buyback program will cover Puget Sound fisheries in addition to the coastal and Columbia River fisheries covered under the 1995-1996 program. The new buyback program will pay the same amount for all permits.

2.2.2 Recreational Fisher Licensing

2.2.2.1 California

In California, anyone over the age of 16 participating in recreational fishing in ocean waters is required to have a license. However, no license is required for pier fishing in ocean waters, including, but not limited to, San Francisco and San Pablo Bays. Licenses may be lifetime, annual, or short term (10-day or daily). Recreational licenses in California fall into different classes. There are general fishing licenses covering all areas, ocean fishing licenses, and ocean finfish licenses. The annual licenses are general fishing licenses except that residents may acquire Pacific-Ocean-only licenses. In 1998, the annual licenses cost $27.05 for residents, $16 for resident Pacific-Ocean-only licenses and $73 for nonresidents (there is no nonresident Pacific-Ocean-only license). Ten-day nonresident general licenses can be acquired for $27.05 and one-day resident and nonresident general licenses for $9.70. One-day Pacific Ocean finfish only licenses run $6.05 for residents and nonresidents. For those fishing south of Point Arguello, an additional $0.50 must be paid for an ocean enhancement stamp. Salmon fishers in the ocean north of Point Delgada or in the Klamath

River system must also acquire salmon punch cards for $1.05. Lifetime permits can be acquired for fees which range from $300 to $495 depending on the age of the applicant. Reduced fee and free annual permits are available to disabled veterans and the elderly poor. Free licenses are available to those with mobility restricting disabilities, low-income American Indians, wards of the state residing in state hospitals, and certain developmentally disabled individuals (California, 1998)

2.2.2.2 Oregon

In Oregon, anyone recreational fishing over the age of 13 is required to have an Oregon fishing license with the exception of those taking smelt or shellfish and Washington residents fishing in the ocean under a Washington license between Cape Falcon, Oregon and Point Leadbetter, Washington. In 1998, annual licenses for residents were $20.50 for adults and $6.25 for juveniles age 14-17. The fee for an annual license for nonresidents is $48 for all ages required to have licenses. In addition to the general fishing license, salmon tags must be held for each salmon landed. These tags cost $10.50 each. Single-day and seven-day general fishing licenses include salmon tags and may be purchased for $8.75 and $34.25, respectively. For no charge or a small fee; the blind, wheelchair bound, disabled war veterans, senior citizens over 70 years old, and 50-year residents over 65 years old may acquire permanent licenses. Annual fishing licenses may also be purchased together with hunting privileges for $32.50 or as part of a $101 "Sportpak License" (ODFW, 1998).

2.2.2.3 Washington

For 1998, a Washington recreational fishing license is required for recreational fishing by any resident over the age of 14 and any nonresident. There are "Food Fish," "Game Fish," "Steelhead," and "Shellfish/Seaweed" licenses. A "Food Fish" license is required to fish for salmon. These licenses are $8.00 for residents and $20.00 for nonresidents. Catch record cards for salmon, halibut, and sturgeon are provided with the license. A maximum of 15 salmon may be landed on each salmon catch record card. Three- day licenses for residents and nonresidents are $5.00. A "Puget Sound Enhancement License" must be purchased to fish for any marine species in Puget Sound. Annual enhancement licenses run $10.00 and three-day enhancement licenses are $5.00. Beginning in 1999, the license structure will change, and there will be licenses for saltwater, freshwater, and shellfish/seawead. The charge for marine water licenses will be $18.00 for residents and $36.00 for nonresidents. Enhancement fees are included in the license fees. There are, and will be, reduced fee licenses for individuals over 70 and free licenses for certain handicapped, blind, developmentally, and otherwise disabled fishers. Washington recognizes Oregon fishing permits for anglers fishing in Washington waters when the fishing trips depart from and return to Oregon ports. There are no lifetime permits available in Washington (WDFW, 1998a and 1998b).

2.3 LANDINGS TAXES FOR COMMERCIAL SALMON

2.3.1 California

Fees for the landing of salmon are generally paid by the fish processor, but may be paid by the vessel if the vessel sells its fish under commercial fish receivers or a fish retailers licenses. The California fish and game code is silent on the treatment of take-home fish. Beginning in 1998, a policy was implemented to require that fish taken home for personal use be recorded on the official state fishticket of a commercial fish business, licensed fish receiver, or licensed fish retailer. These licensed fish recipients would then be responsible for paying the taxes. The landings fees total $0.05 per pound with $0.02 of the amount going to the state Salmon Council (a salmon marketing board) and the remainder going to CDFG. Fees must be paid on all salmon landed, included that taken by the commercial fishers for personal use. (Blakely, 1998)

2.3.2 Oregon

There are two components to landings fees for salmon landed in Oregon. One is an ad valorem fee of 3.15% of the landed value; the second is a $0.05 per-pound (round weight equivalent) surcharge that goes to the Fish Restoration and Enhancement Program. The processor pays the fee in most cases. The exception is for those fishermen who have limited salmon fish seller licenses (limited to 40 per year) who sell directly to consumers from their vessel. They would submit fishtickets and pay the landings fee. (Note: the ad valorem rate for other species is 1.09%.) Fishers who wish to take salmon home must first sell it to a licensed fish receiver then buy it back at an agreed upon price (e.g., the exvessel price plus the fees paid by the processor [Carter, 1998]).

2.3.3 Washington

Excise taxes are paid on salmon by the first fish buyer. Washington legislation specifically authorized the buyer to deduct one half the excise tax from the price paid for the raw product. The excise tax is based on the value of the fish landed and is 0.0525% for chinook coho and chum salmon, and 0.0315% for pink and sockeye salmon (RCW 82.27). Fish taken home by the fishers are supposed to be recorded on fishtickets along with a zero price. Tickets are recorded as "Takehome," and no landings taxes are paid.

3.0 THE SALMON HARVEST AND HARVESTERS

3.1 ALASKA AND CANADA

West Coast salmon stocks are among those harvested in Alaska and Canadian salmon fisheries. The amount of fish available for harvest in PFMC management areas depends, in part, on harvest in Canada and Alaska. In turn, management of West Coast fisheries affects the amount of West Coast production and amount of fish available in these northern fisheries. For some chinook stocks, the impacts of PFMC fisheries are significant as well as those of Alaska and/or Canada (e.g., Stayton Pond fall chinook on the Columbia River, Table B-14). For other stocks the level of PFMC impacts rounds to zero and most of the impacts occur in Alaska and Canada (e.g., Queets fall fingerlings). Information on the impacts of fisheries in different areas, for example coho stocks, is provided in Table B-15. Production from Alaskan and Canadian commercial fisheries is discussed in Section 2 of this appendix.

3.2 WEST COAST INDIAN FISHERIES

West Coast harvest is allocated between Indian and non-Indian fishers in accordance with judicial interpretations of U. S. treaty obligations. These obligations are reviewed in Chapter 5 of the FMP. Tribal harvest is taken in commercial fisheries and in ceremonial and substance fisheries. This section covers tribes with federally recognized harvest rights. Not included are tribes that harvest salmon, but do not have federally recognized fishing rights, such as the Karuks on the Klamath River.

3.2.1 Tribal Ceremonial and Subsistence Fisheries

The amounts of salmon used for ceremonial and subsistence purposes are documented in Appendix B of the PFMC's annual *Review of Ocean Salmon Fisheries*.

The following reflects some of the tribal perspective on the cultural importance of salmon to tribes:

> The First Salmon Ceremony is general to tribes throughout Northwest Indian Country, from the Pacific Coast to Puget Sound to the Inland Northwest. It is a rite to ensure the continued return of salmon and it has been performed for thousands of years. The symbolic acts, attitudes of respect and reverence, and concern for the salmon reflect a conception of the interdependence and relatedness of all living things which is a dominant feature of Indian world view.
>
> The importance of the First Salmon Ceremony has to do with the celebration of life, of the salmon as subsistence. The annual celebration is an appreciation that the salmon are returning. It is the natural law; the cycle of life.
>
> As an example of ceremony, the Washat service, the longhouse and the Seven Drums are all part of the traditional religion of the Columbia River tribes. Before tribal celebrations, commemorative or memorial services, Washat prayers are offered. Water is the most essential part of all longhouse rituals and has a deep symbolic significance for tribal people. One of the most important services is the First Food Feast. This ceremony must occur before hunting, fishing, root digging, or gathering can take place. Salmon are also used in naming and burial ceremonies.
>
> Designated subsistence fisheries provide food for a fisherman's family, and often for many other tribal members. All of the subsistence fisheries count against the yearly tribal allocation of fish.

(Provided by Stuart Ellis, NWIFC)

3.2.1.1 Washington Coast and Puget Sound Tribes

Washington Coast-Ocean Fishery

Indian regulations have restricted ceremonial and subsistence harvest since 1983. Since 1989, treaty Indian troll regulations for the Quinault, Quileute, and Hoh tribes have restricted ceremonial and subsistence harvest to no more than two chinook over 24 inches per day per person with no limit on smaller fish. Since 1985, no more than eight fixed lines have been allowed per boat, with the additional restriction for the Makah tribe there be no more than four hand-held lines (PFMC, 1998).

Washington Coast-Inside Fisheries

There are ceremonial and subsistence fisheries in most drainages from the Grays Harbor system north. The Quinault Nation has ceremonial and subsistence fisheries in the Grays Harbor system and its tributaries as well as the Quinault and Queets River systems. The Hoh tribe has ceremonial and subsistence fisheries in the Hoh River system. The Quileute tribe has ceremonial and subsistence fisheries in the Quillayute River and its tributaries. The Makah tribe has ceremonial and subsistence fisheries in the Soooes River. These fisheries use primarily gill nets, but other gears can be used, as regulated by the tribe. These fisheries can occur at any time year round when harvestable fish are present. Tribes consider it desirable to have subsistence opportunity throughout the year. Catch limits on the fisheries are determined by the status of the individual run and are typically one or two fish per day of a certain size (Ellis, 1998).

Puget Sound

Regulations for the harvest of ceremonial and subsistence fish generally allow fishing year round. Under such regulations fishers are usually allowed to take one or two fish per day of a certain size. Harvest under these regulations tends to be more for substance purposes. Ceremonial salmon are generally taken in special fisheries that allow a certain number of salmon (e.g., 50) to be taken by a group for use in a particular ceremony (Ellis, 1998)

On the White River, the Muckleshoot have a traditional fish drive and ceremonial and subsistence hook-and-line fishing for spring chinook. There is a ceremonial and subsistence hook-and-line fishery for seniors to catch coho, chum, and steelhead.

3.2.1.2 Columbia River Tribes

Treaty Indian fisheries on the Columbia River are managed under the Columbia River Fish Management Plan adopted by the federal district court as part of its continuing jurisdiction under U.S. v. Oregon. The tribes adopt regulations for their fisheries. The states of Oregon and Washington also adopt fishing regulations for the tribal fisheries as part of the co-management process. The Nez Perce tribe, the Confederated Tribes of the Umatilla Indian Reservation, the Confederated Tribes of the Warm Springs Reservation of Oregon, and the Confederated Tribes and Bands of the Yakima Indian Nation are the only tribes in the Columbia Basin to have adjudicated reserved rights to anadromous fish pursuant to 1,855 treaties with the United States. These are the tribes that are members of CRITFC. The Shoshone-Bannock tribe has asserted tribal fishing rights under a separate treaty. The Shoshone-Bannock Tribe harvests spring and summer chinook, on which the PFMC fisheries have little impact. The Coville and Spokane tribes have also asserted such rights, however, dams prevent salmon from returning to the usual and accustomed fishing areas for these tribes.

Subsistence fish are generally taken with dipnets, hoopnets, setnets, and hook-and-line gear from platforms primarily in the areas below the Dalles at Lone Pine and above Bonneville in the Cascade Locks area. Spears and gaffs are also used in specific tributary areas. Fish taken from platforms can be used personally or sold or traded to other Indians, but may not be sold or traded to non-Indians. The subsistence platform fishery is generally open year round, however the harvest is monitored and must remain within catch guidelines. Harvest controls of subsistence fisheries sometimes include restrictions on the amount of gear used. Ceremonial and some subsistence fish are taken under tribal permits using gill nets in the spring and fall (Lumley, 1998; WDFW/ODFW, 1997).

3.2.1.3 Siletz Tribe

The Confederated Tribes of Siletz Indians have harvest rights agreed to in 1980 with the State of Oregon and the United States. These rights allow the harvest of 200 salmon for cultural fishery purposes only at sites on the Siletz River and its tributaries. Dipnets, spears, and gaffhooks are used in these fisheries at specific sites in October and November (Oregon, 1997).

3.2.1.4 Klamath River Basin Tribes

The Hoopa and Yurok tribes have federally recognized fishery rights on the Klamath River Basin. Members of the Karuk tribe also fish salmon in the basin. The following excerpt reflects one tribal perspective on the importance of salmon to the tribes:

> The Native People of the Klamath River Basin have depended on the salmon of the River since time immemorial. The awesome cyclical nature of the salmon's yearly migrations over the centuries influenced almost every aspect of their lives. Religion, lore, law, and technology all evolved from the Indian's relationship with the salmon and other fish of the Basin. The Supreme Court recognized the importance of salmon to the Northwest Tribes such as these, when it concluded that access to the fisheries was "not much less necessary to the existence of the Indians than the air they breathed." (Pierce, 1998)

Hoopa Valley and Yurok tribal subsistence and ceremonial fisheries are prosecuted under the regulatory authority of each respective tribe. Each respective tribe determines the level of fishing opportunity that will be provided to its respective tribal members based on estimates of preseason abundance.

Traditional fishing methods for salmon fishing have included the use of gill nets, dipnets, triggernets, spears, and communal fish dams. Currently the primary gears used are gill nets, dipnets, and triggernets. Construction of temporary communal fishing dams was at one time used to ensure adequate subsistence for all tribal members (Pierce, 1998). Such dams are still used on occasion (Orcutt, 1998). Fishing sites were, and to some extent still are, considered privately owned (Pierce, 1998). Indian fishers in the Klamath River fish steelhead from November through the spring, spring chinook as early as late March and April and continuing to mid-July and early August, fall chinook from July through November, and coho beginning in mid-September and peaking in October (Orcutt, 1998).

3.2.2 Tribal Commercial Fisheries

Historically, the tribal commercial fish harvest was exchanged through barter and trade. In the modern tribal commercial fishery, fish are generally sold to processors. Puget Sound, Washington coastal, and Columbia River Indian commercial fishery harvest of chinook, coho, and pink salmon, as recorded on state fishtickets is reported in (Tables B-16 through B-21). The fishticket data on which these tables are based do not include Klamath River Indian commercial harvest or direct sales by Indian fishers to consumers. It has been reported that on the Columbia River there are fairly substantial sales of Indian salmon directly to consumers.

3.2.2.1 Washington Coast-Ocean Troll Fishery

In the ocean fisheries along the Washington coast (Areas 2, 3, 3N, 4, and 4A), troll gear is used by the Quinault, Quileute, Hoh, and Makah tribes. In the ocean areas out to 200 miles, tribal regulations generally allow all-except-coho fisheries in May and June and all-salmon fisheries for portions of the summer, depending on stock abundance, since 1983. The duration of the summer all-salmon fisheries has varied from 12 days to 92 days with most years running between 20 days and 42 days. From 1977 through 1983, the seasons were open for all salmon from May through October.

In Area 4B, the Makah and S'Kallam tribes have troll fisheries. The Area 4B Indian troll fisheries are considered part of the ocean fisheries from May through October. The Area 4B fisheries generally ran for more than 300 days through 1990 and were open for all salmon species. Chinook-only openings became a regular feature of the fishery beginning in 1991 (May and June of each year). In the mid 1990s ocean fisheries were reduced due to stock status. The precice timing of fisheries is variable and is determined each year in responce to the status of various stocks. Beginning in 1995, chinook-only fishing regulations dominated the season with coho retention allowed only in August, September, and December. All Area 4B catch is counted as ocean catch in Tables B-16 through B-21.

3.2.2.2 Washington Coast-Inside Fisheries

In Grays Harbor, the Quinault Nation fishes primarily with gill nets on fall chinook and coho in late summer through early winter. Additionally, the Chehalis Tribe uses gill nets to take fall chinook that pass through its reservation.

On the Quinault and Queets Rivers, the Quinault Nation fishes primarily with gill nets on spring, summer, and fall chinook, chum, sockeye, and coho. The fisheries generally occur in spring through early winter.

The Hoh tribe on the Hoh River and the Quileute tribe on the Quillayute River take coho and spring, summer, and fall chinook in commercial gill net fisheries. These fisheries typically occur in spring through early winter.

The precise timing and harvest levels of these fisheries vary and are determined by the status of the stocks and through agreements with the State of Washington.

3.2.2.3 Puget Sound Area-Strait of Juan de Fuca

In Puget Sound, the Strait of Juan de Fuca, Hood Canal, and related terminal areas, the primary means of harvest by Indian fishers are drift gill net, marine setnet, stakenet, purse seine, troll, and beach seine. Gears typically vary by tribe and location. In the Strait of Juan de Fuca the primary species targeted are sockeye, coho, chum, chinook, and pink salmon. In the north Puget Sound, the primary species targeted are sockeye, chum, and pink salmon. In central Puget Sound, south Puget Sound, and the Hood Canal the primary target species are coho, chum, and chinook. The tribes fish in Puget Sound primarily from summer through late fall, but in the Strait of Juan de Fuca fisheries can extend through the winter months. In freshwater and terminal areas, fisheries can occur in any month year round when harvestable salmon are present. Timing and duration of fisheries change according to the status of impacted stocks. In some cases fisheries change according to inseason updates. Each tribe regulates its fisheries, including allowable gears and locations, individually within its usual and accustomed area. In many cases these areas partially overlap the usual and accustomed areas of other tribes, and a coordinated management approach is dictated. A detailed listing of agreed to treaty and non-treaty fisheries including dates, areas, and target species is published annually by the NWIFC and the WDFW.

3.2.2.4 Columbia River Tribal Fisheries

Prior to 1957, the primary Indian fishery occurring in Zone 6 (the area from above Bonneville Dam to McNary Dam) was the Indian platform-dipnet fishery located at Celilo Falls. This area was permanently inundated in 1957 by the Dalles Dam and fishing switched to other gears and areas regulated under tribal authority. The Columbia River Fish Management Plan establishes commercial fisheries in Zone 6 exclusively for the Indians. The treaty Indian commercial fishery is now conducted primarily with set gill nets in the main stem of the Columbia. In recent years, treaty Indian commercial seasons in Zone 6 above Bonneville Dam have opened in February and March, then again from mid-August through mid-October. The current tribal February-March fishery is primarily for sturgeon and steelhead (WDFW/ODFW, 1997). In the fall fishery, fall chinook and steelhead dominate the catch, however, the catch can include substantial numbers of sturgeon and coho. In recent years, the sale of sturgeon during fall commercial fisheries has been prohibited. Gill net mesh size regulations, time of the fishery, and zoning have been used to keep wild steelhead harvest rates down and to increase escapement of some runs (Columbia River Compact, 1998).

Falling processor/wholesale prices for commercially caught salmon have spurred efforts by Columbia River tribes to increase their direct sales to the public. These direct sales to the public are included in catch estimates, but not reported on the state fishtickets used to produce Tables B-16 through B-21. In the 1980s, over $2.00 per pound was received for bright fall chinook. In 1996, the wholesale price was only about $0.30 per pound. In 1996 about one-third of the commercial fall chinook harvest and one-half of the steelhead harvest went home with the tribal fishers or was sold to the general public. The estimated total value of sales to the general public is $330,000 (WDFW/ODFW, 1997). Part way through 1997, it was reported about half the Indian chinook caught were sold to the public at an average price of about $1.75 per pound. On this basis it was estimated that total sales would run about $1,375. If the 1996 price to buyers/processors had been received, the total sale value would have been only about $585,000 (CRITFC, 1998).

3.2.2.5 Klamath River Basin Tribal Fisheries

Since the late 1980s, Yurok and Hoopa Valley tribal commercial fisheries have been prosecuted under the regulatory authority of each respective tribe. From 1934-1976, there were no Indian commercial or subsistence fisheries on the lower 20 miles of the Klamath River. In 1977, the Bureau of Indian Affairs (BIA) reopened the fishery for one year. It was then closed again until restablished in 1987 pursuant to the settlement of People v. McCovey. Members of the Hoopa Valley and Yurok tribes participated in commercial harvests of fall chinook in 1987, 1988, 1989, and 1996 (PFMC, 1998 and Pierce, 1998). The Hoopa Valley tribe also had some minor commercial fisheries in 1990 and 1991 (Orcutt, 1998). There have been some commercial test fisheries on spring chinook. Gill nets are the primary gears used in the commercial fisheries. There was no commercial Indian gill net fishery in the Klamath River in 1997. The 1996 Yurok harvest was 43,277 chinook. The value at first sale for the harvest is estimated at $525,000. The average weight of fish landed was 13.5 pounds. The 1989 Yurok harvest of 27,504 chinook had an average weight of 15.4 pounds and was sold for $852,000 (the equivalent of $1.1 million in 1997 dollars; PFMC, 1998).

3.3 All Citizens Commercial Fisheries

3.3.1 Ocean Troll Fishery

In the ocean fishery only salmon taken with commercial troll gear may be retained and sold. Salmon taken under special permits in the trawl whiting fishery may be retained for donation to charity, but may not be sold.

Season maps reveal increasing restrictions in the ocean troll fisheries (Tables B-22 through B-26). Some of the major changes in seasons in recent years as compared to the 1980s include the elimination of coho fishing south of Cape Falcon and increasing closures in the Klamath management zone (KMZ). Season maps for recent years also show increasing closures in the south of Cape Falcon fisheries close to the KMZ as compared to those further away. North of Cape Falcon, the change in season durations is not very apparent when season maps are compared, however, season length has decreased by close to 50%, comparing the last three years to 1981-1988.

The following discussion and accompanying tables refer to the non-Indian commercial troll fishery in PFMC management areas and associated state territorial ocean area waters.

3.3.1.1 Trends in Aggregate Harvest Volume and Value

The total value of the ocean commercial salmon harvest is affected by trends in prices, number of salmon caught, and average weight of salmon caught. In general, the value of commercial harvest has been at depressed levels for most of the 1990s (Figure B-13 and Table B-27). Fishing opportunity in the ocean commercial salmon fisheries has declined resulting in decreased harvests, both in terms of total number of fish harvested and pounds of harvest (Figure B-14 and Tables B-16, B-18, and B-20). At the same time exvessel prices have been on a downward trend. Average weight per fish has varied (Table B-28). In the most recent five years (1993-1997) total exvessel value has averaged about $10.3 million, adjusted for inflation. This is 79% below the 1976-1992 average of $48.5 million and below the depressed values associated with the 1983-1984 *El Niño* years.

3.3.1.2 Geographic Distribution of Harvest

By State

The 1997 California commercial troll catch was 64% below its 1976-1996 average exvessel value, the 1997 value for the Oregon commercial troll catch was 81% below the 1976-1996 average, and the 1997 value for the Washington non-Indian ocean commercial troll catch was 98% below the 1976-1996 average (all values adjusted for inflation, Tables B-29, B-30, and B-31).

By Management Area and Community

In the 1990s, due to declining fisheries in the north, there has been southward shift in harvest concentration by area of harvest (Table B-27).

In 1997, about 75% of the coastwide chinook harvest (by weight) was landed in California, from the San Francisco area south, as compared to 59% in 1996 (Table B-32, B-33, and B-34). Landings in the San Francisco and Monterey areas increased substantially from 1996 levels while decreases were observed in Crescent City, Eureka, and Fort Bragg. In Oregon, chinook landings were down coastwide (by weight), with the bulk of the landings continuing to come into Newport. In Washington, there are generally some small landings of chinook from other areas of the coast every year. However, 1997 was the first year in which there was a chinook directed non-Indian commercial troll fishery of some significance since 1993. The amounts landed were substantially below the levels of previous chinook fisheries (nearly 80% below the 1993 landings). Coho have not been landed south of Cape Falcon in any significant quantities since 1992.

3.3.1.3 The Ocean Troll Fleet

Numbers of Participants

Coastwide, 1,286 vessels participated in the 1997 salmon troll fishery, down about 14% to from 1996 and about 75% below the average number of vessels participating from 1986-1990.[9/] The active fleet in Oregon decreased by 22 vessels (five percent), the active fleet in Washington decreased by 39 vessels (43%), and the active fleet in California decreased by 153 vessels (16%), all comparisons to 1996. Coastwide, the number of salmon limited entry permits issued decreased by 254 (six percent) to 3,678 permits. From 1995 to 1997, a federally funded permit buyback program purchased 262 Washington troll licenses and delivery permits. There had been 667 Washington non-Indian ocean troll permits issued in 1993, and 323 such permits were issued in 1997. Thirty-six percent of all permits made salmon landings in 1997 (Tables B-35).

Average Vessel Harvest and Concentration of Harvest

Average per vessel exvessel value increased 29% in 1997, as compared to 1996 (adjusted for inflation), to approximately $7,700. Per vessel average exvessel values increased in California and Washington, while decreasing in Oregon (Table B-35). The averages are generally at the higher end of the typical range seen over the last 15 years. However, caution needs to be exercised in interpreting the average. The averages may increase as much from small producers dropping out at a higher rate relative to larger producers as from an increase in revenue earned by remaining vessels.

9/ Based on state fishtickets submitted to Pacific Fishery Information Network (PacFIN). The vessel counts listed in Table B-35 sum to more than 1,286 vessels, because of the double counting of vessels participating in more than one state.

Geographic Distribution of Participants

In recent years the majority of the commercial salmon fleet participated in fisheries south of Point Arena, California. The other area in which harvesters concentrate is off the central Oregon coast (Cape Falcon to Cape Blanco). Restricted seasons have resulted in more dramatic declines in the numbers of vessels participating in other areas (Table B-36).

Bycatch in the Salmon Troll Fishery

Salmon fishers may retain any species of fish caught on their gear, subject to the harvest limits governing those species, except steelhead and halibut. For halibut, regulations have been established to allow salmon trollers to choose between participation in a directed halibut fishery or taking halibut as bycatch in the ocean troll fishery. Retained bycatch rates for halibut taken in the troll fishery are subject to a ratio limit that specifies a number of salmon which must be harvested for every halibut taken as bycatch. For most other species, troll vessels do not typically have bycatch that exceed the landing limits for those species.

3.3.1.4 Other Ocean Fisheries Taking Salmon as Bycatch

Trawlers are the primary group encountering salmon as bycatch. Other groundfish and shrimp trawl gear types do not have substantial salmon bycatch (NMFS, 1992). In 1992, NMFS estimated that 6,000 to 9,000 chinook would be taken annually in the bottom trawl fishery and a comparable number in the midwater trawl fishery. Trawl vessels participating under special permits in the whiting fishery are allowed to land salmon bycatch, however, this bycatch may not be sold and is donated to food charities. These bycatch levels will have changed with declining groundfish harvests and declining salmon abundance. In the Eureka and Monterey areas, salmon bycatch in the whiting fishery declined from between about 3,000 and 6,000 fish from 1988 to 1991 to 100 or less in 1992 and 1993 (PFMC, 1994).

3.3.2 Inside Commercial Fisheries

Inside commercial fisheries occur in Puget Sound, the Washington Coast (Grays Harbor and Willapa Bay), and the Columbia River. Gill nets are used in Grays Harbor, Willapa Bay, and the Columbia River. In Puget Sound, gill nets and purse sein and reef nets are used in the non-Indian commercial fisheries. Total non-Indian salmon revenue from these fisheries is provided in Table B-27. Numbers of vessels participating in these fisheries is provided in Table B-36.

3.4 ALL CITIZEN FISHERIES RECREATIONAL FISHERIES

Season maps reveal increasing restrictions in the ocean recreational fisheries (Tables B-37 though B-41). In the recent period the seasons in northern areas have been reduced substantially more than in southern areas. For the north of Cape Falcon area, the 1984 and 1988 example years do not illustrate well the range of seasons observed during early and mid 1980s. The number of days in the 1984 and 1988 seasons are within the range and below the average for the 1993 through 1997 period, with the exception of Neah Bay. However, in the 1993 through 1997 recent period the average season durations have declined between one third and two thirds compared to 1981 through 1988.[10/]

3.4.1 Ocean

Ocean recreational anglers use poles and generally troll or mooch for salmon from vessels. Recreational salmon fishing takes place primarily in one of two modes, (1) anglers fishing from privately owned pleasure crafts and (2) anglers employing the services of the charter boat fleet. In general, success rates on charter

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10/ Off Neah Bay, Area 4B is considered part of the ocean area when ocean fisheries are open, but is managed under separate state regulations when the ocean fishery is closed. State managed seasons provided to Area 4B are not reflected in this discussion.

vessels tend to be higher than success rates on private vessels. In marine areas, there are small amounts of shore based effort directed toward salmon, primarily fishing occurring off jetties and piers.

3.4.1.1 Harvest and Effort

In general, the recreational fishery has tended to have a more stable harvest than the troll fishery (in both absolute and relative terms); the majority of the annual variation in available ocean harvest is usually taken up in the troll fishery (Figures B-14 and B-15). However, like the troll fishery, the recreational fishery has suffered substantial declines in recent years, the effects of which are amplified when specific geographic areas are considered.

From 1979 through 1990, total angler effort on the West Coast ranged from about 500,000 to 750,000 trips. After a decline from 1990 to 1992, total angler effort appears to have leveled off with effort in four out of the last six years of between about 300,000 and 400,000 trips.

Number of West Coast charter and private vessel recreational angler trips (thousands).

	'81-'85	'86-'90	'79	'80	'81	'82	'83	'84	'85	'86'	'87	'88	'89	'90	'91	'92	'93	'94	'95	'96	'97
Chart	217	206	373	342	289	255	222	116	201	188	220	197	227	199	153	116	120	74	175	106	119
Priv	336	389	363	384	381	361	340	241	355	304	406	366	409	459	347	272	245	143	287	203	173
TOT	552	595	736	726	670	616	562	357	556	492	625	563	636	658	500	388	364	217	462	308	292

From 1983-1996 the proportion of trips taken on charter vessels varied between 30% and 40%. In 1997 and prior to 1983, more than 40% of the trips were taken on charter vessels.

3.4.1.2 Geographic Distribution

Effort in California has remained relatively high compared to historic levels while season restrictions have caused declines in effort in Oregon and Washington (Figure B-16). The areas of the coast experiencing the greatest reduction are north of Cape Falcon and the KMZ. The reduction in seasons on the central Oregon coast has not been as severe as in the areas directly to the north and south, however, the prohibition of coho retention has significantly reduced angler retained catch rates.

The proportion of trips taken on charter vessels has declined in Washington and Oregon, while remaining relatively stable in California (Figure B-16).

3.4.1.3 The Charter Vessel Fleet

The historic charter vessel counts available for each state are different in terms of what is counted. The count for Washington is a count of charter vessels licensed for salmon (including vessels that operate in Puget Sound), the count for Oregon is a count of all ocean recreational charter vessel regardless of whether or not they target on salmon in a particular year, the count for California is a count of only those vessels that are licensed and participate in the ocean salmon fishery each year (Table B-43).

An attempt was made to characterize the recent charter fleet by area based on information obtained from state sampling programs and the California commercial passenger fishing vessel (CPFV) logbooks. The information provided for each state is for a different recent period.

In central and northern California, 92 charter vessels fished for salmon, rockfish/lingcod, nearshore species, and offshore species in the 1995-1997 period. Tables B-44 and B-45 show the various targeting strategies of charter vessels by region. Over 85% of the charter vessels in central and northern California target on salmon. In central California, 50% of the trips targeted on salmon and in northern California, 40% of the trips targeted on salmon.

In Oregon, 83 charter vessels operated in 1998. Table B-46 shows the various targeting strategies of charter vessels. Vessels which land salmon predominate the charter vessel fleet in Astoria and Newport.

Those with a strategy that includes bottomfish predominate in Garibaldi and Depoe Bay. Brookings vessels combine salmon and bottom fish while Gold Beach vessels target only on salmon.

In Washington, a total of 70 charter vessels operated in 1995-1996 out of 3 major ports: Ilwaco, Neah Bay, and Westport. The most common fishing strategy is fishing for a combination of salmon, bottomfish, halibut, and tuna. Table B-47 shows the different strategies by charter vessels by port.

3.4.2 Inside

The same stocks caught in the ocean are also subject to recreational harvest in inside marine and freshwater salmon fisheries. These fisheries occur in estuaries and rivers along the coast and Puget Sound as well as major river basins such as the Columbia, Klamath, and Sacramento River Basins. In addition to the West Coast states, some freshwater salmon fishing occurs in Idaho. Two of the larger inside marine recreational fisheries for salmon are those in Puget Sound and the Columbia River estuary (Table B-48).

4.0 PROCESSORS/BUYERS

A relatively small number of large processor/buyer firms handle most of the ocean salmon catch on the West Coast. There were 1,927 firms with state processor/buyer licenses for the period of this descriptive analysis (1995-1997).[11/] These firms include both operators of processing plants and buyers that may do little more than hold the fish prior to their shipment to a processor or market. In some cases, the buyers may be owners of vessels who also own licenses allowing them to sell fish directly to the public or retail markets. Of these processor/buyers (here after referred to as "buyers"), 442 received salmon from the West Coast Indian and non-Indian ocean troll fisheries (including vessels that acted as "buyers," receiving the fish from themselves, Table B-49). The top 24 state licensed buyer firms each received over $3,000,000 worth of fish (exvessel value) from West Coast fisheries. These 24 firms handled 50% of the exvessel value of all West Coast fishery landings and 50% of the exvessel value of all landings of ocean caught salmon. Top ocean caught salmon buying firms include some firms that are not among the top fish buyers when all species are counted. The top 5% of the salmon buying firms (top 22 firms) buy 73% of all ocean caught salmon in terms of exvessel value. The bottom 80% of these firms buy 6.4% of all ocean caught salmon (Table B-50). Larger processing firms are more likely to handle ocean caught salmon than smaller firms. Of the top 24 fish buyers (all species) 80% handled salmon (19 of 24). The proportion of smaller buyers handling salmon was substantially less, about 20% for buyers purchasing less than $500,000 of product (Table B-51).

There are many small buyers that specialize in salmon, only handle small amounts of product, and receive product from two or fewer vessels. Ocean caught salmon comprised more than 95% of all purchases for about 25% of all salmon buyers. The vast majority of those expending more than 95% of their fish purchases on salmon are small operations handling less than $10,000 exvessel value (Table B-49). It is likely that most of these buyers are vessels that also have licenses allowing them to sell directly to the public or other retail outlets (e.g., restaurants). Sixty-three percent of all buyers of ocean caught salmon received deliveries from an average of two or fewer vessels and handled 4.1% of the exvessel value of the ocean catch (Table B-52). Four percent of all such buyers received deliveries from over 64 vessels and handled 65% of the exvessel value of all ocean caught salmon.

Most larger salmon buying firms acquire fish from sites in more than one port (Table B-53). The largest salmon buyers tend buy salmon from over 64 vessels landing and buy fish in 4-8 ports. Of the 199 processors that bought fish in only one port, 174 received salmon from only one or two vessels (Table B-54). Instances where a buyer purchases from one to two vessels, but buys fish at over eight ports, are explained as either large firms with buying stations in multiple ports that acquire only a few salmon at one or two of their locations, or as vessels with buyer licenses that take fish to different ports to sell.

11/ This estimate was developed using cross ownership of processing plant information from Radtke and Davis (1997) and an exact match of names from processor/buyer license files containing 15,611 records (individual person names were excluded from the match). Ownership of processing plants changes frequently, therefore, analysis based on ownership information collected at a point in time may not be applicable over a longer period of time. The results presented here should be considered an approximation for the period of the descriptive analysis (1995-1997). Exact name matches will tend to miss matches between licenses held by the same firm when the firm's name differs between the license records due to typographical errors or data entry choices (e.g., entering "&" or "and"). It is also likely that Radtke and Davis (1997) did not detect all instances of cross ownership between firms with different names. For these reasons, the actual number of processors/buyers is likely to be lower, and the concentration of processing/buying activities greater than represented in this analysis.

5.0 WEST COAST HATCHERIES AND SALMON AQUACULTURE

5.1 HATCHERIES

Hatchery production plays a significant role in West Coast salmon management. Fish are released from hatcheries to rear in the ocean and return to be harvested by recreational and commercial fishers. Many of the hatchery programs were created to mitigate for lost production due to the construction of dams. The mass marking of hatchery salmon to allow harvesters to retain hatchery salmon and release wild salmon is one of the most recent developments in salmon management and one of the subjects of Amendment 14 to the salmon FMP.

5.2 RANCHING

Salmon ranching is an acquaculture practice similar to that of hatcheries except that fish are harvested when they return to the hatcheries rather than in fisheries. Salmon ranching has not proven to be an economically successful way of producing salmon.

5.3 PENS

Salmon pens are used to produce fish directly for food markets, for enhancement of fisheries, and for preservation of genetic material for endangered species. Pen culture depends on hatcheries for rearing stock. Salmon reared in pens are never released to the wild. In Puget Sound about six million pounds a year of Atlantic salmon have been produced for direct marketing for the last three or four years. Salmon are raised in pens to enhance commercial fisheries in Willapa Bay and at two locations in the Columbia River estuary. Pen operations to preserve the genetic material of endangered species are occurring in south Puget Sound (for White River spring chinook).

6.0 COMMUNITIES

Communities are affected by most aspects of salmon harvest and management. Fishers, processors, association employees, fishery managers, fishery data collectors, and hatchery workers live and spend money in communities which, because of the presence of these individuals, are in one manner or another and to varying degrees, dependent on the salmon fishery. Most general economic data available on ports is county level data. Table B-55 lists ports in which salmon were landed from 1995-1997 and the corresponding county.

6.1 LOCAL LEVEL COMMERCIAL AND RECREATIONAL FISHERY DATA

Information on commercial harvest by port area is provided in Tables B-32 through B-34. Numbers of vessels landing salmon and total number of vessels landing by county are provided in Table B-56. Recreational effort levels for charter and private vessel salmon trips is provided by port area in Tables B-57 through B-59. Charter vessel counts by port area (geographic region for California) are provided in Tables B-43 through B-47.

6.2 INCOME IMPACTS

Coastal community impacts are presented in order to address concerns about the effects of regulations on local economies and small businesses. Income impact estimates per commercial pound and per recreational day were generated using the Fishery Economic Assessment Model. Reference information on the model is available from PFMC.

6.2.1 Interpretation of State and Coastal Community Income Impacts

Estimated state and community income impacts of commercial and recreational ocean salmon fisheries and selected state-managed fisheries are shown in Tables B-60 through B-62. The impacts presented are estimates of total personal income associated with activity in the commercial and recreational salmon fisheries in counties and states. Income impact estimates are based on the landings in the area, an inventory of the fleet and processors, estimates of fleet and processor expenditures, surveys of the expenditure patterns of recreational fishers, and income coefficients from the U.S. Forest Service IMPLAN model. Commercial ocean harvest not landed in the coastal areas (e.g., landed in Puget Sound ports) is not included in the estimates of coastal community impacts, but is included in the estimate of state impacts.

The numbers presented here are estimates of annual trends and the possible redirection of money between nonfishing-dependent and fishing-dependent sectors; they are likely an upper bounds on the local community and state income impacts which may have been generated by West Coast ocean salmon fisheries as well as some selected inside fisheries. All income impact estimates in this review are reported in real (inflation adjusted) 1997 dollars.

6.2.2 West Coast Ocean Fishery Income Impacts

From 1976-1996 the total state level income impact associated with the recreational and troll ocean fisheries for all three states combined averaged $138.1 million (adjusted for inflation). In 1997 state level impacts were $50.5 million, up five percent compared to 1996, but still 63% below the 1976-1996 average (adjusted for inflation). State level income impacts related to the commercial troll fishery were up nine percent compared to 1996, but were still 73% below the 1976-1996 average; and those impacts related to the recreational fishery were up one percent, but were 45% below the 1976-1996 average (all comparisons are adjusted for inflation). These coastwide values, while low compared to historic averages, do not reveal the greater reductions which have occurred in particular communities such as those in the KMZ (Eureka, Crescent City, and Brookings) and north of Cape Falcon (Astoria, Ilwaco, Westport, La Push, and Neah Bay).

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TABLE B-1. Price index[a] and Canadian to U.S. dollar exchange rate.

Year	Price Index	$Candian: $U.S.[b]
1960	20.7	
1961	20.9	
1962	21.2	
1963	21.5	
1964	21.8	
1965	22.2	
1966	22.8	
1967	23.6	
1968	24.6	
1969	25.7	
1970	27.1	
1971	28.5	
1972	29.7	
1973	31.4	
1974	34.2	
1975	37.4	
1976	39.6	
1977	42.2	
1978	45.3	
1979	49.1	
1980	53.7	
1981	58.7	1.19
1982	62.4	1.23
1983	65.1	1.24
1984	67.5	1.32
1985	69.9	1.40
1986	71.7	1.39
1987	73.9	1.33
1988	76.6	1.23
1989	79.8	1.18
1990	83.3	1.17
1991	86.6	1.15
1992	89.0	1.21
1993	91.3	1.29
1994	93.5	1.35
1995	95.9	1.37
1996	98.1	1.36
1997	100.0	1.38

a/ Based on gross domestic product implicit price deflator.

b/ Rates for 1981 through 1984 from *World Currency Yearbook* published by International Currency Analysis, rates for 1986 through 1997 from U.S. Bank, July 6, 1998.

TABLE B-2. North American commercial **chinook** salmon landings (pounds and value) by major harvest area, 1981-1997.

Year	Puget Sound	Inside Washington Coast	Columbia River	West Coast Ocean	U.S. West Coast Total[a/]	Alaska[b/c/]	U.S. Total	Canada[d/]	North America Total
				Thousands of Round Pounds					
1981	3,016	759	1,748	9,600	15,124	15,738	30,862	N/A	30,862
1982	2,988	722	3,051	13,143	19,905	16,904	36,809	N/A	36,809
1983	2,235	324	1,049	4,045	7,654	15,684	23,338	10,440	33,778
1984	2,731	353	2,069	3,859	9,012	12,524	21,536	12,120	33,656
1985	3,315	543	2,661	8,127	14,647	13,477	28,124	10,670	38,794
1986	2,916	664	4,764	13,012	21,356	11,712	33,068	9,750	42,818
1987	2,639	1,250	9,087	17,348	30,325	13,282	43,607	10,040	53,647
1988	2,392	1,610	10,617	23,022	37,642	10,913	48,555	11,330	59,885
1989	2,555	2,006	6,363	11,428	22,351	11,314	33,666	10,230	43,896
1990	2,896	1,365	3,291	8,043	15,596	11,482	27,078	10,120	37,198
1991	1,571	1,146	2,169	5,126	10,013	10,728	20,741	9,890	30,631
1992	1,160	1,290	1,108	3,873	7,431	10,763	18,194	10,220	28,414
1993	926	1,087	896	4,453	7,362	11,070	18,432	9,300	27,732
1994	1,127	912	766	3,970	6,775	11,790	18,565	6,880	25,445
1995	890	932	613	9,989	12,424	12,862	25,286	2,910	28,196
1996	903	1,074	1,030	7,064	10,071	9,350	19,421	990	20,411
1997	1,077	613	958	8,027	10,675	11,580	22,255	N/A	N/A
				Nominal Exvessel Value (Thousands of U.S. Dollars)					
1981	5,124	1,156	1,853	21,626	29,759	23,700	53,459	N/A	53,459
1982	4,898	867	2,731	29,550	38,046	27,000	65,046	N/A	65,046
1983	2,474	397	1,167	7,092	11,130	18,200	29,330	8,392	37,722
1984	4,741	518	2,767	9,320	17,347	21,800	39,147	9,175	48,322
1985	4,306	453	2,871	17,931	25,561	20,800	46,361	7,638	53,999
1986	3,466	494	4,203	22,113	30,276	17,800	48,076	14,151	62,227
1987	4,309	1,877	13,449	41,123	60,758	26,800	87,558	23,029	110,587
1988	5,324	2,885	20,621	58,894	87,724	29,600	117,324	35,595	152,920
1989	2,655	1,670	5,392	23,085	32,801	20,848	53,650	17,034	70,684
1990	3,724	1,655	4,788	18,802	28,969	21,526	50,495	17,557	68,051
1991	1,732	1,376	2,525	11,323	16,957	22,167	39,124	17,145	56,269
1992	1,418	1,651	1,379	8,580	13,028	24,579	37,607	20,238	57,845
1993	914	1,082	724	8,543	11,262	18,037	29,299	11,314	40,614
1994	1,270	1,161	663	7,257	10,352	15,800	26,152	9,660	35,811
1995	777	851	231	15,158	17,017	18,021	35,038	3,753	38,791
1996	756	906	355	9,094	11,111	13,350	24,461	895	25,356
1997	944	589	476	9,991	12,001	17,990	29,991	N/A	N/A

a/ All West Coast data are derived from PacFIN vessel summary files.
b/ Alaska values for 1996 and 1997 are preliminary.
c/ Historic data are from the Salmon Market Information Service (1994), and preliminary data are from the Alaska Department of Fish and Game Blue Sheet.
d/ Canadian data from Canadian Department of Fisheries and Oceans web page.

TABLE B-3. North American commercial **coho** salmon landings (pounds and value) by major harvest area, 1981-1997.

Year	Puget Sound	Inside Washington Coast	Columbia River	West Coast Ocean	U.S. West Coast Total[a/]	Alaska[b/c/]	U.S. Total	Canada[d/]	North America Total
				Thousands of Round Pounds					
1981	4,267	765	477	6,407	11,916	25,847	37,763	N/A	N/A
1982	7,621	1,399	1,604	6,142	16,766	46,541	63,307	N/A	N/A
1983	5,059	286	48	1,907	7,300	26,793	34,093	20,230	54,323
1984	4,062	851	1,619	879	7,411	44,515	51,926	19,360	71,286
1985	7,524	648	1,674	1,956	11,802	47,263	59,065	17,570	76,635
1986	7,848	1,838	6,927	3,195	19,808	46,603	66,411	25,720	92,131
1987	9,976	1,592	1,314	3,181	16,064	25,312	41,376	16,220	57,596
1988	6,582	869	2,721	4,555	14,728	35,455	50,183	13,570	63,753
1989	5,602	938	2,710	3,347	12,597	33,177	45,774	16,980	62,754
1990	6,320	1,091	512	2,262	10,184	40,022	50,206	20,330	70,536
1991	3,277	2,319	2,752	2,899	11,246	43,827	55,073	19,250	74,323
1992	1,918	379	305	640	3,242	53,759	57,002	14,040	71,042
1993	763	491	275	404	1,932	36,620	38,553	8,300	46,853
1994	2,414	315	520	0	3,249	75,241	78,490	14,910	93,400
1995	1,582	1,020	200	296	3,097	47,239	50,336	9,260	59,596
1996	772	1,533	235	189	2,729	46,420	49,149	7,380	56,529
1997	630	115	162	65	972	22,830	23,802	N/A	N/A
				Nominal Exvessel Value (Thousands of U.S. Dollars)					
1981	4,930	862	525	8,996	15,313	23,700	39,013	N/A	N/A
1982	6,421	1,097	1,379	7,492	16,390	40,000	56,390	N/A	N/A
1983	4,413	308	51	1,680	6,451	16,200	22,651	16,262	38,913
1984	4,095	1,017	1,871	1,308	8,291	42,700	50,991	14,656	65,647
1985	6,621	456	1,392	2,310	10,780	42,600	53,380	12,577	65,957
1986	8,394	1,809	6,870	2,979	20,052	42,000	62,052	28,259	90,311
1987	18,614	3,059	2,501	4,803	28,976	28,800	57,776	25,458	83,234
1988	14,997	1,770	5,974	9,088	31,828	61,800	93,628	30,630	124,258
1989	5,719	972	2,409	3,367	12,466	27,091	39,558	16,341	55,899
1990	8,180	1,438	612	3,128	13,357	40,413	53,769	24,063	77,833
1991	2,846	1,850	2,194	2,790	9,679	34,527	44,207	22,060	66,267
1992	1,922	335	275	688	3,220	49,350	52,570	17,060	69,630
1993	620	419	223	376	1,638	32,454	34,092	8,461	42,552
1994	1,776	267	423	0	2,466	66,252	68,718	15,677	84,395
1995	964	610	123	215	1,912	29,519	31,431	9,269	40,700
1996	398	897	144	148	1,586	N/A	N/A	7,042	8,628
1997	394	89	118	56	658	N/A	N/A	N/A	N/A

a/ All West Coast data are derived from PacFIN vessel summary files.
b/ Alaska values for 1996 and 1997 are preliminary.
c/ Historic data are from the Salmon Market Information Service (1994), and preliminary data are from the Alaska Department of Fish and Game Blue Sheet.
d/ Canadian data from Canadian Department of Fisheries and Oceans web page.

TABLE B-4. North American commercial **pink** salmon landings (pounds and value) by major harvest area, 1981-1997.

Year	Puget Sound	Inside Washington Coast	Columbia River	West Coast Ocean	U.S. West Coast Total[a/]	Alaska[b/c/]	U.S. Total	Canada[d/]	North America Total
				Thousands of Round Pounds					
1981	18,834	0	0	1,481	20,314	244,970	265,285	N/A	N/A
1982	0	0	0	0	1	219,149	219,150	N/A	N/A
1983	7,958	0	0	448	8,407	194,083	202,489	85,370	287,859
1984	0	0	0	0	0	276,684	276,684	25,780	302,464
1985	21,437	0	0	968	22,405	304,261	326,666	80,570	407,236
1986	0	0	0	0	1	259,257	259,258	64,520	323,778
1987	9,518	0	0	198	9,716	164,813	174,529	57,020	231,549
1988	0	0	0	0	1	177,904	177,904	69,370	247,274
1989	14,962	0	0	247	15,208	331,469	346,677	65,240	411,917
1990	1	0	0	0	2	271,909	271,911	56,470	328,381
1991	13,313	0	0	198	13,512	338,845	352,357	75,240	427,597
1992	1	0	0	0	1	203,402	203,402	32,110	235,512
1993	8,150	0	0	23	8,173	335,233	343,406	33,790	377,196
1994	1	0	0	0	1	364,683	364,684	7,220	371,904
1995	10,009	0	0	169	10,179	431,701	441,880	41,510	483,390
1996	0	0	0	0	1	325,160	325,161	18,080	343,240
1997	7,057	0	0	7	7,064	271,530	285,658	N/A	N/A
				Nominal Exvessel Value (Thousands of U.S. Dollars)					
1981	8,779	0	0	973	9,753	106,000	115,753	N/A	N/A
1982	0	0	0	0	0	47,500	47,500	N/A	N/A
1983	2,725	0	0	204	2,930	48,000	50,930	68,625	119,555
1984	0	0	0	0	0	70,500	70,500	19,516	90,016
1985	5,508	0	0	508	6,016	71,900	77,916	57,674	135,590
1986	0	0	0	0	0	62,000	62,000	18,491	80,492
1987	4,705	0	0	119	4,824	69,100	73,924	25,255	99,179
1988	0	0	0	0	0	141,300	141,300	40,065	181,365
1989	5,947	0	0	145	6,092	144,599	150,691	28,289	178,980
1990	0	0	0	0	1	90,807	90,808	23,129	113,937
1991	2,683	0	0	80	2,763	49,413	52,177	26,163	78,340
1992	0	0	0	0	0	41,658	41,658	8,948	50,606
1993	1,310	0	0	9	1,319	54,301	55,620	8,949	64,570
1994	0	0	0	0	0	70,281	70,281	1,776	72,058
1995	1,718	0	0	39	1,757	80,031	81,788	10,005	91,793
1996	0	0	0	0	0	31,620	31,620	3,624	35,244
1997	1,291	0	0	2	1,293	36,630	37,923	N/A	N/A

a/ All West Coast data are derived from PacFIN vessel summary files.

b/ Alaska values for 1996 and 1997 are preliminary.

c/ Historic data are from the Salmon Market Information Service (1994), and preliminary data are from the Alaska Department of Fish and Game Blue Sheet.

d/ Canadian data from Canadian Department of Fisheries and Oceans web page.

TABLE B-5. U.S. salmon trade, proportions fresh and frozen and export/import balance.

	1993	1994	1995	1996	1997
Imports					
Fresh and Frozen	$249,467,463	$260,258,209	$339,042,725	$392,503,642	$503,549,473
All Salmon Products	$266,310,980	$277,911,756	$359,084,988	$411,813,956	$522,279,670
Percent Fresh and Frozen	94%	94%	94%	95%	96%
Exports					
Fresh and Frozen	$583,059,930	$518,482,529	$545,283,012	$462,981,812	$300,021,421
All Salmon Products	$867,664,718	$797,693,669	$850,162,050	$715,003,751	$499,693,017
Percent Fresh and Frozen	67%	65%	64%	65%	60%
Exports/Imports Ratio					
Fresh and Frozen	2.34	1.99	1.61	1.18	0.60
All Salmon Products	3.26	2.87	2.37	1.74	0.96

TABLE B-6. Value of imported salmon from top 15 countries (U.S., millions).

	1993	1994	1995	1996	1997	Average	Cumulative Percent[a/]
Canada	162.7	182.9	206.2	204.6	274.2	206.1	56.1%
Chile	65.7	57.4	111.3	161.6	192.9	117.8	88.1%
Norway	17.8	18.6	22.8	17.6	17.5	18.9	93.3%
United Kingdom	4.5	7.5	9.5	13.5	13.5	9.7	95.9%
Iceland	4.8	4.6	2.9	5.8	5.0	4.6	97.2%
Denmark	2.8	2.7	2.7	1.1	2.8	2.4	97.8%
Faroe Is.	4.1	1.1	0.1	1.6	3.7	2.1	98.4%
Japan	0.6	0.1	0.2	0.1	7.0	1.6	98.8%
Russia	0.7	0.5	0.5	2.1	0.5	0.9	99.1%
New Zealand	0.1	0.4	0.7	0.8	0.4	0.5	99.2%
Ireland	1.0	0.3	0.2	0.2	0.2	0.4	99.3%
Australia	0.6	0.6	0.2	0.1	0.0	0.3	99.4%
China	0.0	0.1	0.1	0.2	0.9	0.3	99.5%
Netherlands	0.0	0.1	0.1	0.4	0.4	0.2	99.5%
Sweden	0.2	0.2	0.2	0.3	0.0	0.2	99.6%
Ecuador	0.1	0.0	0.0	0.0	0.8	0.2	99.6%
Total (all countries)	266.3	277.9	359.1	411.8	522.3	367.5	100%

a/ Cumulative percent based on 1993-1997 average.

TABLE B-7. Value of salmon exported to top 25 recipients of U.S. salmon ($U.S. millions).

	1993	1994	1995	1996	1997	Average	Cumulative Percent[a/]
Japan	604.2	543.1	543.1	437.5	265.1	478.6	64.2%
Canada	81.8	83.2	122.0	113.2	77.9	95.6	77.0%
United Kingdom	93.7	80.8	89.5	75.4	69.0	81.7	87.9%
France	26.1	18.4	21.3	13.1	14.5	18.7	90.4%
Australia	14.9	17.4	15.5	18.1	18.4	16.9	92.7%
Netherlands	11.7	17.9	14.9	11.5	11.4	13.5	94.5%
Belgium	6.2	6.0	7.8	7.2	6.6	6.8	95.4%
Denmark	5.0	5.6	5.3	6.2	4.1	5.3	96.1%
Germany	3.4	4.0	3.7	3.9	4.1	3.8	96.6%
Sweden	4.2	3.6	3.3	3.5	1.5	3.2	97.0%
Taiwan	0.6	1.5	3.7	4.5	3.4	2.7	97.4%
China	0.8	2.1	4.3	3.3	2.6	2.6	97.8%
Spain	2.0	0.9	3.0	1.8	3.2	2.2	98.0%
South Korea	2.1	2.8	1.4	2.3	1.2	1.9	98.3%
New Zealand	1.7	0.9	1.1	0.9	2.1	1.3	98.5%
Mexico	1.2	2.2	0.5	0.5	1.8	1.2	98.7%
Italy	0.6	0.8	1.6	1.1	2.0	1.2	98.8%
Switzerland	1.0	0.7	1.2	1.0	1.1	1.0	98.9%
Ireland	1.0	1.2	1.2	1.0	0.7	1.0	99.1%
Israel	0.3	0.4	0.5	1.5	2.1	1.0	99.2%
Hong Kong	1.0	0.7	0.6	1.4	0.7	0.9	99.3%
South Africa	0.5	0.4	1.4	1.0	0.7	0.8	99.4%
Russia	0.0	0.1	0.1	0.6	1.6	0.5	99.5%
Thailand	1.0	0.3	0.1	0.3	0.1	0.3	99.5%
Portugal	0.2	0.3	0.1	0.1	0.7	0.3	99.6%
Total (all countries)	867.7	797.7	850.2	715.0	499.7	746.0	100%

a/ Cumulative percent based on 1993-1997 average.

TABLE B-8. Japanese salmon imports from the U.S.

	Value ($U.S.)	Percent of Japanese Imports
Japanese Salmon Imports	$796,745,317	100%
Salmon Imports from the U.S.	$260,000,726	33%
Sockeye Imports from the U.S.	$228,562,478	29%
Other Salmon Imports from the U.S.	$31,438,248	4%

TABLE B-9. U.S. per capita consumption (pounds per person) and population.[a/]

	Fresh & Frozen	Canned	Total	US Population (millions)
1979	0.39	0.44	0.84	223
1980	0.52	0.56	1.08	226
1981	0.18	0.66	0.85	228
1982	0.21	0.31	0.52	230
1983	0.23	0.55	0.77	232
1984	0.32	0.56	0.88	234
1985	0.34	0.53	0.87	236
1986	0.39	0.52	0.91	238
1987	0.31	0.44	0.75	241
1988	0.36	0.29	0.64	243
1989	0.49	0.30	0.79	245
1990	0.50	0.44	0.94	248
1991	0.79	0.54	1.33	251
1992	0.63	0.49	1.11	254
1993	0.81	0.51	1.32	256
1994	0.97	0.47	1.44	259
1995	1.15	0.52	1.67	261
1996	1.43	0.62	2.05	264

a/ Data from the Salmon Market Information Service, 1997.

TABLE B-10. Exprocessor prices (nominal) for selected West Coast salmon products together with number of processors and total pounds on which the prices are based (from the NMFS Processed Product Survey).

Product Group		1991	1992	1993	1994	1995	1996
Chinook				**Average Prices**			
Salmon Chinook Dressed	Fresh	$2.41	$2.66	$2.37	$2.57	$2.05	$1.83
	Frozen	$3.20	$3.20	$1.83	$2.28	$1.74	$1.76
Salmon Chinook Fillet	Fresh	$3.61	$3.53	$3.63	$3.94	$3.71	$3.42
	Frozen	$4.83	$3.58	$3.57	$3.74	$2.23	$3.97
Salmon Chinook Head on	Fresh	$2.56	$2.76	$2.36	$2.28	$2.38	$2.16
Salmon Chinook Smoked	Cured	$6.51	$5.84	$7.74	$8.87	$7.07	$8.42
Coho							
Salmon Coho Dressed	Fresh	$1.87	$2.01	$1.84	$1.78	$1.43	$2.08
	Frozen	$1.96	$2.01	$0.91	$1.63	$1.32	$1.25
Salmon Coho Fillet	Fresh	$4.42	$3.94	$3.89	$3.07	$2.91	$3.09
				Number of Processors Reporting Price			
Chinook							
Salmon Chinook Dressed	Fresh	44	36	25	14	10	6
	Frozen	81	68	12	11	13	11
Salmon Chinook Fillet	Fresh	12	9	10	7	7	5
	Frozen	6	6	4	3	3	7
Salmon Chinook Head on	Fresh	15	13	12	8	5	4
Salmon Chinook Smoked	Cured	13	13	12	9	10	10
Coho							
Salmon Coho Dressed	Fresh	38	34	23	13	9	6
	Frozen	76	61	14	11	11	10
Salmon Coho Fillet	Frozen	4	6	3	5	5	6
				Total Pounds for Which Price Was Reported			
Chinook							
Salmon Chinook Dressed	Fresh	2,704,533	1,357,639	942,682	422,967	545,301	453,988
	Frozen	5,074,068	4,379,066	1,513,989	1,124,553	1,155,324	1,797,697
Salmon Chinook Fillet	Fresh	574,883	492,807	327,347	347,245	217,579	172,127
	Frozen	202,930	370,865	359,147	410,000	99,821	351,045
Salmon Chinook Head on	Fresh	1,315,518	1,350,007	474,683	516,524	437,288	869,991
Salmon Chinook Smoked	Cured	337,497	142,313	83,625	142,850	188,928	65,860
Coho							
Salmon Coho Dressed	Fresh	3,157,259	2,124,198	660,437	531,113	675,851	618,209
	Frozen	16,853,211	25,278,830	3,870,284	4,847,136	4,909,645	1,857,838
Salmon Coho Fillet	Frozen	359,465	319,931	175,200	294,338	883,202	1,510,759

TABLE B-11. Annual wholesale market price trends for selected salmon products (nominal dollars per pound).[a/]

Product	Year 1989	1990	1991	1992	1993	1994	1995
Chum, Seattle	-	-	1.50	1.43	1.13	1.00	0.86
West Coast Atlantic, Seattle, 10-12 Pounds	-	-	-	3.39	3.00	2.86	2.53
West Coast Atlantic, Seattle, 8-10 Pounds	-	-	-	3.23	2.91	2.74	2.43
West Coast Atlantic, Seattle, 6-8 Pounds	-	-	-	3.06	2.70	2.57	2.35
Canadian Farmed King, Fresh, Seattle, 4-6 Pounds	2.22	2.37	2.52	2.63	2.42	2.33	2.43
Canadian Farmed King, Fresh, FOB Seattle, 4-6 Pounds	2.22	2.37	2.52	2.67	2.61	-	-
Canadian Farmed King, Fresh, Seattle, 4-6 Pounds	3.31	3.36	2.91	2.98	2.62	2.53	2.51

a/ As reported by Urner Barry Publications, Inc.

TABLE B-12. Generalized summary of Canadian recreational salt water regulations for chinook, coho, chum, pink, and sockeye salmon.[a/]

Species	Fishing Season[b/]	Daily Limits[c/d/]	Possession Limit	Yearly Limits
Chinook	Year-round w/ partial summer & early fall month closures.	2	4	from: 15-30
Sockeye	Year-round w/ partial summer & early fall month closures.	4	8	None
Pink	Year-round w/ partial summer & early fall month closures.	4	8	None
Chum	Year-round w/ partial summer & early fall month closures.	4	8	None
Coho	Non-retention of coho	N/A	N/A	N/A

a/ Based on information from BC Online Tidal Waters Sport Fishing Guide 1998/99 (July 21, 1998)

b/ Salmon closure times in the North Coast, for most salmon, fall between June 29 and Aug. 27. Salmon closure times in the South Coast, for most salmon, fall between July 1 to Oct. 15.

c/ Minimum size limit ranges from 30 in. to 62 in.

d/ Aggregate daily limit for all species of Pacific salmon from tidal and non-tidal waters combined is 4.

TABLE B-13. Generalized summary of Alaskan salt water regulations for king, coho, chum, pink, and sockeye salmon.[a/]

Species	Fishing Season	Daily Limits	Possession Limits	Yearly Limits
Chinook	Year-round	From: 2-3 daily w/ minimum of 2 fish greater than 28 inches.	2-3 in possession (2 must be a minimum of 28 inches)	• 4 fish yearly limit for fish 28 inches or larger for non-residents only between Cape Suckling and the Int'l Boundary at Dixon entrance. • No yearly limits for resident and non-resident in Alaska Peninsula, Aleutian Islands & Kodiak. • 5 fish yearly limit in Bristol Bay area for residents & non-residents.
Coho, Chum, Pink, and Sockeye	Year-round	From: 5-6 daily w/ size limits for areas between Cape Suckling and the International Boundary at Dixon entrance.	• Kodiak, Alaska Pen., Aleutian Is., & Bristol bay: 5 in possession w/ no size limits. • Between Cape Suckling & the Int'l Boundary at Dixon Entrance: 12 of each species in possession.	None

a/ Based on information in 1998 Sport Fishing Regulations Summary from Alaska's Department of Fish and Game.

TABLE B-14. Distribution of total average chinook mortalities for selected stocks, 1984-1994 in adult equivalent impacts.

		Fisheries with Ceilings				Other Fisheries				
Location	Stock	All Alaska	All North/Central British Columbia	West Coast Vancouver Island Troll	All Strait of Georgia	Canada Net	Canada Sport	U.S. Troll	U.S. Net	U.S. Sport
Puget Sound	Stillaguamish Fall Fingerling	3.9%	2.6%	29.8%	22.7%	2.2%	2.9%	6.1%	2.7%	22.2%
Puget Sound	South Puget Sound Fall Fingerling	0.3%	1.0%	27.0%	14.8%	1.4%	0.7%	11.7%	11.3%	31.2%
Washington Coast	Queets Fall Fingerling	21.1%	41.8%	25.6%	0.0%	0.0%	0.0%	0.0%	4.8%	1.9%
Columbia River	Stayton Pond Tule	0.0%	1.1%	47.5%	2.5%	0.4%	0.7%	28.1%	2.7%	16.2%
Columbia River	Columbia River Upriver Bright	29.8%	22.3%	26.1%	0.0%	0.1%	0.4%	2.5%	13.6%	5.1%
Columbia River	Lyons Ferry	12.5%	12.6%	24.8%	0.3%	2.1%	0.8%	12.6%	28.8%	5.3%

TABLE B-15. Base fishery (1979-1981) coho impacts for selected stocks by fishery area.

Region	Nooksack-Samish	Stillaguamish-Snohomish	Hood Canal	Grays Harbor	Columbia River Early	Columbia River Late	Robertson Creek	Fraser River
Alaska	0	0	0	331	105	0	378	0
W. Coast Ocean	36,564	94,331	55,853	39,425	435,813	181,610	3,971	8,352
Puget Sound	140,125	176,527	91,552	210	649	1,932	192	19,143
Canada	224,203	293,770	134,731	77,237	16,424	18,317	243,594	195,190
Total	400,892	564,628	282,145	117,227	454,039	202,349	248,135	222,685
Alaska	0.0%	0.0%	0.0%	0.3%	0.0%	0.0%	0.2%	0.0%
W Coast Ocean	9.1%	16.7%	19.8%	33.6%	96.0%	89.8%	1.6%	3.8%
Puget Sound	35.0%	31.3%	32.4%	0.2%	0.1%	1.0%	0.1%	8.6%
Canada	55.9%	52.0%	47.8%	65.9%	3.6%	9.1%	98.2%	87.7%

TABLE B-16. Commercial non-Indian and Indian **chinook** salmon landings **(thousands of round pounds)** by major **West Coast** harvest area, 1981-1997.[a/]

Year	Puget Sound [b/]	Washington Inside Coast	Columbia River	West Coast Ocean	U.S. West Coast
			Non-Indian		
1981	1,086	368	773	9,370	11,597
1982	1,241	274	1,938	12,791	16,244
1983	613	46	635	3,790	5,084
1984	890	95	1,212	3,734	5,930
1985	1,097	182	1,308	7,925	10,512
1986	1,137	233	2,752	12,783	16,905
1987	899	232	6,215	16,998	24,343
1988	580	869	7,233	22,546	31,228
1989	671	794	3,265	11,010	15,740
1990	734	586	1,301	7,656	10,276
1991	273	653	1,000	4,880	6,806
1992	247	833	430	3,628	5,138
1993	254	662	344	4,181	5,441
1994	328	470	64	3,910	4,772
1995	94	581	12	9,891	10,578
1996	120	712	283	6,947	8,062
1997	350	296	189	7,903	8,739
			Indian		
1981	1,930	391	975	231	3,527
1982	1,747	449	1,113	352	3,660
1983	1,622	278	414	255	2,570
1984	1,841	258	857	125	3,081
1985	2,218	361	1,353	203	4,135
1986	1,779	431	2,012	229	4,452
1987	1,740	1,018	2,872	351	5,982
1988	1,812	741	3,384	477	6,414
1989	1,884	1,211	3,098	418	6,612
1990	2,163	779	1,990	387	5,319
1991	1,298	493	1,169	246	3,207
1992	913	457	677	245	2,293
1993	672	425	552	271	1,921
1994	799	443	702	60	2,003
1995	796	351	602	98	1,847
1996	782	362	747	117	2,008
1997	727	317	768	123	1,936

a/ All West Coast data is derived from PacFIN vessel summary files.
b/ All Area 4B catch is included with the West Coast ocean harvest.

TABLE B-17. Commercial non-Indian and Indian **chinook** salmon landings **(exvessel values, thousands of dollars)** by major **West Coast** harvest area, 1981-1997.[a/]

Year	Puget Sound [b/]	Washington Inside Coast	Columbia River	West Coast Ocean	U.S. West Coast
			Non-Indian		
1981	1,799	659	1,054	21,123	24,635
1982	2,122	375	1,968	28,837	33,302
1983	675	65	808	6,574	8,121
1984	1,596	171	1,760	9,029	12,556
1985	1,524	201	1,700	17,515	20,939
1986	1,360	233	2,544	21,684	25,821
1987	1,579	463	8,856	40,301	51,199
1988	1,312	1,972	14,042	57,546	74,872
1989	700	689	2,920	22,245	26,553
1990	990	857	2,273	17,976	22,096
1991	314	838	1,590	10,860	13,602
1992	315	1,100	638	8,170	10,223
1993	256	670	365	8,114	9,406
1994	427	641	145	7,142	8,355
1995	100	538	19	15,018	15,675
1996	111	638	124	8,933	9,806
1997	322	291	154	9,873	10,639
			Indian		
1981	3,325	497	799	503	5,124
1982	2,776	492	763	713	4,744
1983	1,799	332	360	518	3,008
1984	3,145	347	1,008	291	4,791
1985	2,783	253	1,171	415	4,622
1986	2,105	261	1,659	429	4,455
1987	2,730	1,414	4,592	823	9,559
1988	4,012	913	6,579	1,348	12,852
1989	1,955	981	2,472	840	6,248
1990	2,734	798	2,515	826	6,873
1991	1,418	538	935	463	3,355
1992	1,103	550	742	410	2,805
1993	657	412	359	429	1,857
1994	843	521	518	115	1,997
1995	677	313	212	140	1,343
1996	645	268	231	161	1,305
1997	622	299	322	118	1,361

a/ All West Coast data is derived from PacFIN vessel summary files.
b/ All Area 4B catch is included with the West Coast ocean harvest.

TABLE B-18. Commercial non-Indian and Indian **coho** salmon landings (**thousands of round pounds**) by major **West Coast** harvest area, 1981-1997.[a/]

Year	Puget Sound [b/]	Washington Inside Coast	Columbia River	West Coast Ocean	U.S. West Coast
			Non-Indian		
1981	1,560	273	465	6,219	8,518
1982	2,551	770	1,577	5,280	10,179
1983	1,814	90	47	1,690	3,640
1984	1,516	471	1,610	602	4,200
1985	2,808	304	1,628	1,348	6,088
1986	2,869	1,005	6,703	2,799	13,376
1987	3,737	726	1,298	2,732	8,493
1988	2,486	435	2,641	4,232	9,795
1989	2,049	527	2,668	2,846	8,089
1990	2,444	414	494	1,667	5,019
1991	1,120	1,142	2,676	2,486	7,423
1992	498	73	300	335	1,206
1993	115	183	264	89	651
1994	129	120	498	0	747
1995	126	387	190	128	831
1996	109	450	230	81	870
1997	43	14	158	2	217
			Indian		
1981	2,707	492	11	187	3,398
1982	5,070	629	26	862	6,587
1983	3,246	197	1	216	3,660
1984	2,546	380	9	277	3,211
1985	4,717	344	46	607	5,714
1986	4,979	833	224	396	6,431
1987	6,239	866	17	450	7,571
1988	4,096	434	80	323	4,933
1989	3,553	411	42	501	4,508
1990	3,876	677	18	595	5,165
1991	2,157	1,177	77	413	3,823
1992	1,420	306	5	305	2,036
1993	648	308	10	315	1,281
1994	2,285	196	21	0	2,502
1995	1,455	632	10	168	2,266
1996	663	1,083	6	108	1,859
1997	588	101	3	63	756

a/ All West Coast data is derived from PacFIN vessel summary files.
b/ All Area 4B catch is included with the West Coast ocean harvest.

TABLE B-19. Commercial non-Indian and Indian **coho** salmon landings (exvessel values, **thousands of dollars**) by major **West Coast** harvest area, 1981-1997.[a/]

Year	Puget Sound [b/]	Washington Inside Coast	Columbia River	West Coast Ocean	U.S. West Coast
			Non-Indian		
1981	1,818	287	513	8,755	11,372
1982	2,256	634	1,355	6,455	10,700
1983	1,607	99	50	1,486	3,242
1984	1,585	606	1,863	988	5,041
1985	2,611	241	1,358	1,653	5,863
1986	3,265	1,099	6,708	2,595	13,668
1987	7,434	1,537	2,478	4,150	15,599
1988	5,853	956	5,839	8,380	21,029
1989	2,158	544	2,379	2,847	7,928
1990	3,281	513	594	2,401	6,790
1991	1,038	1,007	2,148	2,424	6,617
1992	526	67	271	339	1,204
1993	91	156	216	79	543
1994	101	103	413	0	618
1995	82	255	120	95	552
1996	60	267	142	63	532
1997	27	11	117	7	162
			Indian		
1981	3,113	575	12	241	3,940
1982	4,165	463	24	1,037	5,690
1983	2,805	209	1	194	3,210
1984	2,510	411	9	320	3,250
1985	4,010	215	34	657	4,917
1986	5,129	710	161	384	6,385
1987	11,180	1,522	22	653	13,376
1988	9,143	814	135	708	10,799
1989	3,561	428	30	520	4,539
1990	4,898	925	17	726	6,567
1991	1,808	843	46	366	3,063
1992	1,396	267	4	349	2,016
1993	529	263	7	296	1,095
1994	1,674	163	10	0	1,848
1995	882	355	3	120	1,360
1996	338	631	2	84	1,055
1997	367	79	1	49	496

a/ All West Coast data is derived from PacFIN vessel summary files.

b/ All Area 4B catch is included with the West Coast ocean harvest.

TABLE B-20. Commercial non-Indian and Indian **pink** salmon landings (**thousands of round pounds**) by major **West Coast** harvest area, 1981-1997.[a/]

Year	Puget Sound [b/]	Washington Inside Coast	Columbia River	West Coast Ocean	U.S. West Coast
			Non-Indian		
1981	13,176	0	0	1,453	14,629
1982	0	0	0	0	0
1983	4,531	0	0	349	4,881
1984	0	0	0	0	0
1985	10,409	0	0	874	11,283
1986	0	0	0	0	0
1987	4,436	0	0	117	4,553
1988	0	0	0	0	0
1989	6,857	0	0	177	7,034
1990	0	0	0	0	0
1991	6,376	0	0	175	6,551
1992	0	0	0	0	0
1993	3,831	0	0	10	3,841
1994	0	0	0	0	0
1995	5,029	0	0	116	5,145
1996	0	0	0	0	0
1997	3,246	0	0	0	3,246
			Indian		
1981	5,658	0	0	27	5,686
1982	0	0	0	0	0
1983	3,427	0	0	99	3,526
1984	0	0	0	0	0
1985	11,028	0	0	94	11,122
1986	0	0	0	0	0
1987	5,081	0	0	81	5,163
1988	0	0	0	0	0
1989	8,105	0	0	69	8,174
1990	1	0	0	0	1
1991	6,937	0	0	23	6,961
1992	0	0	0	0	0
1993	4,319	0	0	13	4,332
1994	1	0	0	0	1
1995	4,980	0	0	53	5,034
1996	0	0	0	0	0
1997	3,811	0	0	7	3,818

a/ All West Coast data is derived from PacFIN vessel summary files.
b/ All Area 4B catch is included with the West Coast ocean harvest.

TABLE B-21. Commercial non-Indian and Indian **pink** salmon landings (**exvessel values, thousands of dollars**) by major **West Coast** harvest area, 1981-1997.[a/]

Year	Puget Sound [b/]	Washington Inside Coast	Columbia River	West Coast Ocean	U.S. West Coast
			Non-Indian		
1981	6,182	0	0	958	7,139
1982	0	0	0	0	0
1983	1,511	0	0	162	1,672
1984	0	0	0	0	0
1985	2,710	0	0	472	3,181
1986	0	0	0	0	0
1987	2,221	0	0	78	2,299
1988	0	0	0	0	0
1989	2,781	0	0	109	2,891
1990	0	0	0	0	0
1991	1,290	0	0	73	1,363
1992	0	0	0	0	0
1993	639	0	0	5	644
1994	0	0	0	0	0
1995	844	0	0	27	871
1996	0	0	0	0	0
1997	625	0	0	0	625
			Indian		
1981	2,598	0	0	16	2,613
1982	0	0	0	0	0
1983	1,215	0	0	43	1,257
1984	0	0	0	0	0
1985	2,798	0	0	37	2,835
1986	0	0	0	0	0
1987	2,484	0	0	41	2,525
1988	0	0	0	0	0
1989	3,166	0	0	35	3,201
1990	0	0	0	0	0
1991	1,393	0	0	7	1,400
1992	0	0	0	0	0
1993	671	0	0	4	675
1994	0	0	0	0	0
1995	874	0	0	12	886
1996	0	0	0	0	0
1997	667	0	0	2	668

a/ All West Coast data is derived from PacFIN vessel summary files.
b/ All Area 4B catch is included with the West Coast ocean harvest.

TABLE B-22. Geographic outline of West Coast commercial ocean troll seasons, 1978.

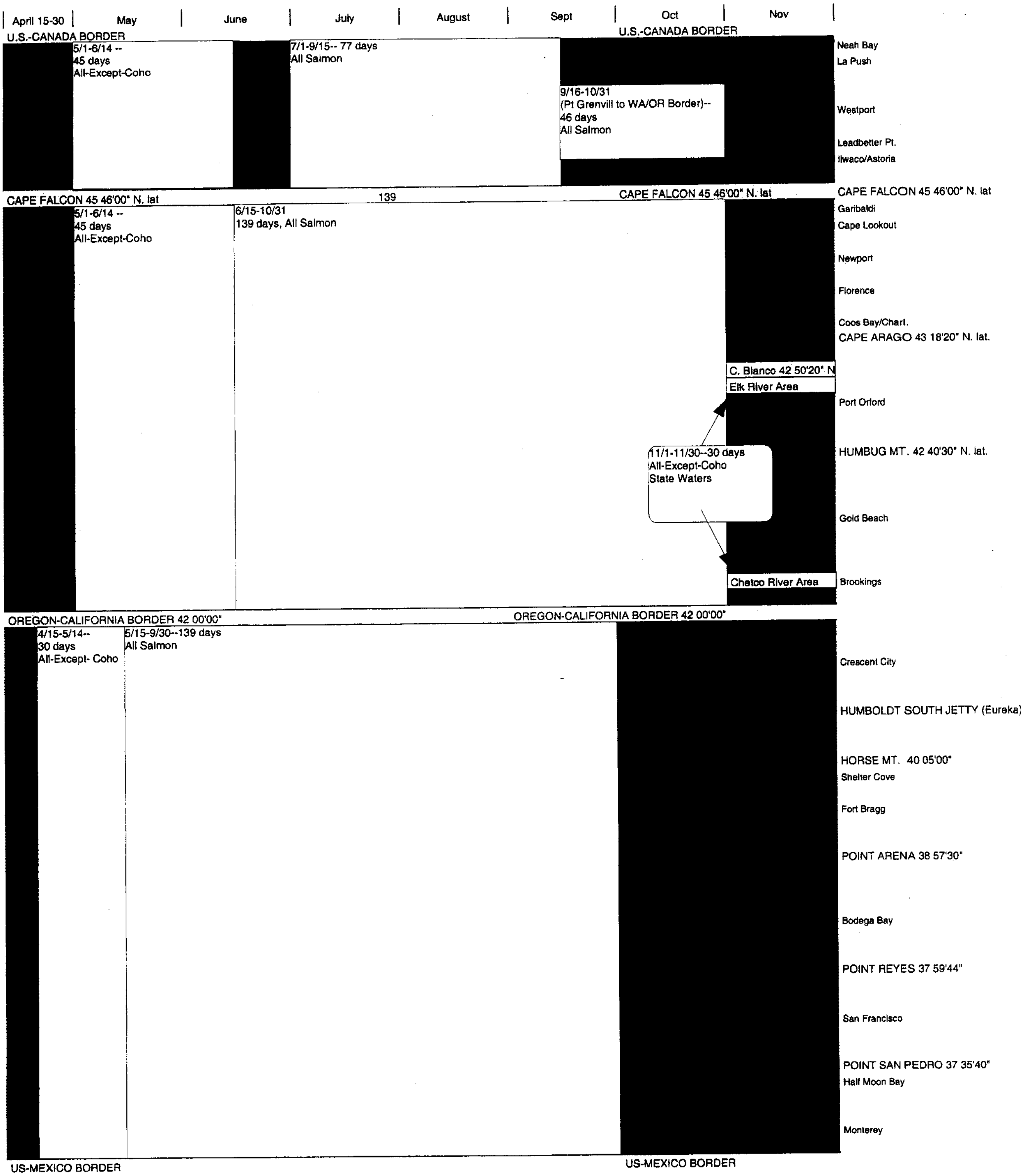


TABLE B-23. Geographic outline of West Coast commercial ocean troll seasons, 1984.

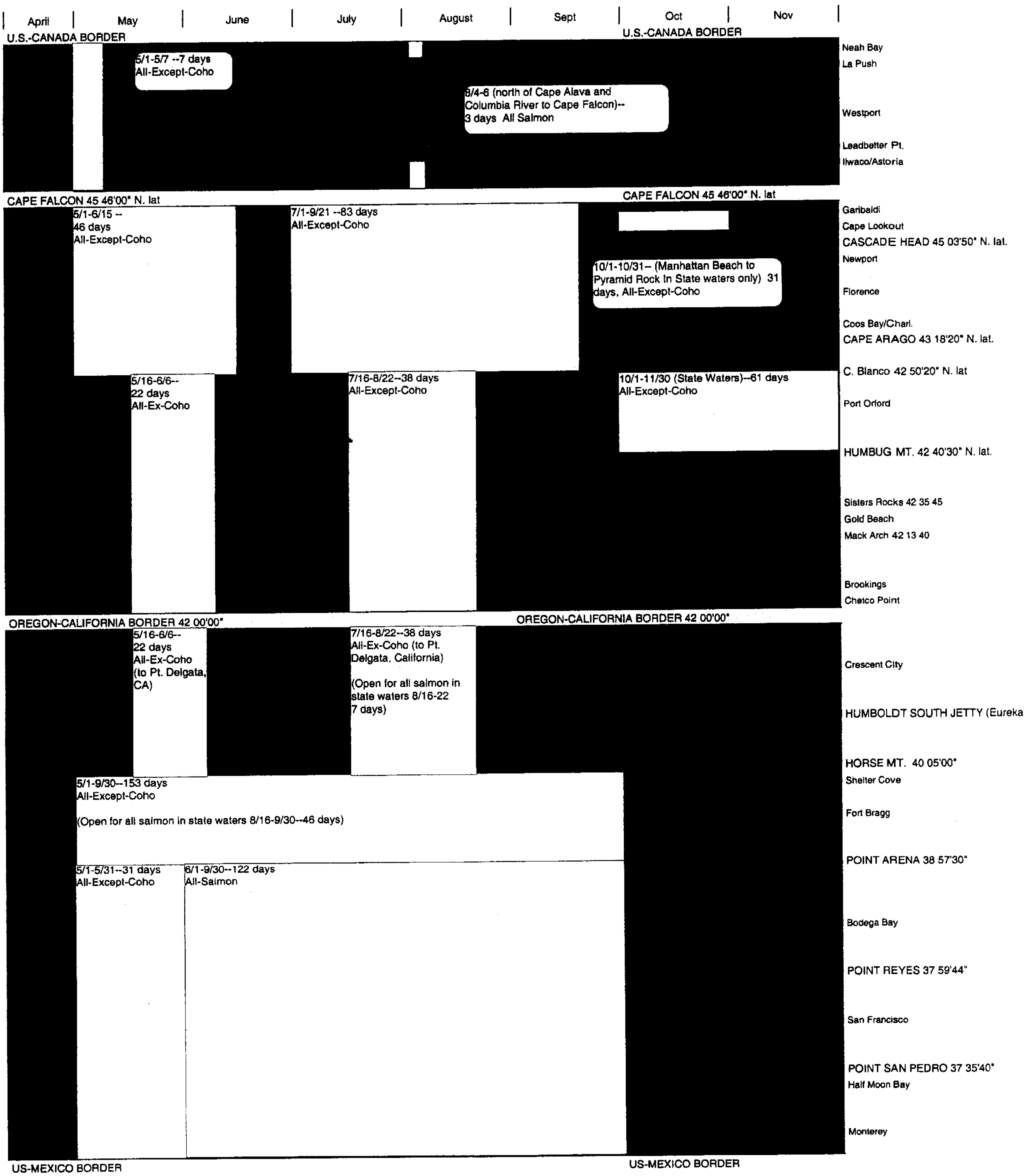


TABLE B-24. Geographic outline of West Coast commercial ocean troll seasons, 1988.

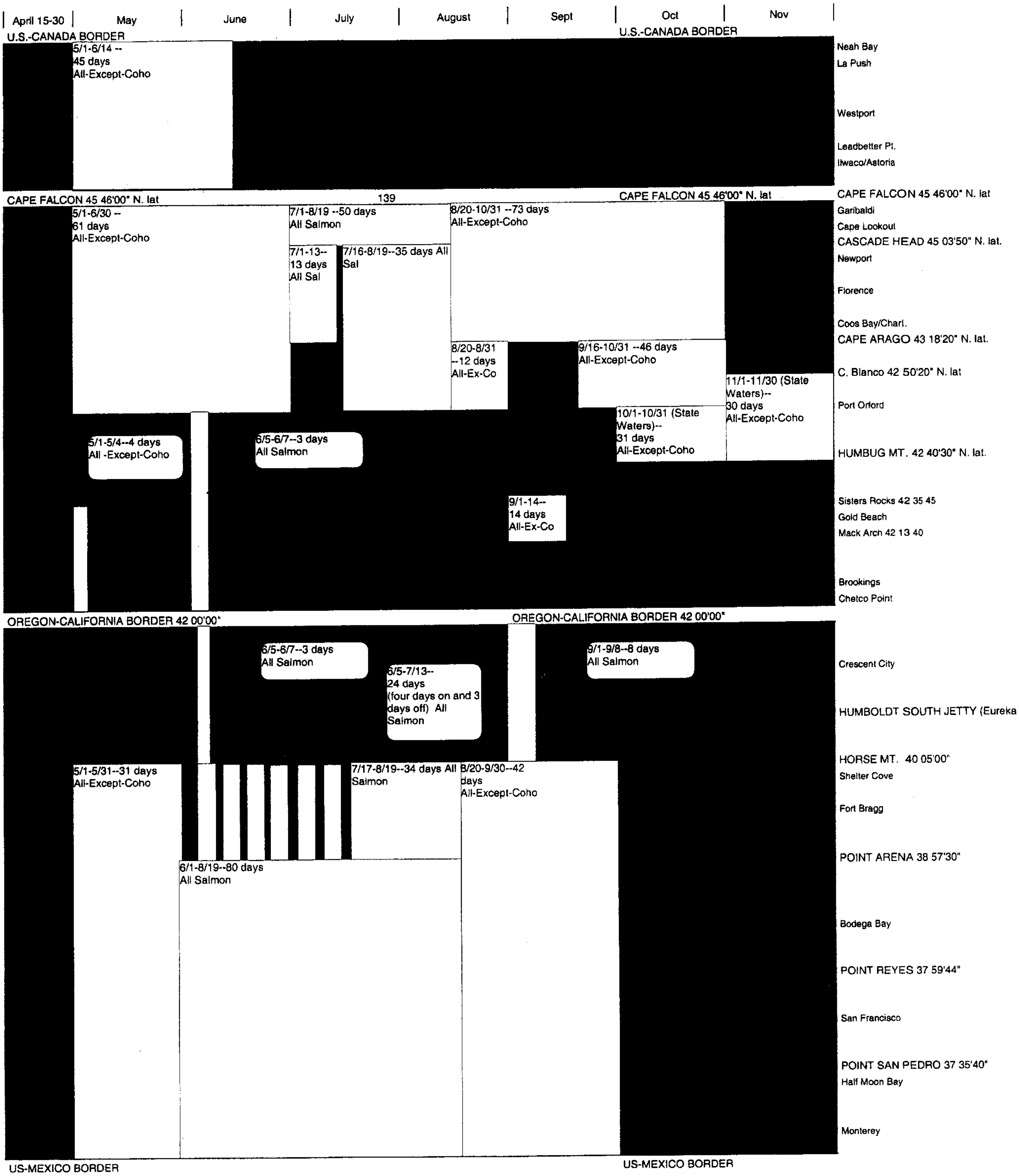


TABLE B-25. Geographic outline of West Coast commercial ocean troll seasons, 1994.

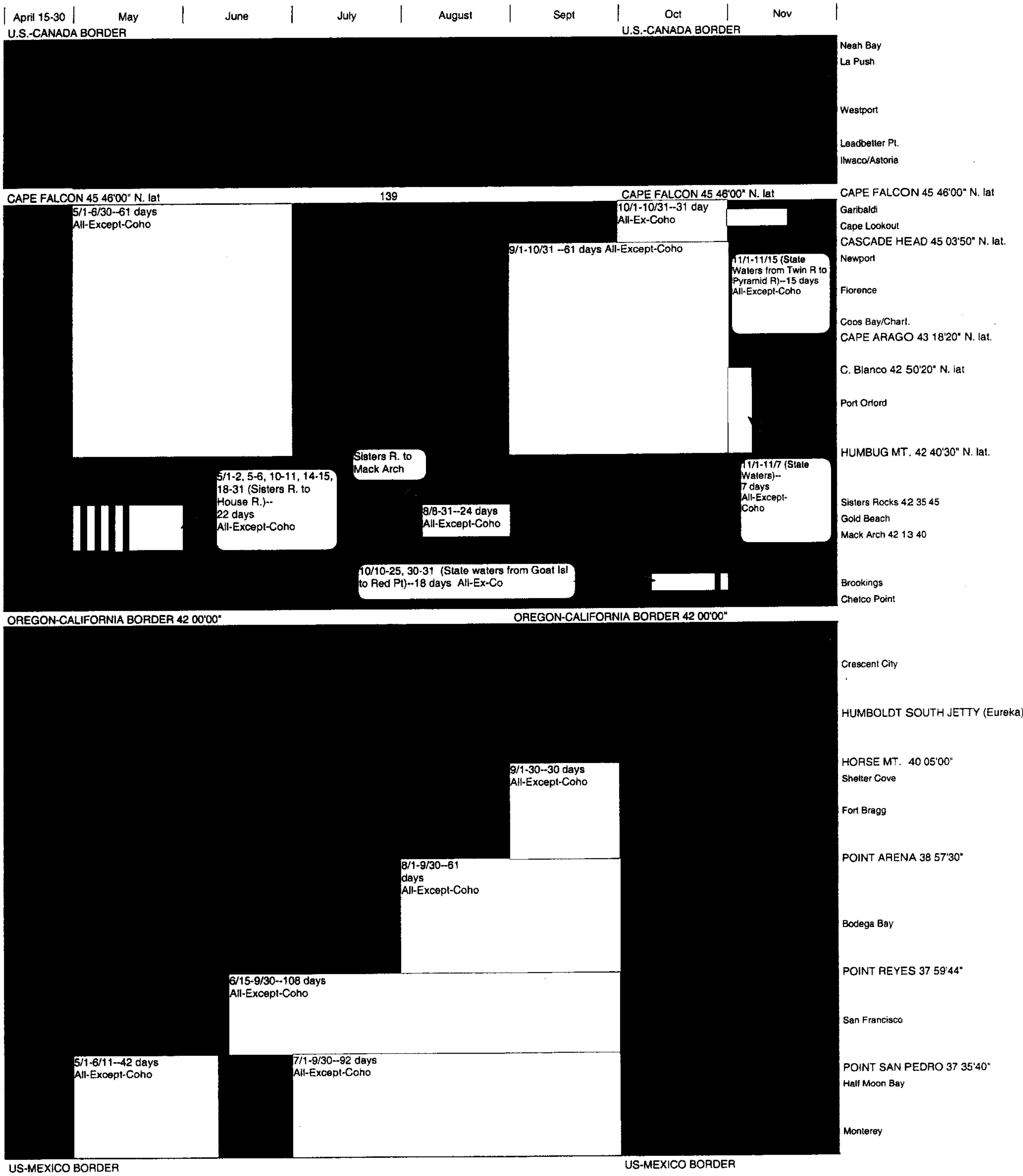
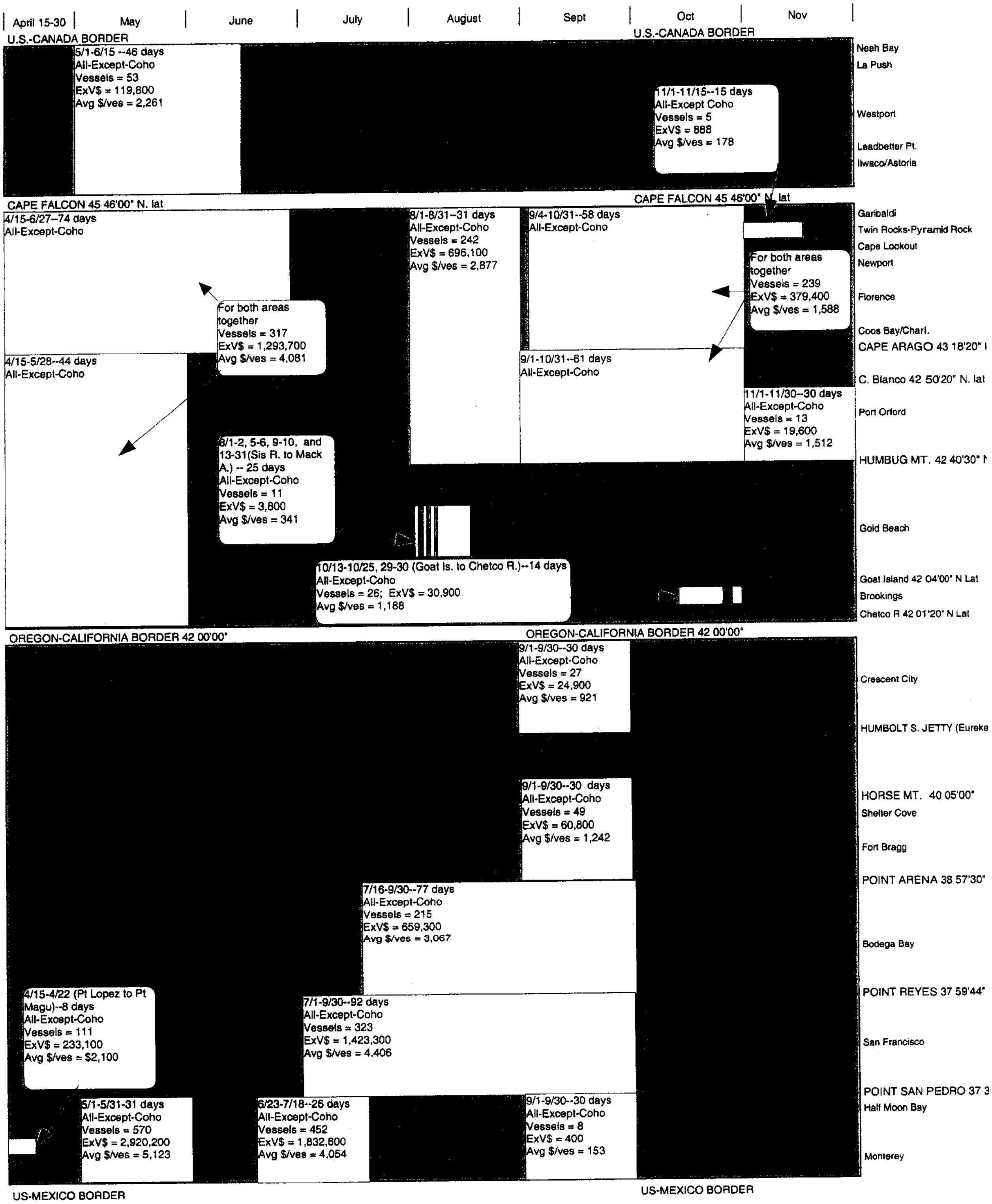


TABLE B-26. Geographic outline of West Coast commercial ocean troll seasons, 1997. a/ b/



a/ The information source for this table is state fish ticket data maintained in the redefined PacFIN database. The data were retrieved January 13, 1998 and may vary somewhat from summary information presented elsewhere in the review. Catch area recorded on tickets is sometimes based on the point of landing. When there is no opening in an area for which catch is reported it was assumed that landings made during a closure came from the nearest open area.

b/ Excludes information on 53,900 pounds of landings for which West Coast catch area was unknown. Total revenue for these landings was $79,500.

TABLE B-27. Exvessel revenue (thousands of dollars, not adjusted for inflation) by management area of catch (non-tribal) all species of salmon.

	Inside Fisheries			Ocean Fisheries				
	Puget Sound	Washington Coast	Columbia River	North of Cape Falcon[a/]	Cape Falcon to Cape Blanco	Cape Blanco to Horse Mountain	Horse Mountain to Point Arena	South of Point Arena
1981	18,693	1,132	1,579	6,253	5,917	6,606	3,034	7,540
1982	19,730	1,574	3,334	5,985	6,376	6,043	4,893	10,852
1983	6,470	582	859	1,393	1,524	1,492	798	2,747
1984	12,595	1,040	3,672	605	766	1,188	1,216	5,980
1985	20,552	540	3,188	2,549	4,647	313	3,770	6,921
1986	21,299	1,523	9,267	1,470	6,528	2,036	3,553	9,899
1987	29,213	2,907	11,515	2,211	14,909	4,294	7,076	14,176
1988	21,078	4,258	20,019	2,361	20,326	3,284	10,724	27,457
1989	21,462	1,381	5,307	1,559	9,194	1,239	2,736	9,654
1990	19,199	1,414	2,873	1,837	6,281	507	1,741	9,560
1991	11,700	2,022	3,740	1,334	2,910	228	1,218	7,604
1992	7,195	1,435	911	1,371	2,619	2	55	4,434
1993	10,664	891	581	821	1,604	28	457	5,236
1994	10,416	753	559	0	637	62	174	6,244
1995	3,316	810	140	119	3,118	121	229	11,406
1996	1,604	909	266	61	2,737	368	377	5,310
1997	5,612	302	271	110	2,337	113	92	7,155

a/ Includes all catch from Area 4B.

TABLE B-28. Troll chinook and coho average dressed weights (pounds) by area of landing (PFMC, 1998).

	Chinook			Coho		
Year	California	Oregon	Washington	California	Oregon	Washington
1981	9.4	9.8	11.4	5.7	5.4	4.3
1982	9.7	10.1	11.2	6.0	5.2	5.0
1983	7.3	8.2	10.5	4.4	3.4	4.2
1984	8.7	8.5	9.4	7.4	5.1	4.5
1985	12.3	9.4	10.4	7.3	5.8	4.6
1986	9.0	8.4	10.2	5.5	4.3	4.1
1987	10.3	9.8	9.5	5.6	5.4	4.3
1988	11.0	10.1	10.6	6.3	5.4	-
1989	10.3	10.0	10.6	5.5	4.4	3.9
1990	9.7	9.4	11.1	5.1	5.2	5.6
1991	11.0	9.3	10.6	5.6	4.6	5.1
1992	10.0	9.2	11.6	4.5	4.2	4.1
1993	9.1	9.3	11.0	-	5.4	4.8
1994	10.5	11.3	9.3	-	-	-
1995	9.8	9.0	8.4	-	-	4.4
1996	10.8	10.9	12.4	-	-	4.0
1997	10.7	10.3	10.6	-	-	-

TABLE B-29. **Troll** salmon landed in **California**, estimates of **exvessel value and average price** (dollars per dressed pound).

	Chinook				Coho				Total[a]	
Year	Nominal Value (thousands of dollars)	Real Value[b] (thousands of dollars)	Nominal Price Per Pound (dollars)	Real Price Per Pound[b] (dollars)	Nominal Value (thousands of dollars)	Real Value[b] (thousands of dollars)	Nominal Price Per Pound (dollars)	Real Price Per Pound[b] (dollars)	Nominal Value (thousands of dollars)	Real Value[b] (thousands of dollars)
1979	17,356	35,334	2.53	5.15	2,303	4,689	2.19	4.46	19,659	40,023
1980	12,741	23,746	2.27	4.23	408	760	1.36	2.53	13,149	24,506
1981	13,417	22,854	2.25	3.83	905	1,542	1.94	3.30	14,322	24,396
1982	18,754	30,051	2.55	4.09	735	1,178	1.36	2.18	19,489	31,229
1983	4,290	6,593	2.09	3.21	318	489	1.25	1.92	4,608	7,082
1984	6,875	10,182	2.67	3.95	687	1,017	1.99	2.95	7,562	11,200
1985	11,390	16,308	2.56	3.67	125	179	1.57	2.25	11,515	16,487
1986	14,874	20,755	2.01	2.80	238	332	1.18	1.65	15,112	21,087
1987	25,130	34,019	2.78	3.76	493	667	2.00	2.71	25,623	34,686
1988	41,221	53,838	2.86	3.74	706	922	2.21	2.89	41,927	54,760
1989	13,095	16,411	2.39	3.00	390	489	1.69	2.12	13,485	16,900
1990	11,434	13,735	2.77	3.33	622	747	1.98	2.38	12,056	14,483
1991	8,351	9,648	2.58	2.98	696	804	1.52	1.76	9,047	10,453
1992	4,487	5,045	2.74	3.08	18	20	1.63	1.83	4,505	5,065
1993	5,707	6,252	2.25	2.46	-	-	-	-	5,707	6,252
1994	6,437	6,887	2.07	2.21	-	-	-	-	6,437	6,887
1995	11,693	12,201	1.76	1.84	-	-	-	-	11,693	12,201
1996	5,984	6,105	1.44	1.47	-	-	-	-	5,984	6,105
1997[c]	7,200	7,200	1.38	1.38	-	-	-	-	7,200	7,200

a/ Does not include pink landings.
b/ Expressed in 1997 dollars.
c/ Preliminary.

TABLE B-30. **Troll** salmon landed in **Oregon**, estimates of **exvessel value and average price** (dollars per dressed pound).

	Chinook				Coho				Total[a/]	
Year	Nominal Value (thousands of dollars)	Real Value[b/] (thousands of dollars)	Nominal Price Per Pound (dollars)	Real Price Per Pound[b/] (dollars)	Nominal Value (thousands of dollars)	Real Value[b/] (thousands of dollars)	Nominal Price Per Pound (dollars)	Real Price Per Pound[b/] (dollars)	Nominal Value (thousands of dollars)	Real Value[b/] (thousands of dollars)
1971-1975	2,036	6,157	0.89	2.74	3,658	11,331	0.64	1.95	5,694	17,488
1976-1980	5,366	11,732	2.16	4.71	6,407	14,430	1.51	3.29	11,773	26,162
1981	4,039	6,880	2.57	4.38	5,534	9,426	1.66	2.83	9,573	16,306
1982	6,094	9,765	2.59	4.15	3,801	6,091	1.40	2.24	9,895	15,856
1983	1,244	1,912	1.90	2.92	1,052	1,617	0.96	1.48	2,296	3,529
1984	1,477	2,187	2.74	4.06	118	175	1.66	2.46	1,595	2,362
1985	5,045	7,223	2.48	3.55	729	1,044	1.51	2.16	5,774	8,267
1986	5,976	8,339	1.77	2.47	1,978	2,760	1.04	1.45	7,954	11,099
1987	13,467	18,231	2.60	3.52	3,296	4,462	1.72	2.33	16,763	22,692
1988	13,940	18,207	3.19	4.17	7,596	9,921	2.28	2.98	21,536	28,128
1989	7,894	9,893	2.23	2.79	2,131	2,671	1.07	1.34	10,025	12,564
1990	5,627	6,760	2.58	3.10	1,014	1,218	1.60	1.92	6,641	7,978
1991	1,721	1,988	2.47	2.85	1,399	1,616	0.99	1.14	3,120	3,605
1992	2,490	2,800	2.46	2.77	222	250	1.08	1.21	2,712	3,049
1993	1,661	1,820	2.18	2.39	10	11	1.13	1.24	1,671	1,831
1994	690	738	2.40	2.57	-	-	-	-	690	738
1995	3,294	3,437	1.70	1.77	-	-	-	-	3,294	3,437
1996	3,007	3,068	1.56	1.59	-	-	-	-	3,007	3,068
1997[c/]	2,469	2,469	1.60	1.60	-	-	-	-	2,469	2,469

a/ Does not include pink landings.
b/ Expressed in 1997 dollars.
c/ Preliminary.

TABLE B-31. **Non-Indian troll** salmon landed in **Washington**, estimates of **exvessel value and average price** (dollars per dressed pound).[a/]

Year or Average	Chinook Nominal Value (thousands of dollars)	Chinook Real Value[c/] (thousands of dollars)	Chinook Nominal Price Per Pound (dollars)	Chinook Real Price Per Pound[c/] (dollars)	Coho Nominal Value (thousands of dollars)	Coho Real Value[c/] (thousands of dollars)	Coho Nominal Price Per Pound (dollars)	Coho Real Price Per Pound[c/] (dollars)	Total[b/] Nominal Value (thousands of dollars)	Total[b/] Real Value[c/] (thousands of dollars)
1971-1975	2,714	8,313	0.89	2.74	3,060	9,395	0.66	2.04	5,775	17,708
1976-1980	5,313	11,851	2.39	5.17	6,086	13,541	1.67	3.62	11,399	25,391
1981	3,279	5,585	2.66	4.53	2,642	4,500	1.52	2.59	5,921	10,086
1982	4,246	6,804	2.57	4.12	2,484	3,980	1.34	2.15	6,730	10,784
1983	1,152	1,771	1.72	2.64	313	481	0.93	1.43	1,465	2,252
1984	255	378	2.78	4.12	155	230	1.48	2.19	410	607
1985	837	1,198	2.57	3.68	764	1,094	1.32	1.89	1,601[d/]	2,292
1986	808	1,127	2.35	3.28	367	512	1.16	1.62	1,175	1,640
1987	1,606	2,173	2.97	4.02	354	480	1.67	2.26	1,960[e/]	2,653
1988	2,289	2,990	2.95	3.85	48[f/]	63	2.45	3.20	2,337	3,052
1989	955	1,197	2.22	2.78	275	345	1.31	1.64	1,230[g/]	1,541
1990	890	1,069	2.57	3.09	758	911	1.52	1.83	1,648	1,980
1991	783	905	2.54	2.93	343	396	1.13	1.31	1,126[h/]	1,301
1992	1,200	1,349	2.41	2.71	99	111	1.33	1.50	1,299	1,461
1993	728	798	2.21	2.42	67	73	1.02	1.12	795[i/]	871
1994	j/	j/	j/	j/	-	-	-	-	j/	j/
1995	j/	j/	j/	j/	91	95	0.83	0.87	91[k/]	95
1996	j/	j/	j/	j/	59	60	0.86	0.88	59	60
1997	125	125	1.55	1.55	-	-	-	-	125[l/]	125

a/ All values in this table are based on preliminary information available at the start of each year's salmon review.
b/ Does not include pink landings.
c/ Expressed in 1997 dollars.
d/ Pink landings nominal exvessel value was $308,000. Nominal pink price per pound was $0.55.
e/ Pink landings nominal exvessel value was $6,500. Nominal pink price per pound was $0.62.
f/ There was no legal coho fishery in 1988. This value is for landings of fish caught south of Cape Falcon and seizures of illegal fish.
g/ Pink landings nominal exvessel value was $91,000. Nominal pink price per pound was $0.70.
h/ Pink landings nominal exvessel value was $69,600. Nominal pink price per pound was $0.47.
i/ Pink landings nominal exvessel value was $4,700. Nominal pink price per pound was $0.54.
j/ Chinook were caught off Oregon and landed in Washington. Value information is not provided in order to preserve confidentiality.
k/ Pink landings nominal exvessel value was $26,000. Nominal pink price per pound was $0.20.
l/ Pink landings nominal exvessel value was $3. Nominal pink price per pound was $0.31.

TABLE B-32. **Pounds** of salmon **landed** by the commercial **troll** ocean fishery for major **California** port areas.[a/]

Year or Average	Crescent City	Eureka	Fort Bragg	San Francisco	Monterey	State Total
			CHINOOK (thousands of pounds)			
1976-1980	393	1,403	1,449	1,733	889	5,867
1981-1985	350	428	1,128	1,806	742	4,454
1986	151	457	2,147	2,751	1,891	7,397
1987	313	656	3,115	3,874	1,090	9,047
1988	188	557	4,201	7,177	2,307	14,431
1989	103	220	1,359	2,545	1,263	5,490
1990	20	133	671	1,892	1,407	4,122
1991	4	79	467	1,685	1,004	3,238
1992	b/	1	21	996	613	1,632
1993	3	11	220	1,316	987	2,537
1994	b/	6	77	2,189	831	3,103
1995	5	26	130	3,277	3,197	6,633
1996	3	92	278	1,695	2,046	4,113
1997[c/]	1	16	54	2,644	2,485	5,200
			COHO (thousands of pounds)			
1976-1980	360	391	277	109	48	1,184
1981-1985	89	104	89	54	9	345
1986	30	30	103	30	8	202
1987	32	67	140	7	1	246
1988	19	78	174	46	2	320
1989	29	24	137	38	3	231
1990	-	15	125	142	32	314
1991	1	19	55	270	115	459
1992	-	b/	b/	10	1	11
1993	-	-	-	-	-	-
1994	-	-	-	-	-	-
1995	-	-	-	-	-	-
1996	-	-	-	-	-	-
1997	-	-	-	-	-	-

a/ The major port areas listed include the following ports: Crescent City includes only Crescent City; Eureka also includes Trinidad and Humboldt Bay locations; Fort Bragg also includes Shelter Cove, Noyo Harbor, Mendocino, and Pt. Arena; San Francisco also includes Bodega Bay, San Francisco Bay, and Half Moon Bay; Monterey also includes Santa Cruz, Moss Landing, Monterey, Morro Bay, and Santa Barbara.

b/ Less than 500 pounds.

c/ Preliminary.

TABLE B-33. **Pounds** of salmon **landed** by the commercial **troll** ocean salmon fishery for major **Oregon** port areas.[a/]

Year or Average	Astoria	Tillamook	Newport	Coos Bay	Brookings	State Total
			CHINOOK (thousands of pounds)			
1976-1980	171	118	530	908	700	2,427
1981-1985	92	45	271	638	386	1,432
1986	61	119	751	1,990	449	3,370
1987	83	419	997	2,997	685	5,182
1988	37	341	1,231	2,198	580	4,387
1989	50	302	777	1,945	449	3,532
1990	28	139	388	1,452	174	2,181
1991	9	110	267	292	18	695
1992	17	108	676	206	7	1,013
1993	5	86	460	182	28	761
1994	b/	29	165	45	47	287
1995	6	96	1,330	453	55	1,941
1996	21	125	1,219	417	142	1,926
1997[c/]	3	32	1,053	381	73	1,542
			COHO (thousands of pounds)			
1976-1980	385	660	1,190	1,661	357	4,252
1981-1985	133	293	451	550	111	1,537
1986	109	418	885	393	101	1,905
1987	57	380	517	894	67	1,916
1988	17	766	1,375	1,087	91	3,336
1989	115	530	615	672	63	1,996
1990	69	272	73	197	24	634
1991	69	431	440	464	7	1,411
1992	6	33	112	55	b/	206
1993	8	1	-	-	-	9
1994	-	-	-	-	-	-
1995	-	-	-	-	-	-
1996	-	-	-	-	-	-
1997	-	-	-	-	-	-

a/ The port areas listed include landings in the following ports: Astoria also includes Gearhart/Seaside and Cannon Beach; Tillamook also includes Garibaldi, Netarts, Pacific City, and Nehalem Bay; Newport also includes Depoe Bay, Siletz Bay, Salmon River, and Waldport; Coos Bay also includes Florence, Winchester Bay, Charleston, and Bandon; Brookings also includes Port Orford and Gold Beach.

b/ Less than 500.

c/ Preliminary.

TABLE B-34. **Pounds** of salmon **landed** by the **non-Indian commercial troll** ocean salmon fishery for major **Washington** port areas.[a/b/]

Year	Neah Bay	La Push	Westport	Ilwaco	Coastal Community Total	Puget Sound	State Total
			CHINOOK (thousands of pounds)				
1976-1980	288	421	919	261	1,889	426	1,543
1981-1985	88	32	370	74	564	124	689
1986	50	21	141	75	286	55	342
1987	42	20	367	65	494	51	545
1988	94	30	250	57	430	348	778
1989	20	2	277	28	327	124	451
1990	149	15	135	17	315	34	349
1991	128	7	127	14	276	32	308
1992	160	46	232	10	447	58	507
1993	122	35	132	2	291	41	332
1994[c/]	-	-	-	-	-	7	7
1995[c/]	-	-	3	-	3	12	15
1996[c/]	-	-	4	1	5	13	19
1997	20	d/	45	0	66	15	80
			COHO (thousands of pounds)				
1976-1980	600	786	1,066	678	3,130	496	3,626
1981-1985	133	63	277	142	616	128	744
1986	58	30	118	72	279	38	317
1987	9	15	135	47	206	7	213
1988	1	0	2	8	11	9	20
1989	121	2	19	79	221	24	245
1990	159	46	214	61	480	20	501
1991	87	16	126	45	274	31	304
1992	25	13	21	4	63	12	75
1993	11	7	43	2	63	3	66
1994	-	-	-	-	-	-	-
1995	84	18	7	-	109	2	111
1996	45	1	23	0	68	d/	68
1997	-	-	-	-	-	-	-

a/ All values in this table are based on preliminary information available at the start of each year's review.

b/ The major port areas listed may include smaller ports as follows: Neah Bay includes only Neah Bay; La Push also includes Kalaloch; Westport also includes Aberdeen, Bay City, Copalis Beach, Hoquiam, Moclips, Taholah, Bay Center, Grayland Beach, Raymond, South Bend, and Tokeland; Ilwaco also includes Long Beach, Nahcotta, Naselle, and all Columbia River Ports; Puget Sound includes all Puget Sound ports east of Neah Bay.

c/ There was no ocean commercial fishery for chinook north of Cape Falcon, however, chinook were caught off Oregon and landed in Washington.

d/ Less than 500.

TABLE B-35. West Coast troll salmon landings[a/] in dressed weight, value of landings and number of registered vessels making commercial salmon landings, by state.[b/]

	California				Oregon				Washington			
Year	Vessels Landing Salmon	Vessels with Permits	Nominal Average Exvessel Value/Vessel (dollars)	Real Average Exvessel Value/Vessel (dollars)[c/]	Vessels Landing Salmon	Vessels with Permits	Nominal Average Exvessel Value/Vessel (dollars)	Real Average Exvessel Value/Vessel (dollars)	Vessels Landing Salmon	Vessels with Permits	Nominal Average Exvessel Value/Vessel (dollars)	Real Average Exvessel Value/Vessel (dollars)
1974	3,185	-	2,516	7,353	2,253	-	3,523	10,297				
1975	3,150	-	2,213	5,913	2,304	-	2,521	6,734				
1976	3,526	-	3,037	7,664	2,770	-	5,368	13,547				
1977	3,797	-	3,180	7,538	3,108	-	3,695	8,760				
1978	4,919	-	2,236	4,941	3,158	-	2,324	5,135	3,041	3,291	3,297	7,284
1979	4,593	-	4,280	8,714	3,114	-	5,456	11,107	2,778	3,068	5,432	11,059
1980	4,738	-	2,775	5,172	3,875[d/]	4,314	2,112	3,937	2,626	2,797	2,709	5,049
1981	4,102	-	3,491	5,947	3,615	3,926	2,648	4,511	2,439	2,603	2,428	4,135
1982	4,013	5,964	4,856	7,782	3,269	3,646	3,027	4,850	2,253	2,512	2,987	4,787
1983	3,223	4,617	1,430	2,197	2,951	3,439	778	1,196	2,045	2,328	716	1,101
1984	2,569	4,180	2,944	4,360	771	3,203[e/]	2,069	3,064	381	2,071[f/]	1,076	1,594
1985	2,308	3,869	4,989	7,144	2,050	2,993[g/]	2,817	4,033	1,259	1,650[h/]	1,272	1,821
1986	2,582	3,753	5,853	8,167	2,288	2,739	3,476	4,851	1,252	1,531	938	1,310
1987	2,442	3,533	10,493	14,204	2,111	2,626	7,941	10,750	883	1,401	2,220	3,005
1988	2,571	3,493	16,308	21,299	2,061	2,597	10,449	13,648	650	1,337	3,596	4,696
1989	2,534	3,464	5,322	6,669	1,937	2,569	5,176	6,486	883	1,306	1,393	1,746
1990	2,115	3,372	5,700	6,848	1,557	2,528	4,265	5,124	897	1,170	1,837	2,207
1991	1,769	3,242	5,114	5,909	1,217	2,044[i/]	2,564	2,962	811	1,013	1,388	1,604
1992	1,085	2,974	4,152	4,669	649	2,111	4,179	4,699	604	806	2,151	2,418
1993	1,240	2,740	4,602	5,042	612	1,814	2,735	2,991	474	668	1,677	1,837
1994	1,024	2,470	6,286	6,726	371	1,569	1,859	1,990	1	7[j/]	f/	f/
1995	1,104	2,333	10,591	11,051	476	1,465	6,920	7,221	96	435[k/]	948	989
1996	985	2,222	6,075	6,198	455	1,377	6,609	6,743	90	333	943	963
1997[l/]	832	2,069	8,654	8,654	433	1,286	5,701	5,701	51	323[m/]	2,470	2,470

a/ Includes only chinook and coho salmon landings.
b/ Derived from vessel registrations and fish landing tickets.
c/ Expressed in 1997 dollars.
d/ The establishment of a restricted vessel permit system drew a number of historically active vessels back into the fishery in 1980.
e/ Vessels were not required to land one salmon in 1984 to be eligible for a permit in 1985. The Oregon Fish and Wildlife Commission waived this requirement, because of the elimination of the coho fishery south of Cape Falcon.
f/ 312 licenses and delivery permits purchased by buyback program.
g/ Vessels traditionally landing salmon south of Cape Blanco and north of Cape Falcon were not required to land one salmon in 1985 to be eligible for a permit in 1986. The Oregon Fish and Wildlife Commission waived this requirement, because of the complete salmon closure south of Cape Blanco and a limited one-day coho season between the Columbia River and Cape Blanco.
h/ 118 licenses and delivery permits purchased by buyback program.
i/ Legislation passed during the 1991 season of the Oregon Legislature **waived** the requirement that troll permit holders must buy a 1991 permit to be able to renew for 1992. This was a **one-time** exemption for 1991 only.
j/ Vessels were not required to purchase a permit in 1994 to maintain their eligibility for a permit in 1995.
k/ 190 licenses and delivery permits purchased by buyback program.
l/ Preliminary.
m/ 72 licenses and delivery permits purchased by buyback program at the end of 1996 and early 1997.

TABLE B-36. Number of commercial salmon vessels by fishery area.[a/]

Year	Inside Fisheries			Ocean Fisheries					
	Puget Sound	Washington Coast	Columbia River	North of Cape Falcon	Cape Falcon to Cape Blanco	Cape Blanco to Horse Mountain	Horse Mountain to Point Arena	South of Point Arena	All Ocean Fisheries[b/]
1981	1,868	366	825	2,812	2,706	1,916	906	2,260	9,037
1982	1,812	370	806	2,464	2,567	1,818	1,064	2,345	8,539
1983	1,746	328	746	2,224	2,312	1,317	620	1,848	7,492
1984	1,532	289	750	572	488	800	519	1,689	3,447
1985	1,645	251	621	1,713	1,808	204	749	1,706	5,379
1986	1,519	234	669	1,618	1,975	893	769	1,653	5,665
1987	1,567	302	755	1,032	1,980	753	832	1,646	4,920
1988	1,619	315	856	684	2,001	723	849	1,830	4,710
1989	1,514	258	695	1,009	1,849	644	789	1,943	4,921
1990	1,482	266	640	1,024	1,466	300	560	1,631	4,216
1991	1,392	265	655	1,056	1,153	176	444	1,494	3,601
1992	1,241	273	519	678	629	6	41	1,065	2,261
1993	1,277	273	463	521	587	29	225	1,110	2,226
1994	1,024	218	390	-	348	54	151	934	1,346
1995	809	189	227	93	455	75	118	1,106	1,683
1996	518	196	230	86	427	125	129	881	1,477
1997	719	164	196	57	404	75	58	788	1,286

a/ Based on PacFIN annual vessel summary files retrieved from system July 9, 1998.
b/ Vessels with unspecified West Coast ocean catch areas are excluded from this total.

TABLE B-37. Geographic outline of West Coast recreational ocean seasons, 1978.

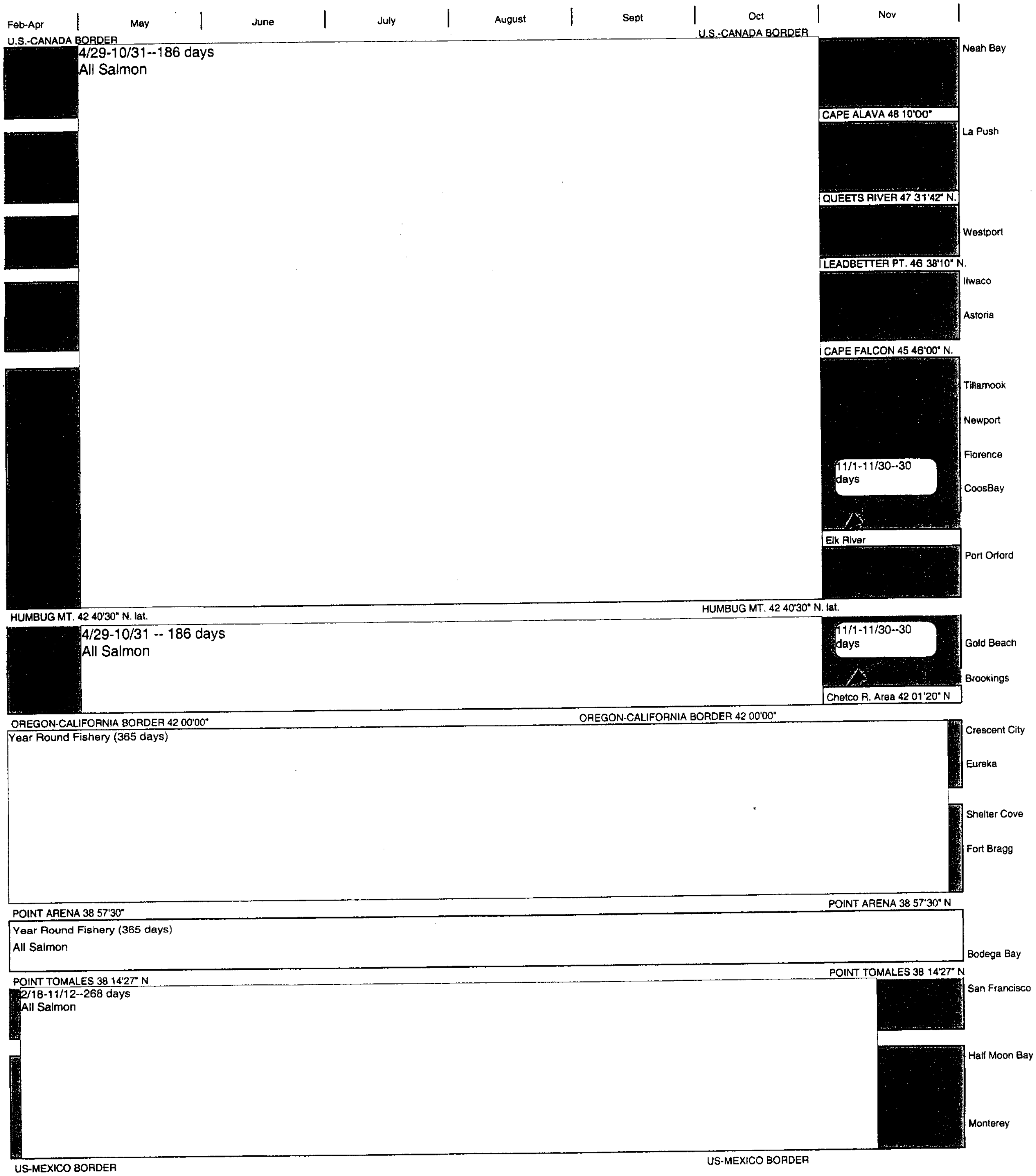


TABLE B-38. Geographic outline of West Coast recreational ocean seasons, 1984.

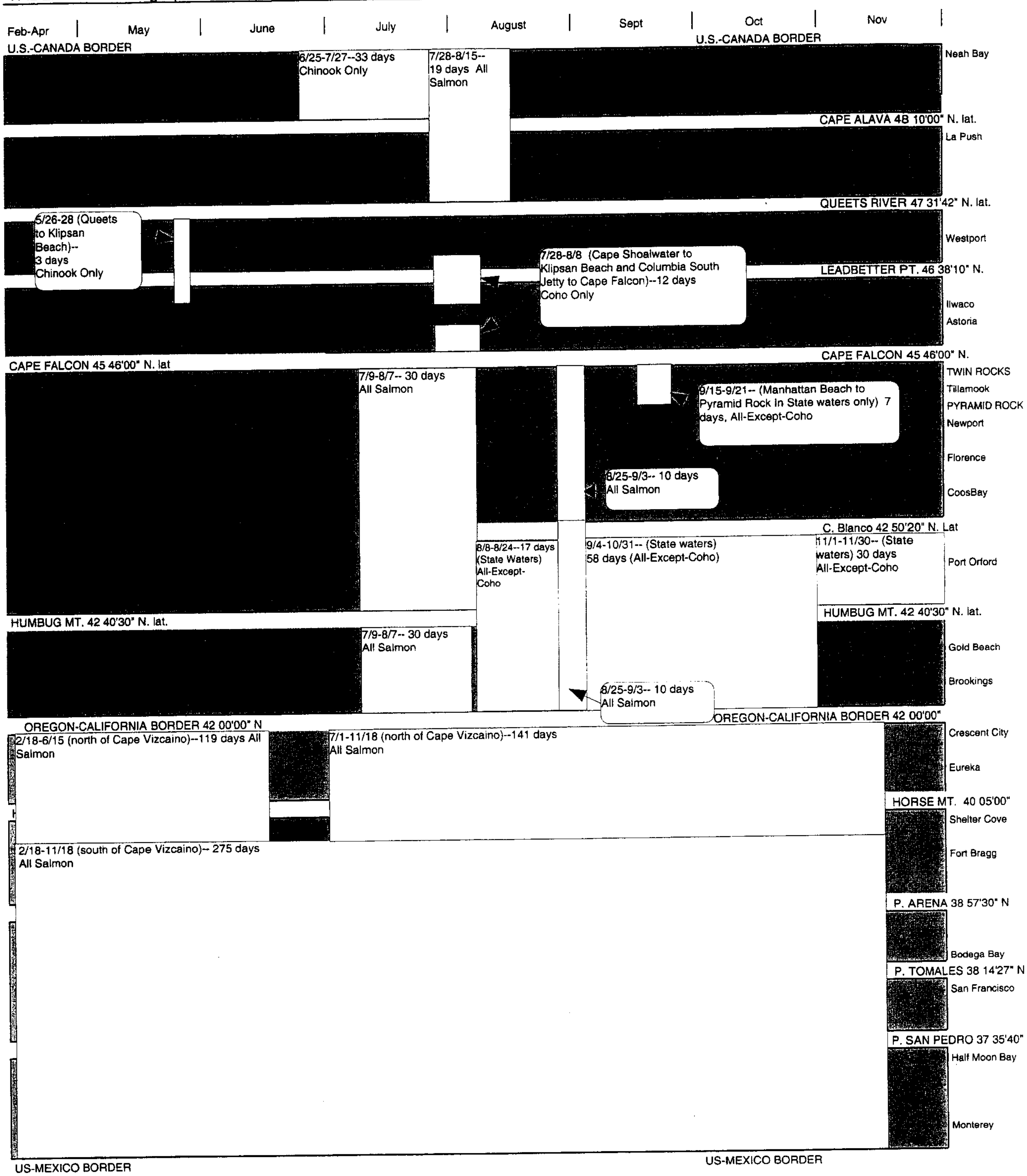


TABLE B-39. Geographic outline of West Coast recreational ocean seasons, 1988.

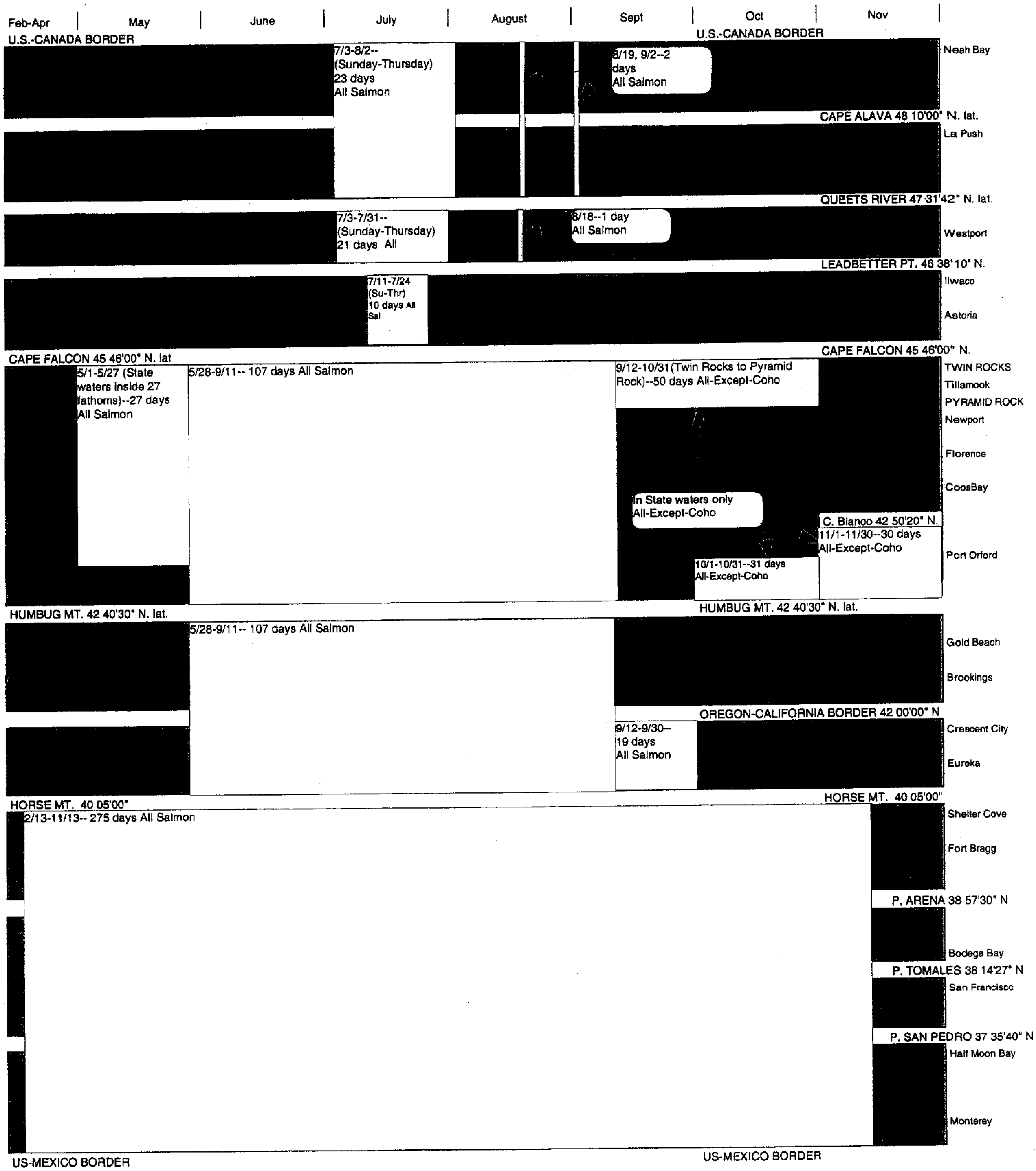


TABLE B-40. Geographic outline of West Coast recreational ocean seasons, 1994.

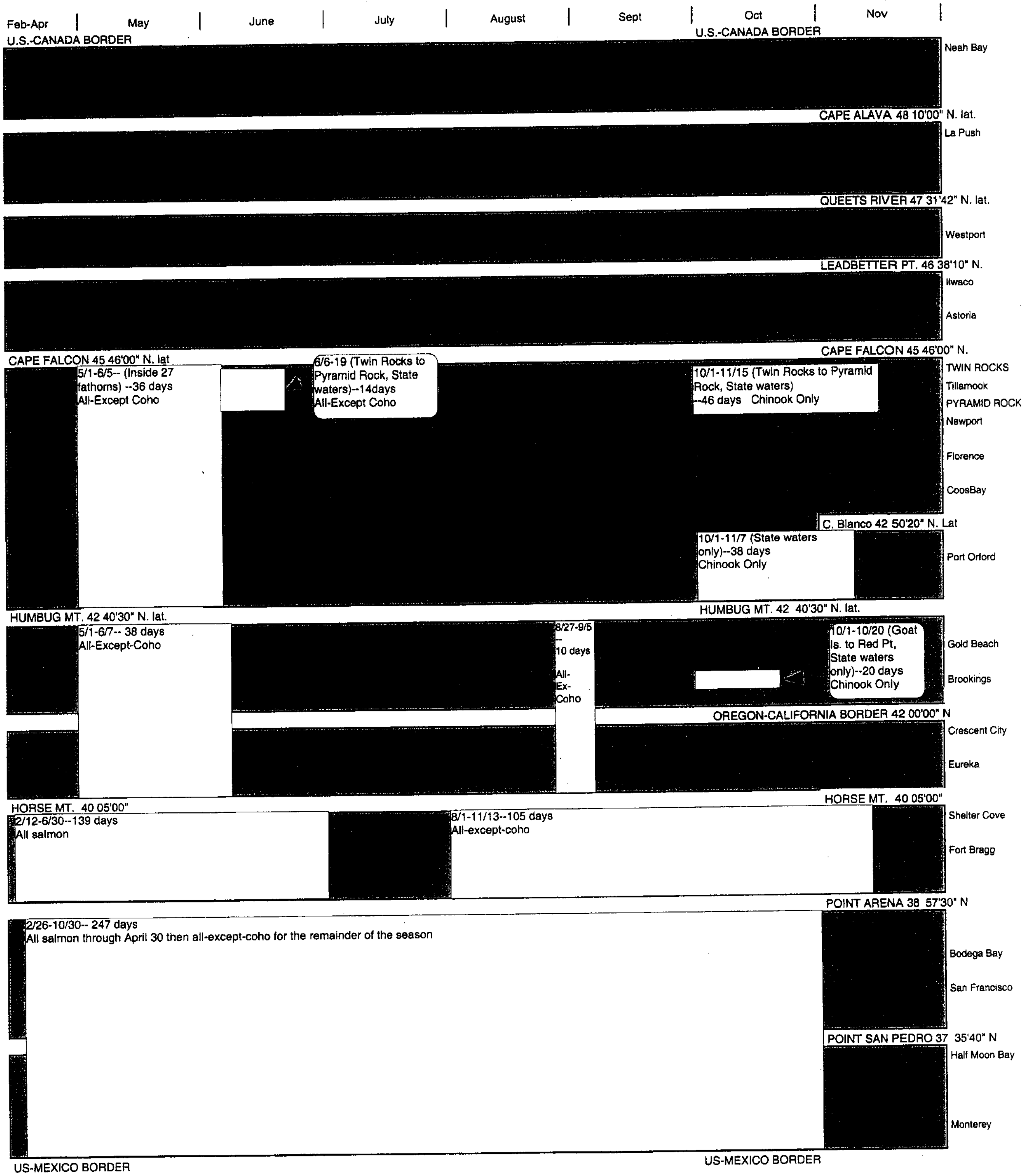


TABLE B-41. Geographic outline of West Coast recreational ocean seasons, 1997.

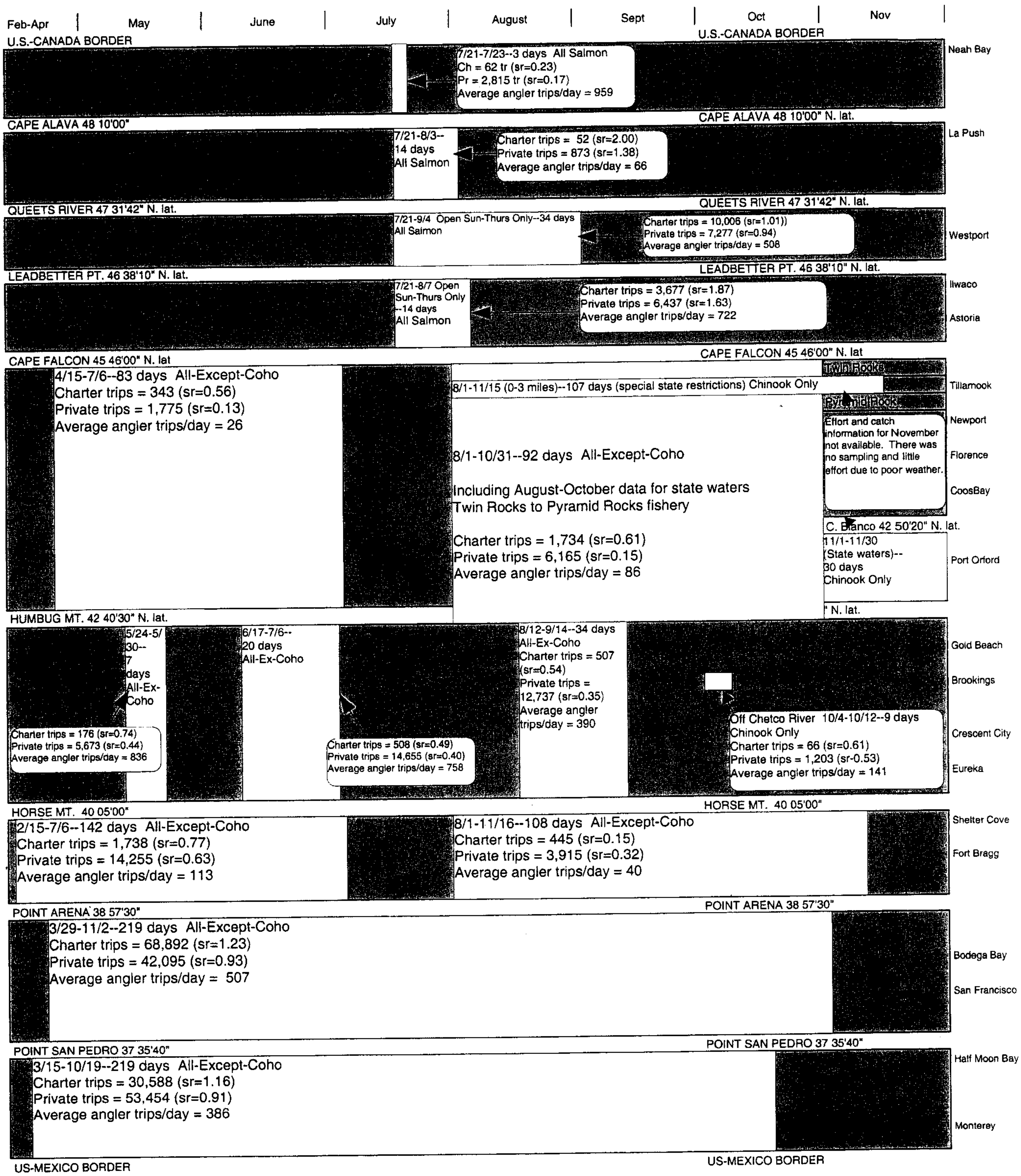


TABLE B-42. **California, Oregon, and Washington** ocean **recreational** salmon **effort** in thousands of angler trips and **catch** in thousands of fish by boat type.

Year or Average	Angler Trips		Chinook Catch[a]		Coho Catch[a]	
	Charter	Private	Charter	Private	Charter	Private
			WASHINGTON[f/g]			
1981-1990	77.8	64.7	29.3	11.9	95.7	73.3
1979	220.8	89.8	61.1	15.7	227.9	62.4
1980	193.9	86.2	41.1	12.5	288.4	73.1
1981	162.2	74.6	62.8	21.7	182.4	55.5
1982	131.9	86.8	85.8	21.0	124.0	82.5
1983	123.0	90.4	39.1	9.5	122.6	89.2
1984	29.9	46.8	7.7	7.4	38.5	49.6
1985	62.9	49.8	17.4	9.2	99.0	69.0
1986	58.1	51.4	13.3	7.9	98.0	77.7
1987	53.7	48.3	27.7	12.9	59.9	58.6
1988	32.4	37.1	11.2	7.8	46.1	43.7
1989	58.5	65.9	11.2	8.1	95.2	94.5
1990	65.0	94.4	16.6	13.0	90.9	113.6
1991	43.7	69.6	5.0	7.3	80.2	111.6
1992	38.2	56.8	11.8	6.6	48.5	62.6
1993	40.2	68.9	5.8	6.9	52.8	62.3
1994	-	-	-	-	-	-
1995	17.9	30.0	b/	0.4	26.1	37.4
1996	15.3	23.5	b/	0.2	24.5	24.4
1997[c]	12.5	15.1	1.7	2.3	12.5	12.8

a/ Catch numbers may include some illegal harvest.
b/ Less than 50 fish.
c/ Preliminary.
d/ Salmon data from surveyed ports only. These generally include Astoria, Garibaldi, Depoe Bay, Newport, Winchester Bay, Coos Bay, and Brookings. Since 1981, Pacific City and Florence have also been included. Gold Beach data are included from 1981-1987. Astoria was not included in 1994.
e/ Numbers do not include angling from the Columbia River jetty.
f/ Numbers do not include angling from the Columbia River jetty or from the late-season state waters Area 4B fishery.
g/ Values for 1982-1985 include some inriver Columbia River fishing after closure of the ocean fishery.

TABLE B-43. Numbers of recreational charter vessels by state.

Year	California (Charter Vessels Catching Salmon)			Oregon (All Charter Vessels)	Washington (Licensed Salmon Charter Vessels)
	Active[a/]	Casual	Total		
1980				194	510
1981				248	478
1982				253	415
1983				255	375
1984				218	334
1985				226	288
1986				247	308
1987	96	53	149	254	280
1988	95	71	166	313	281
1989	89	93	182	322	276
1990	93	67	160	170	273
1991	78	108	186	171	267
1992	49	91	140	157	269
1993	66	61	127	148	265
1994	60	42	102	145	260
1995	93	71	164	134	231
1996	75	51	126	127	210
1997	82	38	120	122	209

a/ Active vessels land over 100 salmon, casual vessels land 1 to 100 salmon.

TABLE B-44. Central California charter vessel targeting strategies[a/]

Target Fishing Strategy					# of Boat Trips Associated with each Target Species Combination				
Rockfish/ Lingcod	Salmon	Potluck	Other	# of boats	Rockfish/ Lingcod	Salmon	Potluck	Other	Total
x				1	-	-	-	-	-
	x			9	0	164	0	0	164
		x		0	0	0	0	0	0
			x	5	0	0	0	95	95
x	x			4	0	0	0	0	0
x		x		0	0	0	0	0	0
x			x	2	-	-	-	-	-
	x	x		3	-	-	-	-	-
	x		x	0	0	0	0	0	0
		x	x	5	0	0	214	176	390
x	x	x		4	14	313	26	0	354
x	x		x	28	1,299	1,824	0	277	3,400
x		x	x	1	-	-	-	-	-
	x	x	x	10	0	438	113	165	717
x	x	x	x	22	683	1,295	446	366	2,790
			Total	94	2,105	4,097	804	1,099	8,105
			Total For Salmon Vessels	80	1,996	4,034	585	808	7,425

a/ Based on data from 1995-1997 CPFV logbooks, provided courtesy of California Department of Fish and Game. The central California region is defined to include: Monterey, Santa Cruz, San Mateo, San Francisco, Marin, Sonoma, Solano, Alameda, and Contra Costa counties. Distribution of boat trips across target species combinations not provided when the number of boats associated with a given combination is less than or equal to three (denoted "–" in the table).

TABLE B-45. Northern California charter vessel targeting strategies.[a/]

Target Fishing Strategy				# of Boat Trips Associated with each Target Species Combination			
Rockfish/ Lingcod	Salmon	Other	# of boats	Rockfish/ Lingcod	Salmon	Other	Total
x			1	-	-	-	-
	x		1	-	-	-	-
		x	0	0	0	0	0
x	x		1	-	-	-	-
x		x	0	0	0	0	0
	x	x	0	0	0	0	0
x	x	x	10	328	282	88	698
		Total	13	352	303	95	751
Total For Salmon Vessels			12	328	282	88	698

a/ Based on data from 1995-1997 CPFV logbooks, provided courtesy of California Department of Fish and Game. The northern California region is defined to include: Mendocino, Humboldt, and Del Norte counties. Distribution of boat trips across target species combinations not provided when the number of boats associated with a given combination is less than or equal to three (denoted "–" in the table).

TABLE B-46. Oregon charter vessels targeting strategies by port, 1998 (ODFW Ocean Salmon Management Program).

Target Fishing Strategy					Number of Boats by Port										
Salmon	Bottomfish	Halibut	Tuna	#boats	Astoria[a]	Nehalem	Garibaldi	Pacific City	Depoe Bay	Newport	Winchester Bay	Coos Bay	Bandon	Gold Beach	Brookings
	X			14			1	1	8	1				3	
		X		4			2			2					
	X	X		8			6					1	1		
	X		X	2					2						
	X	X	X	9			2		6				1		
X				5	5										
X	X			17	6				1	2	1				7
X	X	X		10		1	2		2	5					
X	X		X	1	1										
X	X	X	X	13	1		1		1	9		1			
			Total:	83	13	1	14	1	20	19	1	2	2	3	7
			Total Salmon	46	13	1	3	0	4	16	1	1	0	0	7

a/ All 13 of the Astoria vessels also target sturgeon.

TABLE B-47. Washington charter vessels targeting strategies by port, 1995-1996 (Washington Ocean Sampling Program).

Target Fishing Strategy					Number of Boats by Port		
Salmon	Bottomfish	Halibut	Tuna	# boats	Ilwaco[a/]	Westport	Neah Bay
			x	1	0	1	0
		x		7			7
	x	x		4		1	3
x				11	8	3	
x			x	1	1		
x		x	x	1		1	
x	x			7	5	2	
x	x		x	3	1	2	
x	x	x		16	2	8	6
x	x	x	x	18	3	15	
			Total	69	20	33	16
			Total Salmon	57	20	31	6

a/ 14 of the 16 vessels in Ilwaco also target sturgeon.

TABLE B-48. Recreational trips (thousands) in two of the major inside marine water salmon fisheries on the West Coast.

	Puget Sound	Buoy-10
1985	882	n/a
1986	972	102
1987	1,180	125
1988	927	183
1989	1,027	148
1990	1,016	76
1991	924	169
1992	726	115
1993	809	76
1994	353	9
1995	514	25
1996	n/a	18
1997	n/a	56
Average	848	92

TABLE B-49. Salmon processors/buyers, by total volume purchased of all West Coast salmon species and by percent of total purchases comprised of ocean caught salmon, 1995-1997 average for known processors/buyers (West Coast commercial ocean troll Indian and non-Indian salmon).

Purchases (all species)	Ocean Salmon as a Percent of Purchases of All Species (1995 through 1997 Average) < 5%	5%-20%	20%-50%	50%-80%	80%-95%	>95%	Row Total	Cumulative Row Total
Number of Processors								
≤$10,000	21	29	31	37	20	102	240	240
$10,000-$150,000	40	19	33	12	6	7	117	357
$150,000-$500,000	12	8	8				28	385
$500,000-$3,000,000	25	8	3	1		1	38	423
>$3,000,000	11	7	1				19	442
Column Total	109	71	76	50	26	110	442	
Cumulative Column Total	109	180	256	306	332	442		
Percent of Total Number of Processors								
≤$10,000	4.8	6.6	7.0	8.4	4.5	23.1	54.3	54
$10,000-$150,000	9.0	4.3	7.5	2.7	1.4	1.6	26.5	81
$150,000-$500,000	2.7	1.8	1.8	0.0	0.0	0.0	6.3	87
$500,000-$3,000,000	5.7	1.8	0.7	0.2	0.0	0.2	8.6	96
>$3,000,000	2.5	1.6	0.2	0.0	0.0	0.0	4.3	100
Column Total	24.7	16.1	17.2	11.3	5.9	24.9	100.0	
Cumulative Column Total	24.7	40.7	57.9	69.2	75.1	100		
Exvessel Value of Purchases								
≤$10,000	3,199	16,357	45,226	87,226	51,797	192,054	395,858	395,858
$10,000-$150,000	42,824	121,803	715,268	237,167	209,100	149,093	1,475,256	1,871,114
$150,000-$500,000	92,601	392,301	684,284				1,169,186	3,040,300
$500,000-$3,000,000	255,116	991,753	1,422,760	277,930		853,023	3,800,582	6,840,882
>$3,000,000	2,136,973	3,657,614	961,111				6,755,699	13,596,580
Column Total	2,530,713	5,179,828	3,828,649	602,324	260,897	1,194,171	13,596,580	
Cumulative Colomn Total	2,530,713	7,710,541	11,539,189	12,141,513	12,402,410	13,596,580		
Salmon Purchases By Group as a Percent of Total Salmon Purchases								
≤$10,000	0.0	0.1	0.3	0.6	0.4	1.4	2.9	2.9
$10,000-$150,000	0.3	0.9	5.3	1.7	1.5	1.1	10.9	13.8
$150,000-$500,000	0.7	2.9	5.0	0.0	0.0	0.0	9	22.4
$500,000-$3,000,000	1.9	7.3	10.5	2.0	0.0	6.3	28	50.3
>$3,000,000	15.7	26.9	7.1	0.0	0.0	0.0	50	100.0
Column Total	18.6	38.1	28.2	4.4	1.9	8.8	100	
Cumulative Column Total	18.6	56.7	84.9	89.3	91.2	100.0		

TABLE B-50. Number of salmon processors/buyers and purchases by processor/buyer rank (based on value of ocean caught salmon purchases) and grouped by level of ocean caught salmon purchases, 1995 through 1997 average for known processors/buyers (West Coast commercial ocean troll Indian and non-Indian salmon).

Processor/Buyer Percentile Rank	Total Ocean Caught Salmon Purchases (1995 through 1997) ≤$1,000	$1,000-10,000	$10,000-100,000	$>100,000	Row Total	Cumulative Row Total
Number of Processors/Buyers						
≤50	160	61			221	221
50-80		110	22		132	353
80-90			44		44	397
90-95			18	4	22	419
95-100				23	23	442
Column Total	160	171	84	27	442	
Cumulative Column Total	160	331	415	442		
Percent of Total Processors						
≤50	36.2	13.8			50.0	50.0
50-80		24.9	5.0		29.9	79.9
80-90			10.0		10.0	89.8
90-95			4.1	0.9	5.0	94.8
95-100				5.2	5.2	100.0
Column Total	36.2	38.7	19.0	6.1	100.0	
Cumulative Column Total	36.2	74.9	93.9	100.0		
Exvessel Value of Salmon Purchases ($)						
≤50	56,370	91,638			148,008	148,008
50-80		477,491	255,808		733,299	881,306
80-90			1,051,286		1,051,286	1,932,593
90-95			1,171,845	499,840	1,671,684	3,604,277
95-100				9,992,304	9,992,304	13,596,580
Column Total	56,370	569,128	2,478,939	10,492,143	13,596,580	
Cumulative Column Total	56,370	625,498	3,104,437	13,596,580		
Salmon Purchases By Group as a Percent of Total Salmon Purchases						
≤50	0.4	0.7			1.1	1.1
50-80		3.5	1.9		5.4	6.5
80-90			7.7		7.7	14.2
90-95			8.6	3.7	12.3	26.5
95-100				73.0	73.0	100.0
Column Total	0.4	4.2	17.7	77.7	100.0	
Cumulative Column Total	0.4	4.6	22.3	100.0		

TABLE B-51. Number of state licensed buyers and processors receiving fish landed on the West Coast.

Purchases (All West Coast Species)	Number of Buyers and Processors Handling: All Species	Number of Buyers and Processors Handling: Ocean Caught Salmon	Percent Handling Ocean Caught Salmon
<$10,000	1,101	240	21.8
$10,000-$150,000	557	117	21.0
$150,000-$500,000	123	28	22.8
$500,000-$3,000,000	122	38	31.1
>$3,000,000	24	19	79.2
Column Total	1,927	442	22.3

TABLE B-52. Numbers of processors/buyers and purchases, by processor/buyer rank (based on value of ocean-caught salmon purchases) and by number of vessels from which deliveries are received, 1995 through 1997 average for known processors/buyers (West Coast commercial ocean troll Indian and non-Indian salmon).

Processor/Buyer Percentile Rank	Number of Vessels from Which Deliveries are Received (1995 through 1997 Average) 1-2	>2-8	>8-16	>16-64	>64	Row Total	Cum Row Tot
				Number of Processor/Buyers			
≤50	197	17				214	214
50-80	69	45	16			130	344
80-90	5	15	11	10		41	385
90-95		2	3	17		22	407
95-100				6	17	23	430
Column Total	271	79	30	33	17	430	
Cumulative Column Total	271	350	380	413	430		
				Percent of Processors/Buyers			
≤50	45.8	4.0				49.8	49.8
50-80	16.0	10.5	3.7			30.2	80.0
80-90	1.2	3.5	2.6	2.3		9.5	89.5
90-95		0.5	0.7	4.0		5.1	94.7
95-100				1.4	4.0	5.3	100.0
Column Total	63.0	18.4	7.0	7.7	4.0	100.0	
Cumulative Column Total	63.0	81.4	88.4	96.0	100.0		
				Exvessel Value of Salmon Purchases ($)			
≤50	124,156	21,990				146,146	146,146
50-80	302,431	286,572	138,735			727,738	873,883
80-90	124,847	316,500	268,328	256,688		966,362	1,840,245
90-95		132,189	176,151	1,363,344		1,671,684	3,511,929
95-100				1,214,885	8,777,418	9,992,304	13,504,233
Column Total	551,433	757,251	583,213	2,834,917	8,777,418	13,504,233	
Cumulative Column Total	551,433	1,308,684	1,891,897	4,726,815	13,504,233		
				Salmon Purchases By Group as a Percent of Total Salmon Purchases			
≤50	0.9	0.2	0.0	0.0	0.0	1.1	1.1
50-80	2.2	2.1	1.0	0.0	0.0	5.4	6.5
80-90	0.9	2.3	2.0	1.9	0.0	7.2	13.6
90-95	0.0	1.0	1.3	10.1	0.0	12.4	26.0
95-100	0.0	0.0	0.0	9.0	65.0	74.0	100.0
Column Total	5.6	4.3	21.0	65.0	100.0	100.0	
Cumulative Column Total	9.7	14.0	35.0	100.0			
				Average Salmon Purchases Per Processor/Buyer			
						Row Average (Weighted)	
≤50	630	1,294				683	
50-80	4,383	6,368	8,671			5,598	
80-90	24,969	21,100	24,393	25,669		23,570	
90-95		66,095	58,717	80,197		75,986	
95-100				202,481	516,319	434,448	
Column Average (Weighted)	2,035	9,585	19,440	85,907	516,319		

TABLE B-53. Numbers of processors/buyers and salmon purchases, by processor rank (based on value of ocean-caught salmon purchases) and by number of processing/buying sites (all species), 1995 through 1997 average for known processors/buyers (West Coast commercial ocean troll Indian and non-Indian salmon).

Processor/Buyer Percentile Rank	Number of Processing/Buying Sites (1995 through 1997 Average) 1	>1-2	>2-4	>4-8	>8	Row Total	Cumulative Row Total
				Number of Processors/Buyers			
≤50	142	51	12	12	4	221	221
50-80	54	37	29	9	3	132	353
80-90	9	8	18	6	3	44	397
90-95	2	2	10	7	1	22	419
95-100	1	2	7	6	7	23	442
Column Total	208	100	76	40	18	442	
Cumulative Column Total	208	308	384	424	442		
				Percent of Total Processors/Buyers			
≤50	32.1	11.5	2.7	2.7	0.9	50.0	50.0
50-80	12.2	8.4	6.6	2.0	0.7	29.9	79.9
80-90	2.0	1.8	4.1	1.4	0.7	10.0	89.8
90-95	0.5	0.5	2.3	1.6	0.2	5.0	94.8
95-100	0.2	0.5	1.6	1.4	1.6	5.2	100.0
Column Total	47.1	22.6	17.2	9.0	4.1	100.0	
Cumulative Column Total	47.1	69.7	86.9	95.9	100.0		
				Exvessel Value of Salmon Purchases ($)			
≤50	80,444	45,712	10,042	8,157	3,652	148,008	148,008
50-80	271,495	208,508	164,723	66,923	21,650	733,299	881,306
80-90	235,996	154,627	438,902	133,082	88,680	1,051,286	1,932,593
90-95	123,874	110,870	773,266	544,888	118,787	1,671,684	3,604,277
95-100	140,628	596,134	1,983,398	3,820,828	3,451,316	9,992,304	13,596,580
Column Total	852,436	1,115,852	3,370,331	4,573,877	3,684,084	13,596,580	
Cumulative Column Total	852,436	1,968,288	5,338,619	9,912,496	13,596,580		
				Salmon Purchases By Group as a Percent of Total Salmon Purchases			
≤50	0.6	0.3	0.1	0.1	0.0	1.1	1.1
50-80	2.0	1.5	1.2	0.5	0.2	5.4	6.5
80-90	1.7	1.1	3.2	1.0	0.7	7.7	14.2
90-95	0.9	0.8	5.7	4.0	0.9	12.3	26.5
95-100	1.0	4.4	14.6	28.1	25.4	73.5	100.0
Column Total	6.3	8.2	24.8	33.6	27.1	100.0	
Cumulative Column Total	6.3	14.5	39.3	72.9	100.0		

TABLE B-54. Numbers of processors/buyers and salmon purchases, by number of vessels from which ocean-caught salmon are received and by number of processing/buying sites (all species), 1995 through 1997 average for known processors/buyers (West Coast commercial ocean troll Indian and non-Indian salmon).

Number of Vessels from Which Deliveries are Received	Processor/Buyer Number of Processing/Buying Sites (1995 through 1997 Average).						
	1	>1-2	>2-4	>4-8	>8	Row Total	Cumulative Row Total
			Number of Processors/Buyers				
1-2	174	59	22	12	4	271	271
>2-8	15	28	22	11	3	79	350
>8-16	8	5	10	4	3	30	380
>16-64	2	4	19	7	1	33	413
>64		1	3	6	7	17	430
Column Total	199	97	76	40	18	430	
Cumulative Column Total	199	296	372	412	430		
			Percent of Total Processors/Buyers				
1-2	40.5	13.7	5.1	2.8	0.9	63.0	63.0
>2-8	3.5	6.5	5.1	2.6	0.7	18.4	81.4
>8-16	1.9	1.2	2.3	0.9	0.7	7.0	88.4
>16-64	0.5	0.9	4.4	1.6	0.2	7.7	96.0
>64	0.0	0.2	0.7	1.4	1.6	4.0	100.0
Column Total	46.3	22.6	17.7	9.3	4.2	100.0	
Cumulative Column Total	46.3	68.8	86.5	95.8	100.0		
			Exvessel Value of Salmon Purchases ($)				
1-2	343,921	117,106	77,864	8,891	3,652	551,433	551,433
>2-8	103,479	206,721	307,713	117,689	21,650	757,251	1,308,684
>8-16	130,946	43,495	174,753	145,340	88,680	583,213	1,891,897
>16-64	206,984	279,206	1,748,811	481,130	118,787	2,834,917	4,726,815
>64		444,084	1,061,190	3,820,828	3,451,316	8,777,418	13,504,233
Column Total	785,330	1,090,611	3,370,331	4,573,877	3,684,084	13,504,233	
Cumulative Column Total	785,330	1,875,941	5,246,271	9,820,149	13,504,233		
			Salmon Purchases By Group as a Percent of Total Salmon Purchases				
1-2	2.5	0.9	0.6	0.1	0.0	4.1	4.1
>2-8	0.8	1.5	2.3	0.9	0.2	5.6	9.7
>8-16	1.0	0.3	1.3	1.1	0.7	4.3	14.0
>16-64	1.5	2.1	13.0	3.6	0.9	21.0	35.0
>64	0.0	3.3	7.9	28.3	25.6	65.0	100.0
Column Total	5.8	8.1	25.0	33.9	27.3	100.0	
Cumulative Column Total	5.8	13.9	38.8	72.7	100.0		
			Average Salmon Purchases Per Processor/Buyer				
						Row Average (Wtd)	
1-2	1,977	1,985	3,539	741	913	2,035	
>2-8	6,899	7,383	13,987	10,699	7,217	9,585	
>8-16	16,368	8,699	17,475	36,335	29,560	19,440	
>16-64	103,492	69,801	92,043	68,733	118,787	85,907	
>64		444,084	353,730	636,805	493,045	516,319	
Column Average (Wtd)	3,946	11,243	44,346	114,347	204,671	31,405	

TABLE B-55. West Coast ports with more than $10,000 exvessel value of salmon landings for a three-year period (1995-1997) for all areas of catch.

Washington		Oregon		California	
Port	County	Port	County	Port	County
Blaine	Whatcom	Columbia River	Oregon Upriver Counties	Cresent City	Del Norte
Bellingham	Whatcom	Astoria	Clatsop	Fields Landing	Humboldt
Point Roberts	Whatcom	Garibaldi (Tillamook)	Tillamook	Eureka	Humboldt
Friday Harbor	San Juan	Pacific City	Tillamook	Trinidad	Humboldt
Anacortes	Skagit	Depoe Bay	Lincoln	Shelter Cove	Humboldt
LaConner	Skagit	Newport	Lincoln	Fort Bragg	Mendocino
Whidbey Island	Island	Florence	Lane	Albion	Mendocino
Everett	Snohomish	Winchester	Douglas	Point Arena	Mendocino
Seattle	King	Charleston (Coos Bay)	Coos	Bodega Bay	Sonoma
Tacoma	Pierce	Bandon	Coos	Jenner	Sonoma
Olympia	Thurston	Port Orford	Curry	Dillon Beach	Marin
Shelton	Mason	Brookings	Curry	Bolinas	Marin
Port Townsend	Jefferson			Sausilito	Marin
Queets	Jefferson			San Francisco	San Francisco
Poulsbo	Kitsap			Berkeley	Alameda
Bremmerton	Kitsap			Richmond	Contra Costa
Port Angeles	Clallam			Princeton	San Mateo
Neah Bay	Clallam			Pigeon Point	San Mateo
La Push	Clallam			Santa Cruz	Santa Cruz
Taholah	Grays Harbor			Monterey	Monterey
Aberdeen	Grays Harbor			Moss Landing	Monterey
Hoquiam	Grays Harbor			Morro Bay	San Luis Obispo
Westport	Grays Harbor			Avila	San Luis Obispo
Grayland	Grays Harbor			Santa Barbara	Santa Barbara
Tokeland	Pacific			Ventura	Ventura
Raymond	Pacific			San Pedro	Los Angeles
South Bend	Pacific				
Bay Center	Pacific				
Naselle	Pacific				
Long Beach	Pacific				
Ilwaco	Pacific				
Chinook	Pacific				
Cathlamet	Wahkiakum				
Skamania	Skamania				
The Dalles	Klickitat				

TABLE B-56. Numbers of nonIndian vessels landing, total non-Indian revenue and non-Indian ocean salmon revenue by county, for vessels with valid identification numbers.[a]

		Vessels Landing						Primary Port[b] Vessels Based on						Exvessel Revenue ($ thousands)					
		All Vessels			Salmon Vessels			All Species			Ocean Salmon			All Species			Salmon[c]		
Region	County	1988	1989	1997	1988	1989	1997	1988	1989	1997	1988	1989	1997	1988	1989	1997	1988	1989	1997
St. of Geo.	Whatcom	1,496	1,436	806	1	25	0	804	762	563	0	19	0	23,513	24,256	18,178	conf	89	0
San Juan	San Juan	322	197	23	11	2	0	78	59	3	2	1	0	1,311	758	42	20	conf	0
	Skagit	1,078	856	276	38	3	0	350	312	136	17	2	0	5,887	5,718	2,799	364	conf	0
Metro Puget	Snohomish	806	790	173	178	166	0	189	219	64	52	73	0	5,501	5,948	1,461	115	54	0
Sound	King	1,516	1,186	318	180	50	2	558	493	127	48	22	2	11,015	9,822	8,103	416	73	conf
	Pierce	223	267	142	6	14	0	85	106	60	1	10	0	1,363	1,765	1,835	conf	3	0
South Puget	Thurston	36	27	5	17	6	0	10	13	2	2	5	0	23	24	conf	8	conf	0
Sound	Mason	44	75	7	0	1	0	20	12	4	0	1	0	62	75	38	0	conf	0
NE Olympic &	Jefferson	308	307	90	19	14	0	92	74	40	12	6	0	1,328	1,416	1,779	141	61	0
NW Olympic	Clallam	842	993	272	162	271	25	341	536	145	77	203	20	3,795	4,535	3,451	413	314	48
Central WA	Grays Harbor	776	803	369	351	457	26	371	521	258	175	334	23	20,943	16,780	20,456	662	651	70
WA S. Coast &	Pacific	1,000	887	342	224	194	0	604	622	253	81	125	0	25,366	18,704	9,863	200	156	0
OR Col. Upriver	Not Identified	700	536	192	0	0	0	483	395	158	0	0	0	13,560	3,300	558	0	0	0
Astoria-	Clatsop	295	374	246	91	185	5	131	162	155	32	63	2	17,559	19,626	22,489	137	261	conf
Tillamook	Tillamook	587	593	132	542	547	69	409	385	106	402	365	58	5,897	3,989	1,603	2,864	1,281	61
Newport	Lincoln	975	890	417	758	711	212	640	519	286	532	419	180	25,195	19,319	21,238	7,201	2,369	1,645
Coos Bay	Lane	245	215	45	227	202	34	96	82	28	98	80	26	2,196	1,004	798	1,252	377	139
	Douglas	362	397	55	332	369	34	237	226	36	221	214	22	2,881	2,018	1,041	1,498	917	41
	Coos	925	909	219	829	771	104	458	506	137	455	497	80	18,674	16,563	12,134	6,625	3,721	436
Brookings	Curry	471	464	226	382	358	63	184	205	155	129	138	40	6,885	9,679	8,895	2,034	1,110	140
Cresc. City	Del Norte	401	390	275	127	148	5	214	231	175	31	60	0	15,824	13,143	14,274	559	294	conf
Eureka	Humboldt	460	420	259	329	281	28	212	213	181	100	100	20	12,774	8,819	14,271	1,774	557	29
Fort Bragg	Mendocino	1,059	1,016	303	842	777	57	666	607	201	583	508	32	22,825	13,544	11,538	10,713	2,719	92
San Fran	Sonoma	1,033	935	371	877	784	199	565	493	211	527	430	110	15,674	6,973	5,801	10,468	2,176	734
	Marin	426	357	144	274	234	58	164	111	52	118	87	31	4,281	1,610	3,064	2,322	612	329
	San Fran	656	679	421	261	318	132	307	325	269	108	115	73	9,263	8,377	19,737	1,894	865	1,089
	Alameda	227	276	156	127	154	48	112	158	73	82	101	23	3,076	3,133	2,068	1,598	674	75
	San Mateo	610	740	411	497	620	270	302	331	226	246	292	175	7,194	5,010	6,427	4,295	2,079	1,772
	Marin	426	357	144	274	234	58	164	111	52	118	87	31	4,281	1,610	3,064	2,322	612	329
Monterey	Monterey	564	574	559	377	397	297	387	391	328	281	304	220	9,340	8,207	14,564	3,315	1,626	2,006
	Santa Cruz	304	376	188	247	299	131	132	171	85	107	139	56	3,079	1,942	1,619	2,002	799	594
S.L. Obispo	S.L. Obispo	445	441	426	222	214	134	255	301	275	131	161	81	8,213	7,467	6,783	1,488	746	533
S. Barbara	S. Barbara	307	351	308	15	12	15	194	223	206	5	6	9	5,691	8,759	8,778	27	46	20
	Ventura	315	404	317	9	4	4	168	219	194	0	2	2	13,390	12,562	21,679	conf	conf	conf
Los Angeles	Los Angeles	587	538	444	0	4	1	390	383	289	0	1	0	59,130	44,442	32,084	0	conf	conf
	Orange	110	107	94	2	3	2	69	75	67	1	2	2	1,118	1,286	1,887	conf	conf	conf
San Diego	San Diego	375	376	236	6	6	0	275	287	170	0	2	0	6,982	9,565	6,456	conf	conf	0
Inland Californ	Not Identified	245	210	25	221	188	1	120	103	14	116	97	0	1,525	599	122	1,436	519	conf
Total								10,836	10,942	5,784	4,890	5,071	1,318	396,612	322,346	310,981	68,192	25,808	10,200
Total Confidential Exvessel Value Excluded														0	0	6	29	45	19

a/ Revenue is not reported where less than 10 vessels made landings in a county, indicated as "conf". Total of landings exvessel value with held for individual counties is reported at the end of the table.

b/ The primary port is the port where a majority of the value of all landings were made. Primary ports were assigned based on all species and on ocean caught salmon landings of chinook, pink and coho salmon.

c/ Ocean caught, chinook, coho and pink salmon only.

TABLE B-57. Estimates of **California recreational** ocean salmon angler **trips** by port area and boat type. (Page 1 of 2)

Year	Crescent City	Eureka	Fort Bragg	San Francisco	Monterey	State Total
			CHARTER TRIPS (thousands)			
1976	0.8	2.2	4.1	66.2	7.9	81.2
1977	1.0	1.2	1.7	72.0	4.8	80.7
1978	2.4	1.3	0.9	47.3	1.3	53.2
1979	2.2	0.7	3.3	69.6	3.1	79.0
1980	1.4	0.6	2.0	62.4	2.9	69.3
1981	0.6	0.5	1.3	56.1	2.7	61.1
1982	0.5	0.4	2.4	72.2	4.4	79.9
1983	0.5	1.4	1.6	50.8	2.7	56.9
1984	0.5	0.9	1.4	56.8	1.9	61.5
1985	1.6	3.5	2.3	74.6	3.2	85.1
1986	1.1	2.8	2.8	69.6	10.1	86.4
1987	1.5	3.8	4.6	82.9	12.3	105.0
1988	0.9	2.5	5.6	81.1	11.7	101.7
1989	0.6	5.4	4.5	83.5	14.0	108.0
1990	0.8	3.2	2.7	54.3	17.4	78.4
1991	1.0	2.1	5.4	43.7	17.0	69.2
1992	0.1	0.2	1.5	38.6	7.3	47.7
1993	0.4	1.0	2.0	53.2	9.4	66.0
1994	0.2	0.2	1.3	63.9	7.2	72.8
1995	0.1	0.7	3.8	79.2	68.9	152.9
1996	a/	0.6	5.0	57.6	21.4	84.6
1997 b/	a/	0.8	2.2	68.9	30.6	102.4
			PRIVATE TRIPS (thousands)			
1976	27.9	28.2	13.0	30.5	6.3	106.0
1977	21.8	25.5	14.0	34.2	5.1	100.7
1978	15.0	19.8	8.5	48.7	5.4	97.5
1979	9.6	17.3	6.5	34.7	6.7	74.8
1980	17.8	22.5	4.4	23.7	6.7	75.1
1981	13.4	15.8	6.8	19.0	5.7	60.8
1982	24.6	22.3	8.0	28.7	7.7	91.4
1983	21.2	21.5	6.8	9.5	6.8	65.8
1984	23.3	17.9	4.6	8.2	11.4	65.5
1985	29.5	31.4	12.6	18.7	14.6	106.8
1986	24.5	26.1	10.4	22.1	26.1	109.2
1987	50.6	42.4	9.4	25.5	35.4	163.3
1988	43.0	30.3	12.2	27.0	28.2	140.7
1989	33.0	37.7	13.0	11.5	41.7	137.0
1990	41.9	35.4	11.9	35.4	49.0	173.7
1991	24.5	25.3	17.2	26.5	33.8	127.4
1992	9.0	8.9	9.7	23.4	29.1	80.2
1993	15.0	17.3	17.4	29.6	29.7	108.9
1994	9.4	6.3	18.1	43.7	39.6	117.1
1995	11.8	12.0	25.4	62.2	114.2	225.6
1996	11.3	13.6	26.2	46.6	43.2	140.9
1997 b/	6.6	11.6	18.2	42.1	53.5	131.9

TABLE B-57. Estimates of **California recreational** ocean salmon angler **trips** by port area and boat type. (Page 2 of 2)

Year	Crescent City	Eureka	Fort Bragg	San Francisco	Monterey	State Total
			TOTAL TRIPS (thousands)			
1976	28.7	30.5	17.0	96.8	14.2	187.2
1977	22.8	26.7	15.7	106.2	9.9	181.3
1978	17.4	21.2	9.5	96.1	6.6	150.7
1979	11.7	18.0	9.8	104.3	9.9	153.7
1980	19.2	23.1	6.4	86.1	9.6	144.4
1981	14.1	16.3	8.1	75.1	8.4	122.0
1982	25.1	22.8	10.4	100.9	12.1	171.3
1983	21.7	22.8	8.4	60.3	9.5	122.7
1984	23.8	18.8	6.0	65.0	13.3	127.0
1985	31.0	34.9	15.0	93.3	17.8	191.9
1986	25.6	28.9	13.2	91.7	36.2	195.6
1987	52.1	46.1	14.0	108.4	47.7	268.3
1988	43.9	32.8	17.8	108.1	39.9	242.4
1989	33.6	43.0	17.5	95.0	55.7	244.9
1990	42.7	38.7	14.6	89.7	66.5	252.1
1991	25.6	27.4	22.6	70.2	50.8	196.6
1992	9.1	9.1	11.2	62.0	36.4	127.9
1993	15.4	18.3	19.3	82.8	39.1	174.9
1994	9.7	6.4	19.4	107.6	46.8	189.9
1995	11.9	12.8	29.3	141.5	183.1	378.5
1996	11.3	14.2	31.3	104.2	64.5	225.4
1997[b/]	6.6	12.4	20.4	111.0	84.0	234.3

a/ Less than 50.
b/ Preliminary.

TABLE B-58. Estimates of **Oregon recreational** ocean salmon angler **trips** by port area and boat type. (Page 1 of 2)

Year	Astoria	Tillamook	Newport	Coos Bay	Brookings	State Total
			CHARTER TRIPS (thousands)			
1979	18.5	2.8	26.7	22.7	3.0	73.7
1980	26.3	3.7	26.7	19.6	2.8	79.1
1981	16.0	3.1	25.5	17.6	3.2	65.4
1982	11.8	2.1	14.6	11.4	3.4	43.3
1983	12.9	1.8	11.5	12.1	3.6	41.9
1984	2.7	2.5	11.1	5.9	2.1	24.3
1985	8.3	5.3	23.1	12.5	4.2	53.4
1986	7.7	3.0	20.0	9.6	3.4	43.7
1987	8.0	5.5	28.4	14.4	4.6	60.9
1988	2.4	7.3	34.2	15.6	3.0	62.5
1989	9.1	5.2	28.3	13.1	4.4	60.2
1990	8.5	5.5	26.6	12.2	2.5	55.3
1991	8.1	2.5	19.2	8.4	2.1	40.3
1992	4.6	2.7	14.8	7.4	0.5	30.0
1993	5.8	0.5	4.7	1.8	0.6	13.4
1994	0.0[a/]	1.2	b/	b/	0.2	1.4
1995	2.5	1.2	0.6	b/	0.3	4.6
1996	1.9	0.8	2.1	0.1	0.6	5.6
1997[c/]	1.3	0.3	1.8	0.0	0.5	3.9
			PRIVATE TRIPS (thousands)			
1979	24.3	16.3	45.4	52.9	48.8	187.7
1980	20.1	29.3	56.6	65.2	47.7	218.9
1981	28.7	34.9	51.8	66.3	64.0	245.8
1982	15.4	22.5	38.8	47.9	58.0	182.7
1983	18.0	23.5	31.0	59.6	52.1	184.1
1984	4.4	21.3	32.8	34.3	35.9	128.7
1985	11.7	33.2	47.4	51.0	54.8	198.2
1986	12.8	15.0	32.2	34.0	49.3	143.3
1987	9.1	23.6	48.6	48.1	64.8	194.2
1988	3.2	26.0	55.5	53.5	50.0	188.2
1989	10.7	26.1	54.4	53.5	61.3	206.1
1990	17.0	28.0	44.8	52.8	48.6	191.2
1991	13.6	18.5	34.0	49.3	34.4	149.7
1992	8.3	23.4	38.3	48.2	17.2	135.4
1993	12.7	5.1	12.4	13.6	23.2	66.9
1994	0.0[a/]	9.1	0.1	0.4	16.0	25.5
1995	7.2	3.9	0.4	0.7	19.1	31.2
1996	3.7	7.5	0.6	3.8	22.7	38.3
1997[c/]	2.3	3.4	0.6	3.9	16.1	26.4

TABLE B-58. Estimates of **Oregon recreational** ocean salmon angler **trips** by port area and boat type. (Page 2 of 2)

Year	Astoria	Tillamook	Newport	Coos Bay	Brookings	State Total
			TOTAL TRIPS (thousands)			
1979	43.3	31.0	72.4	94.7	60.0	301.3
1980	46.3	47.8	83.9	97.4	56.0	331.4
1981	44.7	38.0	77.3	83.9	67.1	311.0
1982	27.2	24.6	53.5	59.4	61.4	226.0
1983	30.9	25.3	42.6	71.6	55.7	226.0
1984	8.3	25.0	41.5	40.2	38.0	153.1
1985	20.0	38.6	70.6	63.5	59.0	251.6
1986	20.5	17.9	52.2	43.6	52.7	187.0
1987	17.1	29.1	76.9	62.6	69.4	255.1
1988	5.7	33.3	89.6	69.0	53.1	250.7
1989	19.8	31.3	82.8	66.6	65.8	266.3
1990	25.5	33.5	71.4	65.0	51.1	246.6
1991	21.7	21.0	53.3	57.7	36.4	190.1
1992	12.9	26.1	53.1	55.6	17.7	165.3
1993	17.8	5.6	17.1	15.3	23.8	79.6
1994	0.0[a/]	10.3	0.1	0.4	16.2	26.9
1995	9.6	5.1	0.9	0.7	19.4	35.8
1996	5.6	8.3	2.8	3.9	23.3	44.0
1997[c/]	3.6	3.7	2.4	3.9	16.6	30.2

a/ The fishery north of Cape Falcon was closed and it is assumed that no trips were taken out of Astoria to the south of Cape Falcon area. No samplers were stationed in Astoria.

b/ Less than 50.

c/ Preliminary.

TABLE B-59. Estimates of **Washington recreational** ocean salmon angler **trips** by port area.

Year	Neah Bay[a]	La Push	Westport	Ilwaco[b]	Coastal Area Total
		CHARTER TRIPS (thousands)			
1984[c]	0.3	0.0	11.6	18.0	29.9
1985[c]	2.0	0.0	42.2	20.7	62.9
1986	2.4	0.0	36.6	19.1	58.1
1987	1.9	0.0	34.1	17.7	53.7
1988	2.0	0.0	23.5	6.9	32.4
1989	1.5	0.0	40.8	16.2	58.5
1990	2.1	0.0	43.4	19.5	65.0
1991	1.4	0.2	28.6	13.5	43.7
1992	0.7	0.2	28.1	9.2	38.2
1993	1.0	0.1	27.4	11.7	40.2
1994	-	-	-	-	-
1995	0.2	0.1	12.7	5.0	17.9
1996	0.2	d/	10.3	4.8	15.3
1997[e]	0.1	0.1	10.0	2.4	12.5
		PRIVATE TRIPS (thousands)			
1984[c]	8.3	0.2	2.3	36.0	46.8
1985[c]	15.2	1.5	13.7	19.4	49.8
1986	17.4	1.7	14.8	17.5	51.4
1987	17.9	2.0	9.8	18.6	48.3
1988	14.8	2.8	13.9	5.6	37.1
1989	15.0	1.6	18.7	30.6	65.9
1990	19.5	4.2	25.9	44.8	94.4
1991	14.8	3.3	24.2	27.3	69.6
1992	11.0	2.3	25.6	17.9	56.8
1993	18.4	2.8	23.5	24.2	68.9
1994	-	-	-	-	-
1995	5.3	1.4	9.0	14.2	30.0
1996	9.1	1.3	5.2	7.9	23.5
1997[e]	2.8	0.9	7.3	4.1	15.1
		TOTAL TRIPS (thousands)			
1984[c]	8.6	0.2	13.9	54.0	76.7
1985[c]	17.2	1.5	55.9	40.1	114.7
1986	19.8	1.7	51.4	36.6	109.5
1987	19.8	2.0	43.9	36.3	102.0
1988	16.8	2.8	37.4	12.5	69.5
1989	16.5	1.6	59.5	46.8	124.4
1990	21.6	4.2	69.3	64.3	159.4
1991	16.2	3.5	52.8	40.8	113.3
1992	11.7	2.5	53.7	27.1	95.0
1993	19.4	2.9	50.9	35.9	109.1
1994	-	-	-	-	-
1995	5.5	1.5	21.7	19.2	47.9
1996	9.3	1.3	15.5	12.7	38.8
1997[e]	2.9	0.9	17.3	6.5	27.6

a/ Does not include effort from the late-season state-water Area 4B fishery.
b/ Does not include effort from the Columbia River Jetty.
c/ Values for 1984 and 1985 include some Columbia River fishing after closure of the ocean fishery.
d/ Less than 50.
e/ Preliminary.

TABLE B-60. Estimates of **California coastal community and state personal income** impacts[a/] of the troll and recreational ocean salmon fishery for major port areas.

Year or Average	Crescent City	Eureka	Fort Bragg	San Francisco	Monterey	Coastal Community Total[b/]	State Total
			OCEAN TROLL (thousands of dollars)[c/]				
1976-1980	5,495	13,882	13,561	17,795	7,732	58,465	75,063
1981-1985	2,696	3,252	7,592	14,337	4,887	32,763	40,793
1986	771	2,146	9,831	16,247	10,424	39,421	49,730
1987	2,289	4,495	18,815	29,413	7,268	62,281	76,645
1988	1,203	3,793	26,102	53,100	14,945	99,143	120,355
1989	623	1,148	6,915	15,646	6,915	31,247	38,374
1990	111	782	4,098	13,202	8,147	26,341	32,073
1991	17	421	2,365	11,074	5,620	19,497	23,594
1992	2	3	100	6,160	3,166	9,432	11,174
1993	7	43	858	6,565	4,330	11,803	14,341
1994	0	25	317	9,931	3,253	13,527	15,997
1995	11	26	276	11,315	10,300	21,927	26,853
1996	9	381	685	4,921	5,743	11,739	14,749
1997[d/]	3	48	163	8,582	6,347	15,142	18,533
			RECREATIONAL (thousands of dollars)				
1976-1980	1,013	1,174	684	10,278	688	13,838	15,522
1981-1985	1,109	1,143	548	9,102	727	12,630	14,216
1986	1,243	1,502	782	10,385	2,227	16,138	18,535
1987	2,487	2,353	921	12,325	2,872	20,958	24,421
1988	2,072	1,661	1,153	12,172	2,488	19,546	22,570
1989	1,583	2,304	1,081	11,618	3,336	19,922	23,190
1990	2,014	1,974	840	9,122	4,023	17,973	21,456
1991	1,241	1,391	1,368	7,230	3,295	14,525	17,329
1992	421	432	608	6,389	2,066	9,917	11,472
1993	733	903	1,014	8,656	2,315	13,622	15,740
1994	454	311	972	10,856	2,529	15,123	17,174
1995	559	632	1,579	13,916	12,326	29,011	34,804
1996	521	686	1,746	10,190	4,170	17,313	20,252
1997[d/]	304	619	1,072	11,423	5,599	19,018	22,138

a/ Expressed in 1997 dollars. Per pound and per day estimates of income impacts provided from output of the Fishery Economic Assessment Model. These are the income impacts associated with expenditures in the troll or recreational sectors. There is no differentiation between money new to the area and money which would otherwise have been expended in other sectors.

b/ Income impacts on the coastal economy. Totals do not include impacts of one coastal community on another.

c/ Excluding pink salmon.

d/ Preliminary.

TABLE B-61. Estimates of **Oregon coastal community and state personal income** impacts of the troll and recreational ocean salmon fishery for major port areas.[a/]

Year or Average	Astoria	Tillamook	Newport	Coos Bay	Brookings[b/]	Coastal Community Total[c/]	State Total
			OCEAN TROLL (thousands of dollars)[d/]				
1976-1980	3,438	4,426	10,377	15,968	6,636	40,845	55,384
1981-1985	1,105	1,426	3,336	5,871	2,556	14,293	19,425
1986	598	1,568	5,308	8,692	1,822	17,989	24,368
1987	707	3,534	7,037	19,063	3,800	34,142	46,107
1988	306	5,470	13,620	18,279	3,529	41,205	55,469
1989	544	2,615	4,686	9,746	1,936	19,526	26,408
1990	361	1,481	2,014	7,157	846	11,859	15,998
1991	194	1,383	2,001	2,241	89	5,908	7,980
1992	91	561	2,984	992	27	4,656	6,279
1993	39	331	1,659	663	97	2,788	3,738
1994	1	124	615	175	180	1,094	1,499
1995	21	293	3,725	1,274	150	5,462	7,352
1996	55	350	3,112	1,055	372	4,944	6,712
1997[e/]	9	96	2,665	1,001	198	3,969	5,370
			RECREATIONAL (thousands of dollars)				
1976-1980	2,912	2,221	4,129	5,461	3,599	18,322	23,719
1981-1985	1,656	1,335	3,190	3,253	2,263	11,697	15,188
1986	1,281	864	3,128	2,305	2,136	9,715	12,650
1987	1,156	1,431	4,557	3,339	2,818	13,301	17,345
1988	366	1,690	5,367	3,674	2,127	13,225	17,228
1989	1,330	1,502	4,778	3,436	2,670	13,716	17,875
1990	1,534	1,604	4,239	3,321	2,031	12,730	16,517
1991	1,354	956	3,126	2,816	1,466	9,718	12,572
1992	793	1,167	2,890	2,676	685	8,211	10,595
1993	1,093	246	927	728	918	3,912	5,064
1994	0	468	4	16	615	1,102	1,484
1995	543	263	71	29	739	1,645	2,175
1996	339	368	218	165	899	1,989	2,650
1997[e/]	222	161	190	159	644	1,377	1,357

a/ Expressed in 1997 dollars. Per pound and per day estimates of income impacts provided by the Fishery Economic Assessment Model. These are the income impacts associated with expenditures in the troll or recreational sectors. There is no differentiation between money new to the area and money which would otherwise have been expended in other sectors.

b/ On average, between 1976-1991 over 50% of the troll fishery community income impacts for the Brookings port area originated from landings in Brookings and Gold Beach. For 1986-1990 an average of about 40% of the impacts for the Brookings port area originated in landings made through Brookings and Gold Beach. In 1992 and 1993, impacts originating through these two ports averaged less than 18% and 11%, respectively, of the total for the Brookings port area. Since 1994, the average has been 61%. Port Orford is the other port included in the Brookings port area.

c/ Income impacts on the coastal economy. Totals do not include impacts of one coastal community on another.

d/ Excludes pink salmon.

e/ Preliminary.

TABLE B-62. Estimates of **Washington coastal community and state personal income** impacts of the non-Indian troll and recreational ocean salmon fishery for major port areas.[a]

Year or Average	Neah Bay	La Push	Westport	Ilwaco[b]	Coastal Community Total[c/d]	Puget Sound	State Total
			OCEAN TROLL (thousands of dollars)[e/f]				
1976-1980	4,964	6,781	14,959	4,813	31,517	6,673	46,699
1981-1985	969	392	4,080	875	6,317	1,416	9,089
1986	385	170	1,269	489	2,314	448	3,393
1987	269	171	3,221	479	4,141	389	5,142
1988	526	147	1,627	307	2,607	2,323	5,829
1989	410	13	1,528	289	2,239	629	3,370
1990	1,042	191	1,593	236	3,063	249	4,020
1991	703	63	1,063	140	1,968	230	2,695
1992	646	201	1,235	46	2,127	295	2,928
1993	439	131	712	10	1,292	172	1,783
1994	-	-	-	-	-	26	32
1995	124	27	29	0	180	42	304
1996	63	2	64	2	131	35	209
1997	49	1	138	0	188	39	265
			RECREATIONAL (thousands of dollars)				
1976-1980	1,749	1,528	12,253	4,843	20,374	-	27,672
1981-1985	1,771	410	8,474	3,935	14,590	-	19,853
1986	884	65	3,973	2,191	7,113	-	9,639
1987	858	77	3,543	2,114	6,593	-	8,950
1988	748	108	2,726	766	4,347	-	5,811
1989	711	61	4,516	2,415	7,704	-	10,435
1990	937	161	5,043	3,189	9,330	-	12,688
1991	694	145	3,606	2,076	6,521	-	8,847
1992	485	106	3,616	1,390	5,597	-	7,525
1993	797	117	3,468	1,818	6,199	-	8,390
1994	-	-	-	-	-	-	-
1995	222	63	1,532	913	2,730	-	3,696
1996	371	50	1,157	674	2,252	-	3,054
1997[g]	117	40	1,215	342	1,714	-	2,278

a/ Expressed in 1997 dollars. Per pound and per recreational day estimates of income impacts provided by the fishery economic assessment model. These are the income impacts associated with expenditures in the troll or recreational sectors. There is no differentiation between money new to the area and money which would otherwise have been expended in other sectors.
b/ Excludes recreational shorebased effort from the north side of the Columbia River jetty.
c/ Income impacts on the coastal economy. Totals do not include impacts of one coastal community on another.
d/ Includes a very small amount of fish landed in other coastal Washington areas.
e/ Excludes pink salmon.
f/ All commercial values in this table are based on preliminary information available at the start of each year's salmon review.
g/ Preliminary.

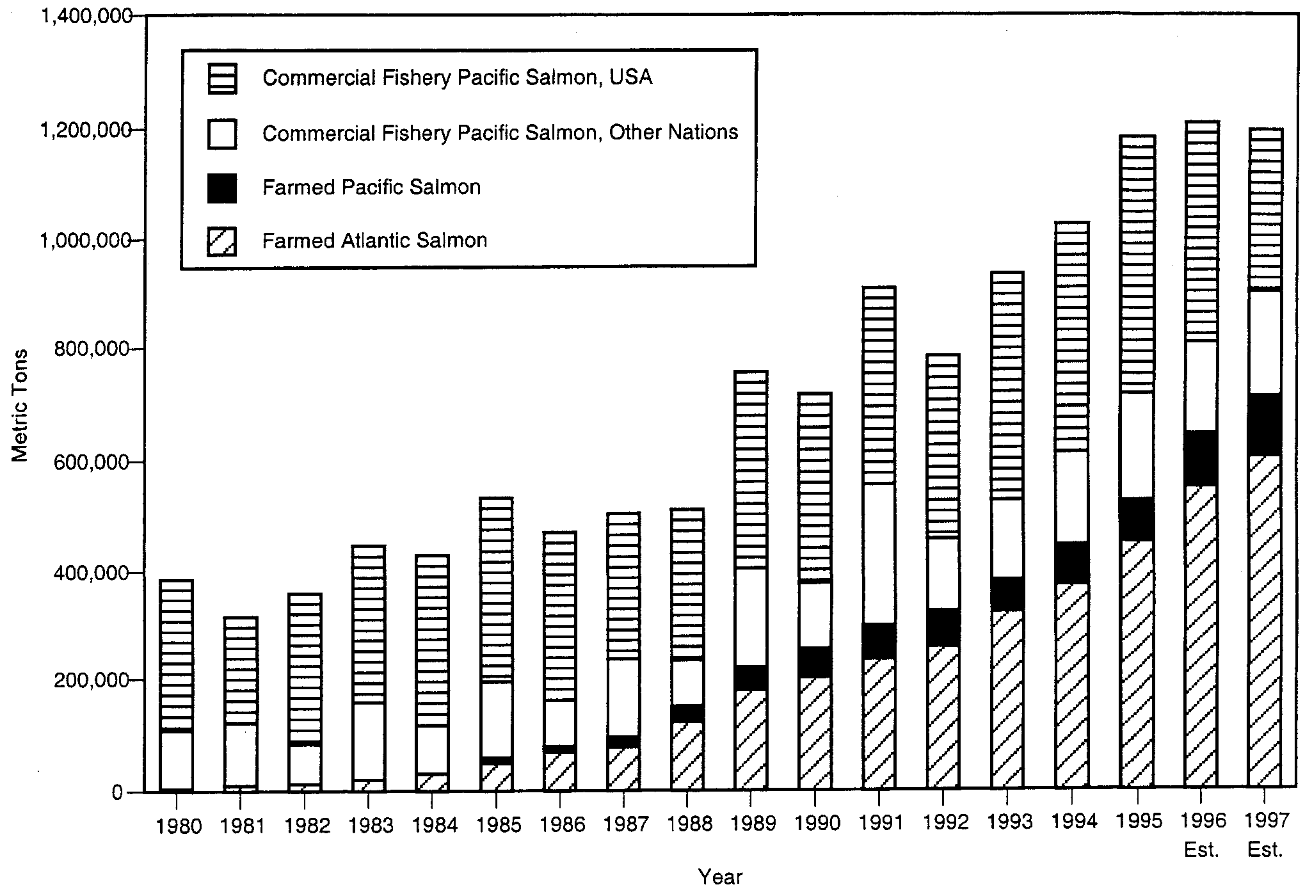


FIGURE B-1a. Estimated world salmon production; comercial fishery harvest includes natural and hatchery produced fish. (World salmon supply estimates prepared by the Salmon Market Information Service, University of Alaska, Anchorage, May 1988).

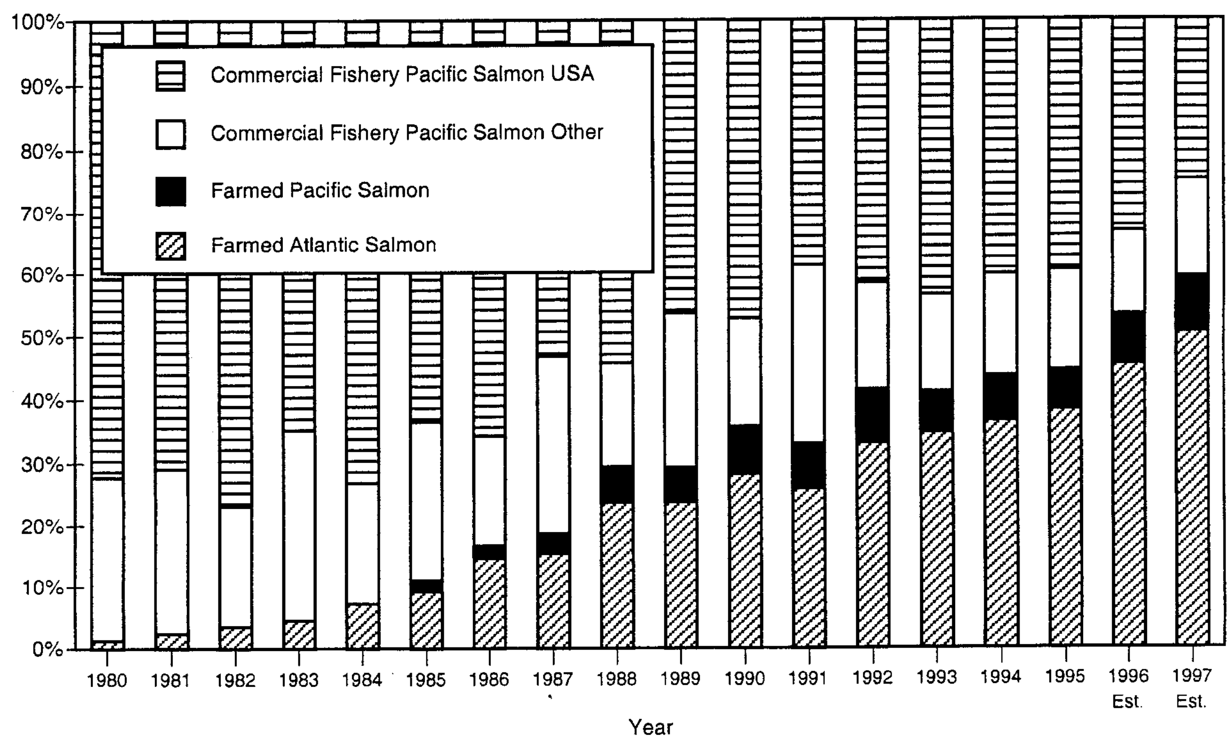


FIGURE B-1b. Percent world salmon production by type. (World salmon supply estimates prepared by the Salmon Market Information Service, University of Alaska, Anchorage, May 1988).

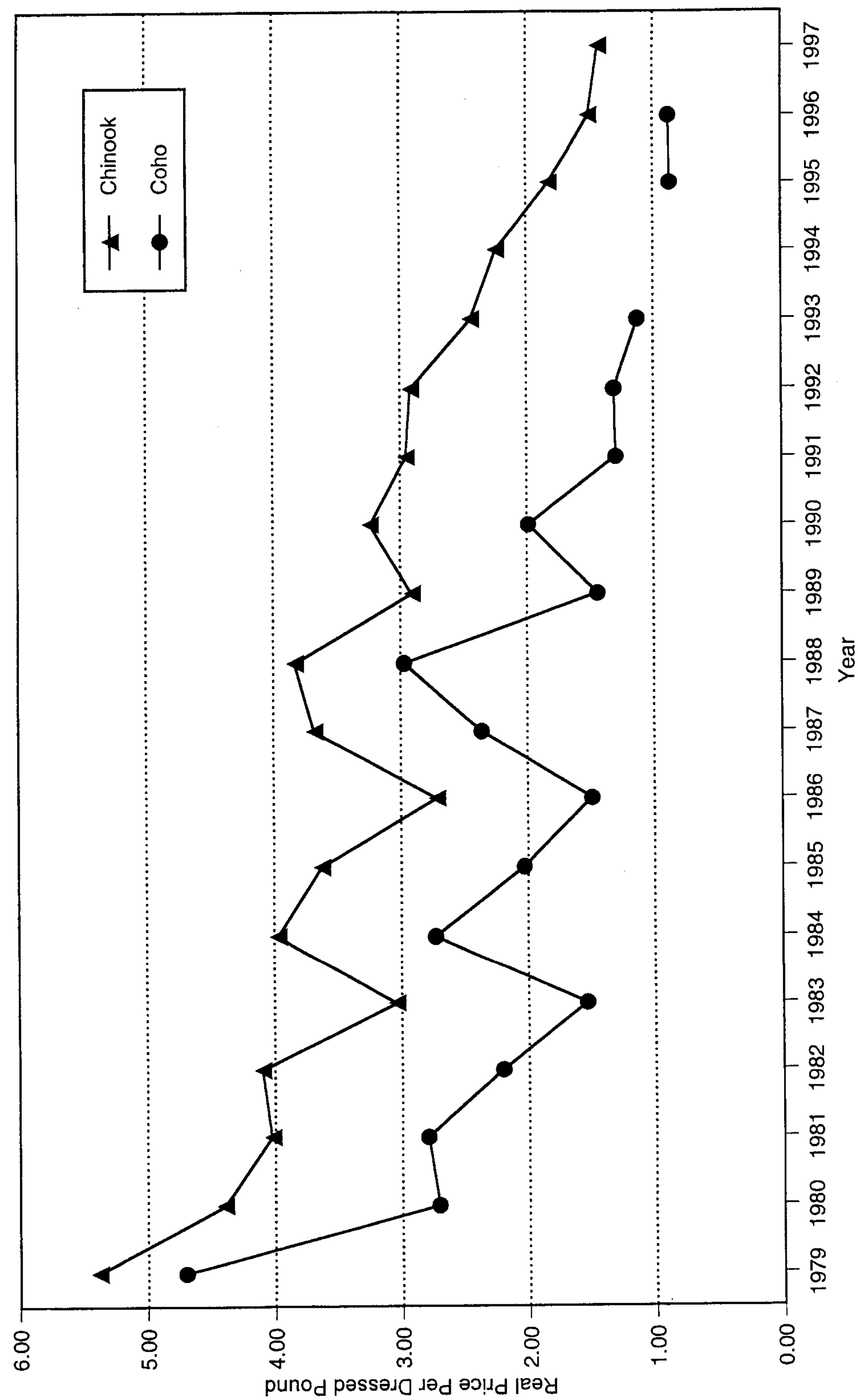


FIGURE B-2. West Coast non-Indian ocean troll exvessel salmon price trends.

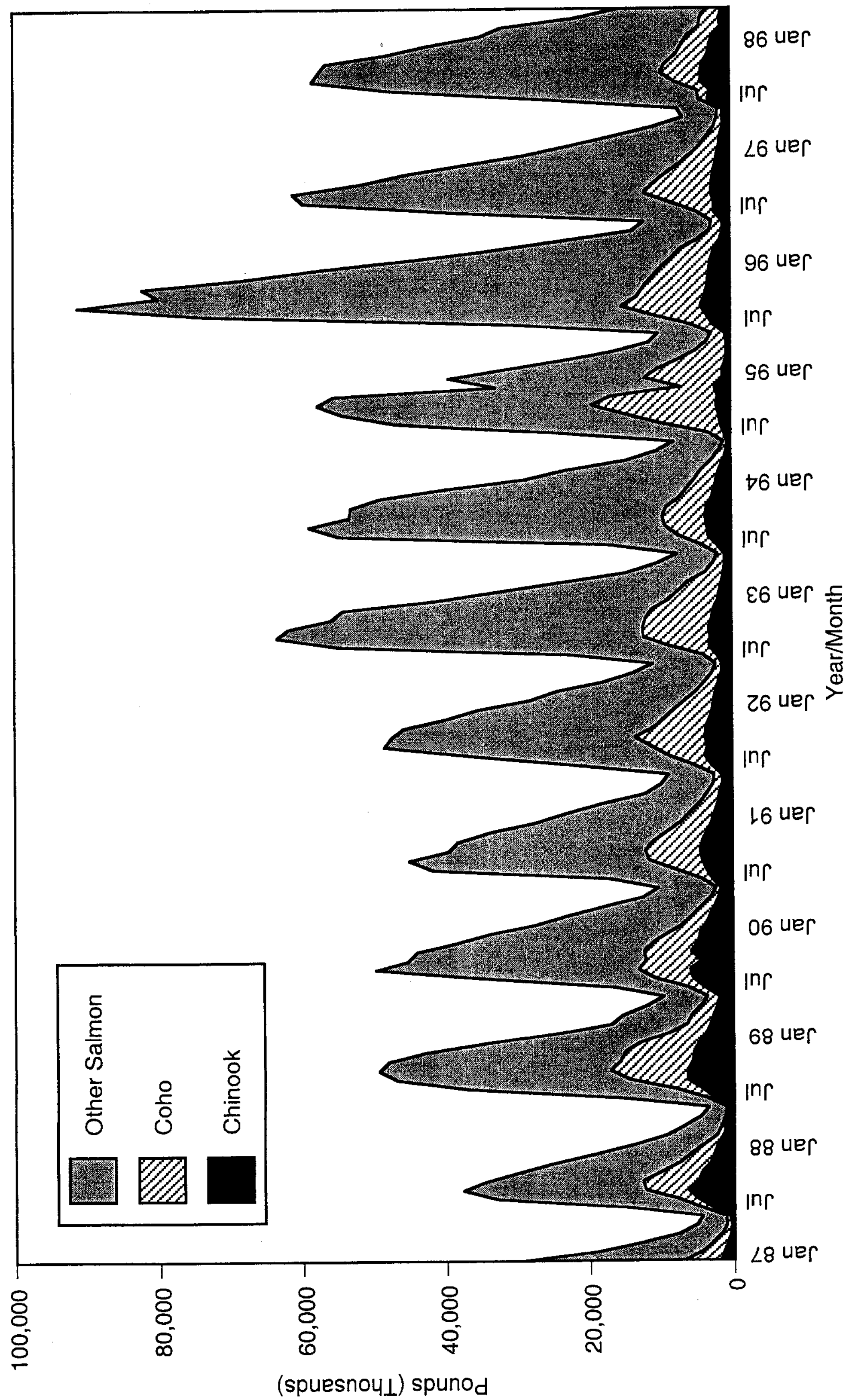


FIGURE B-3. U.S. cold storage holding of dressed and round salmon.

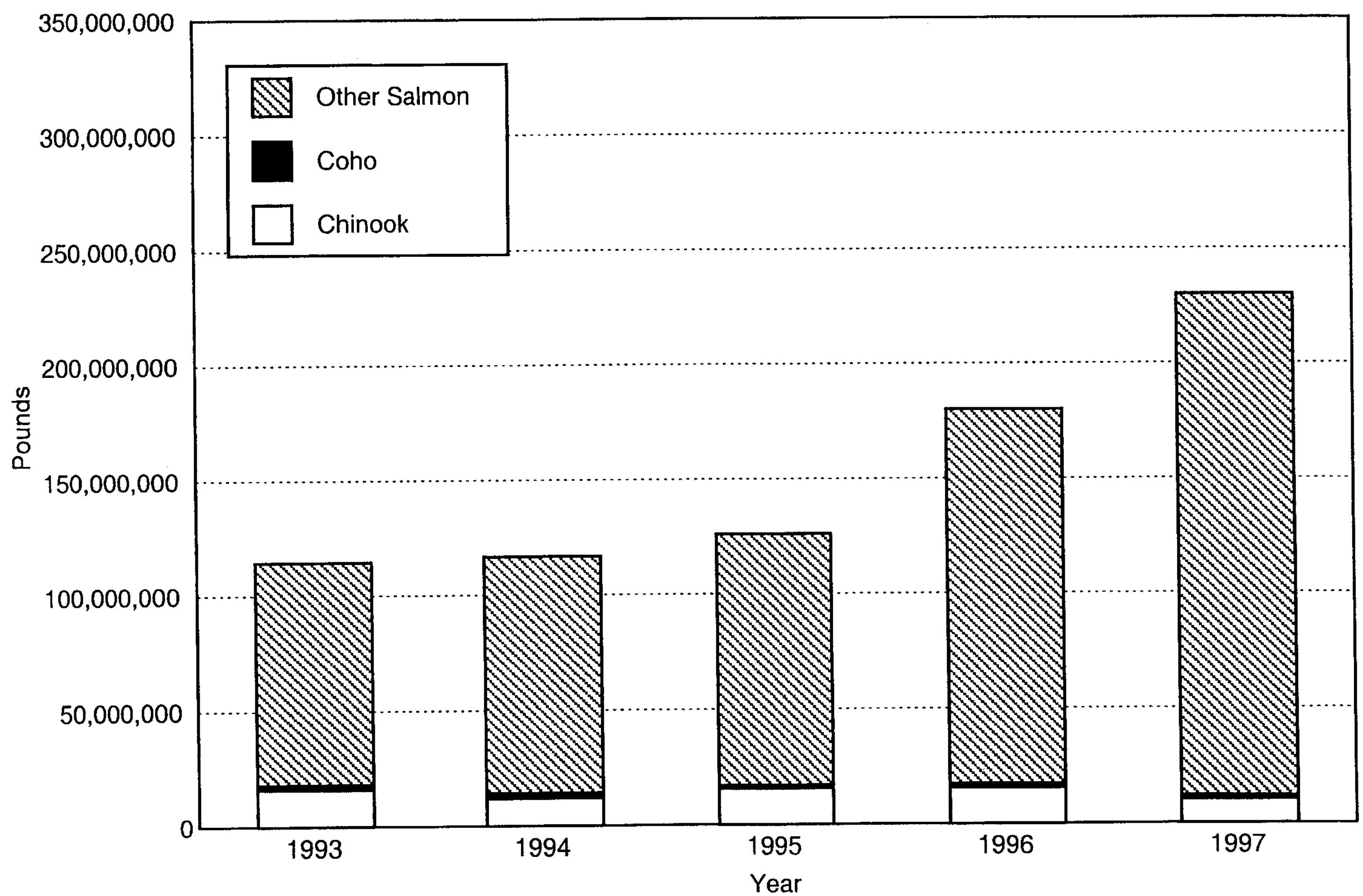


FIGURE B-4. U.S. salmon imports, annual volume of fresh and frozen salmon.

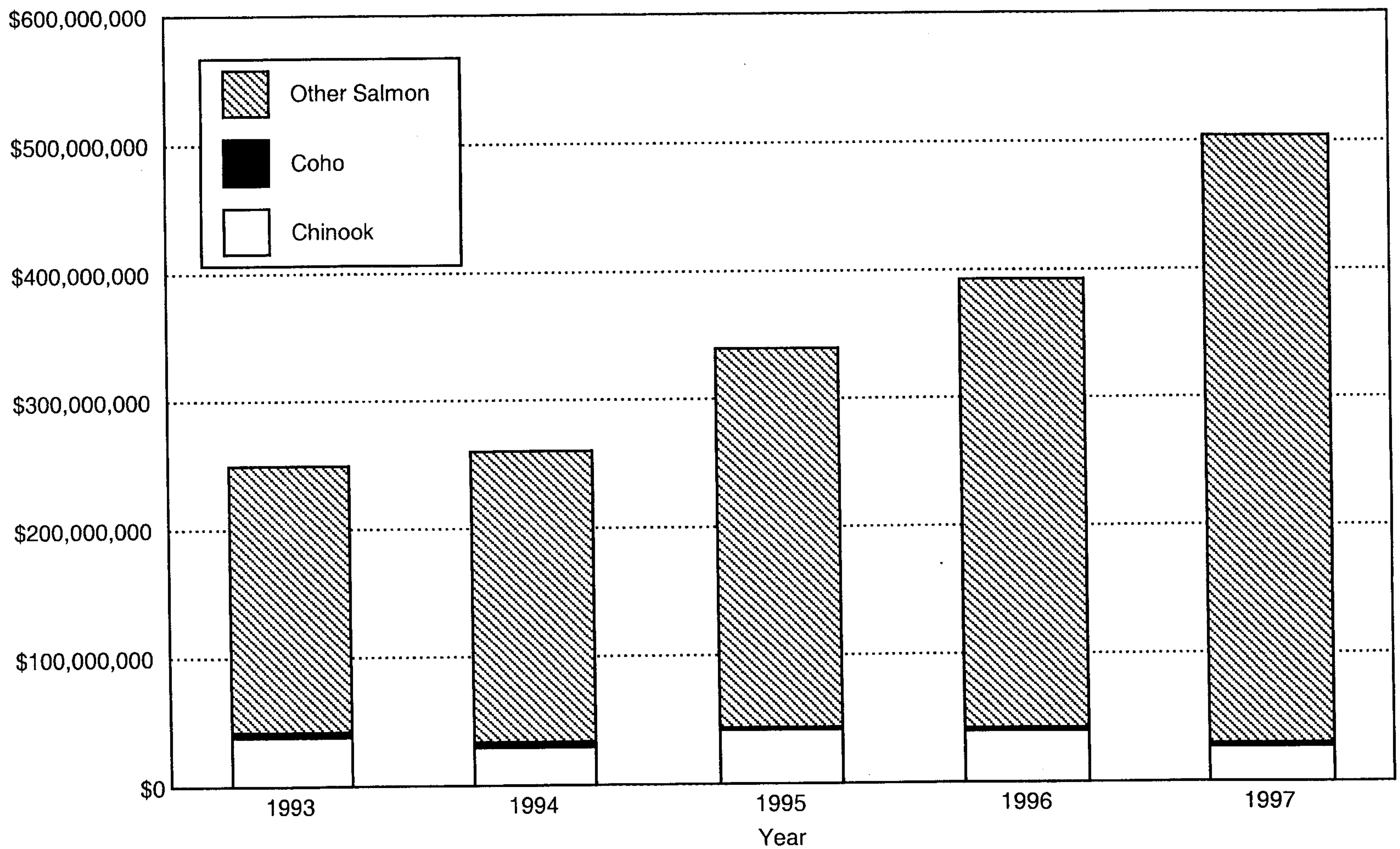


FIGURE B-5. U.S. salmon imports, annual value of fresh and frozen salmon.

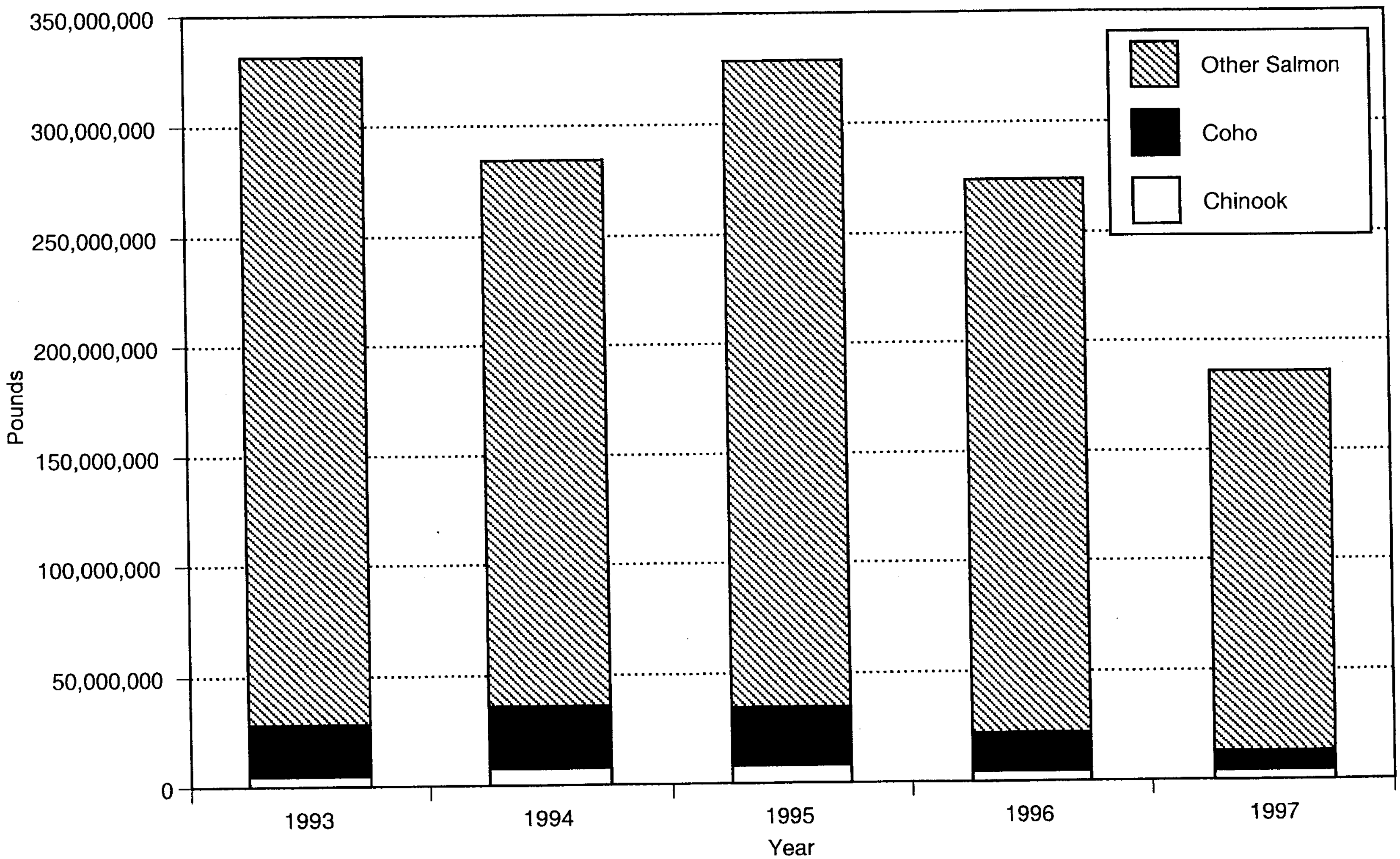


FIGURE B-6. U.S. salmon exports annual volume of fresh and frozen salmon.

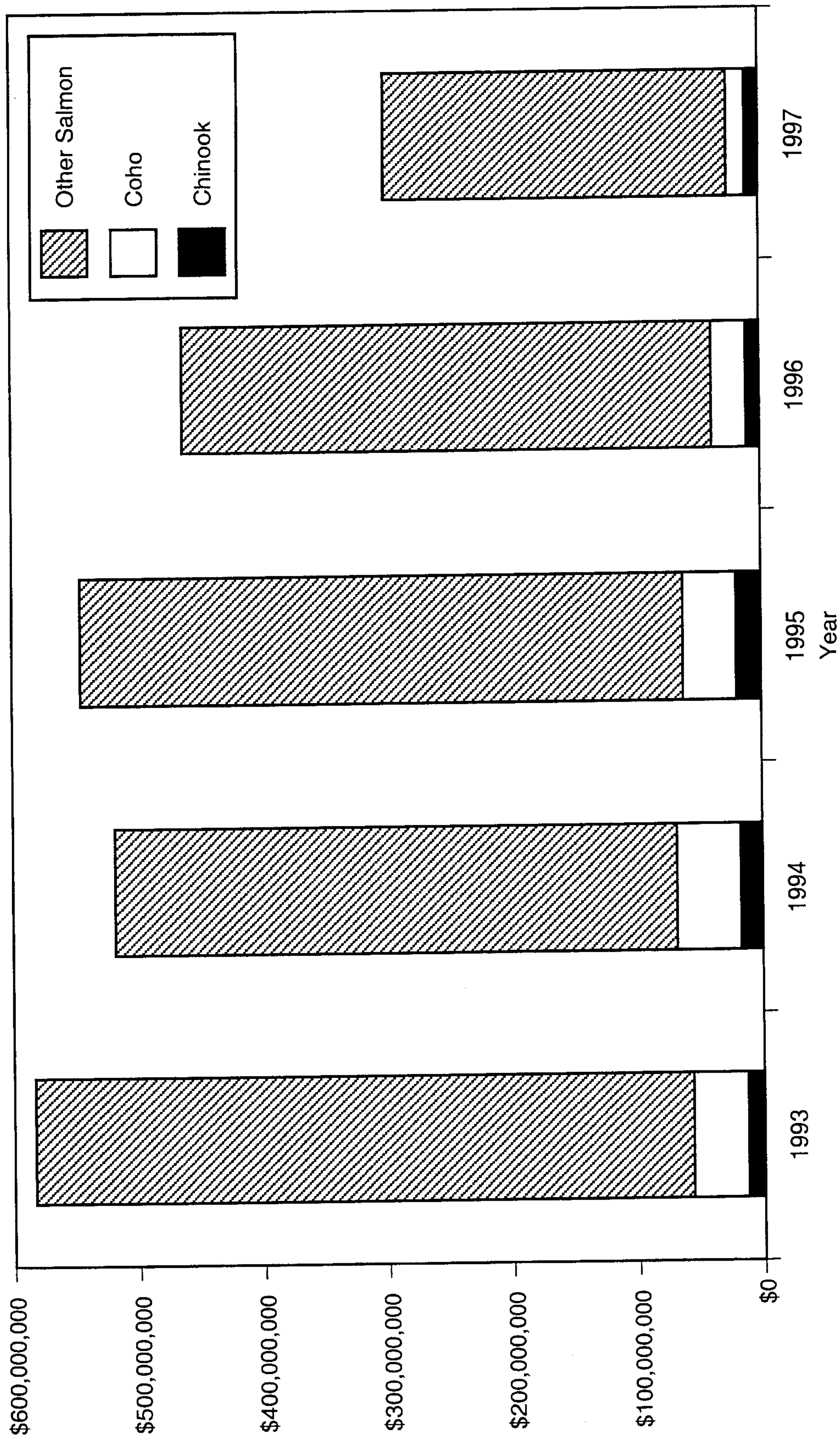


FIGURE B-7. U.S. salmon exports annual value of fresh and frozen salmon.

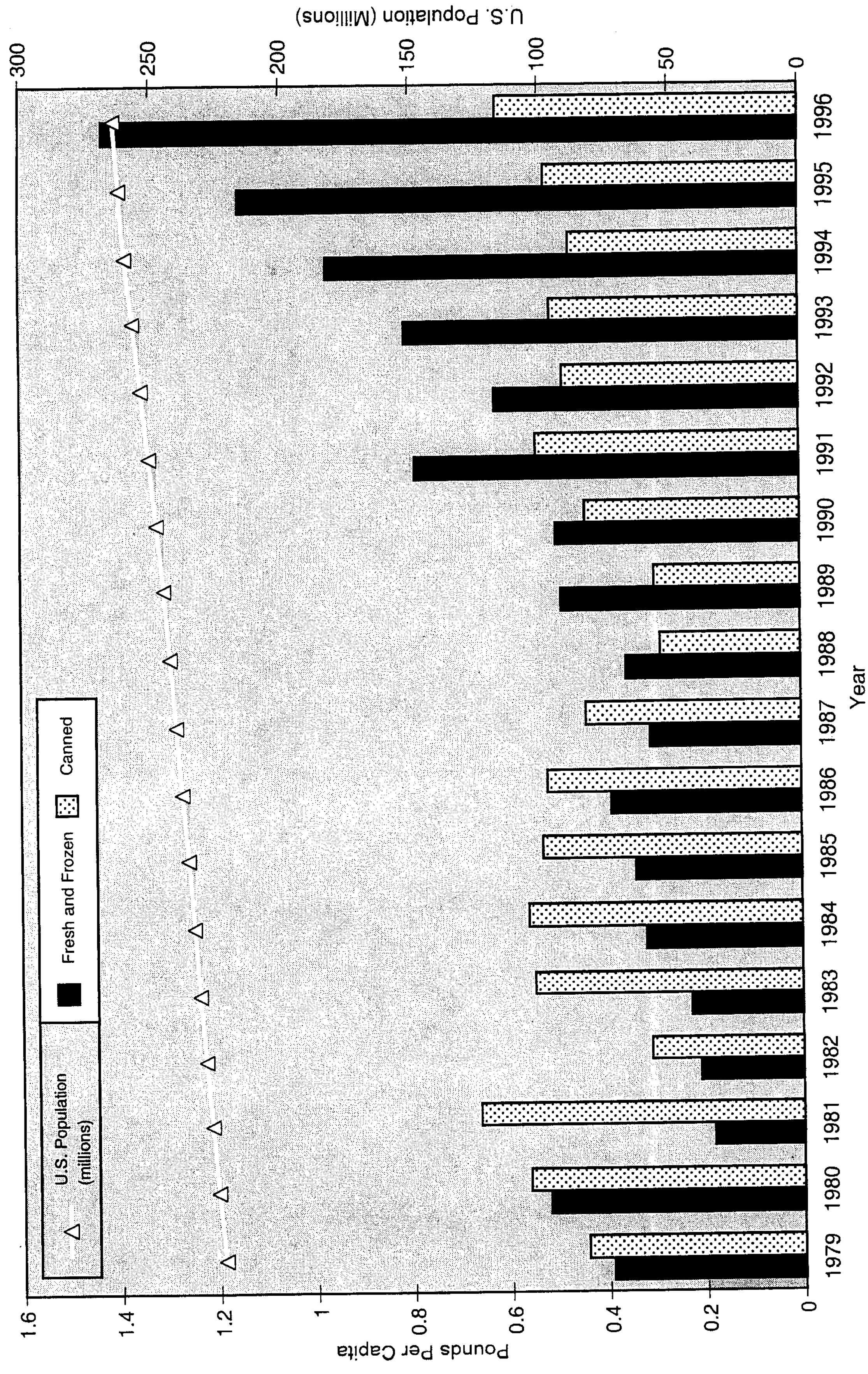


FIGURE B-8. U.S. per capita salmon consumption and population trends.

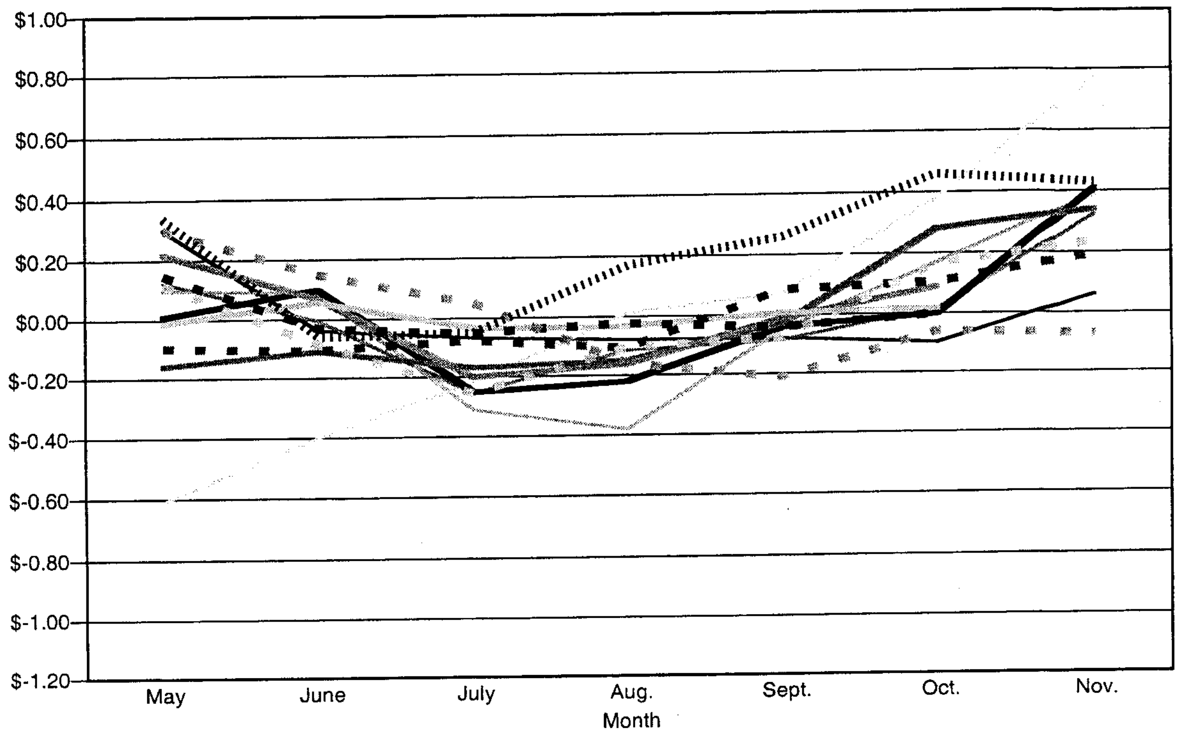
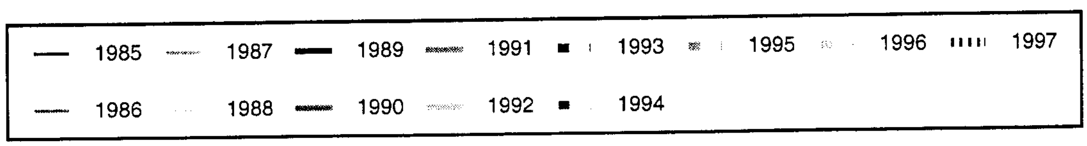


FIGURE B-9. Inseason exvessel price fluctuations for large chinook (Oregon).



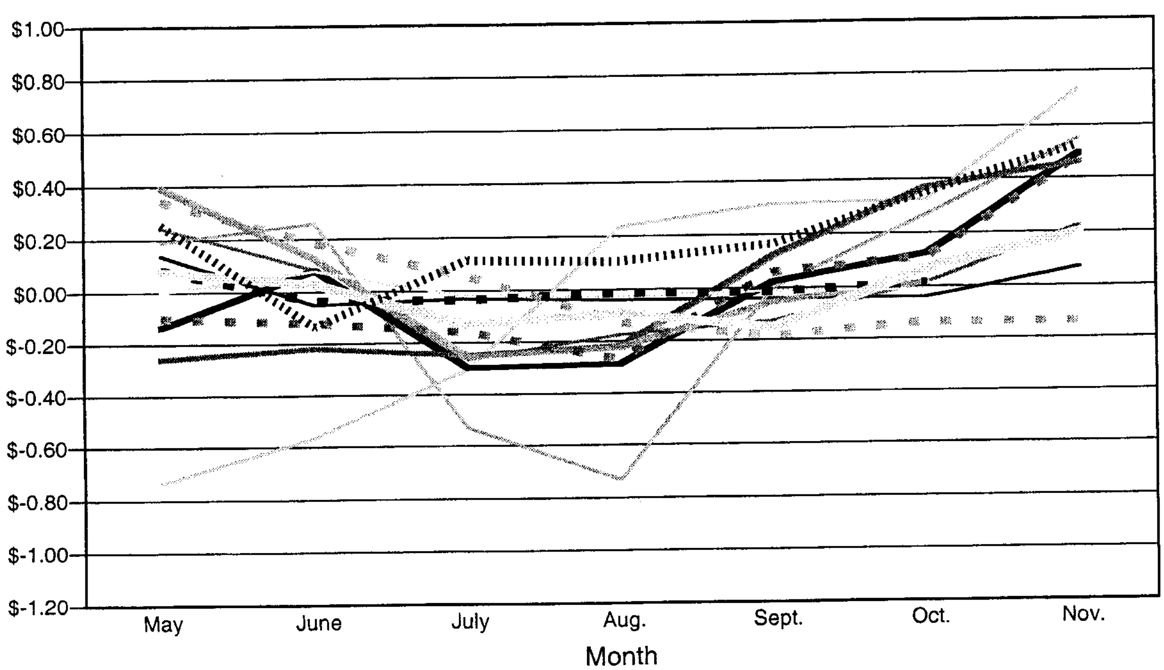


FIGURE B-10. Inseason exvessel price fluctuations for medium chinook (Oregon).

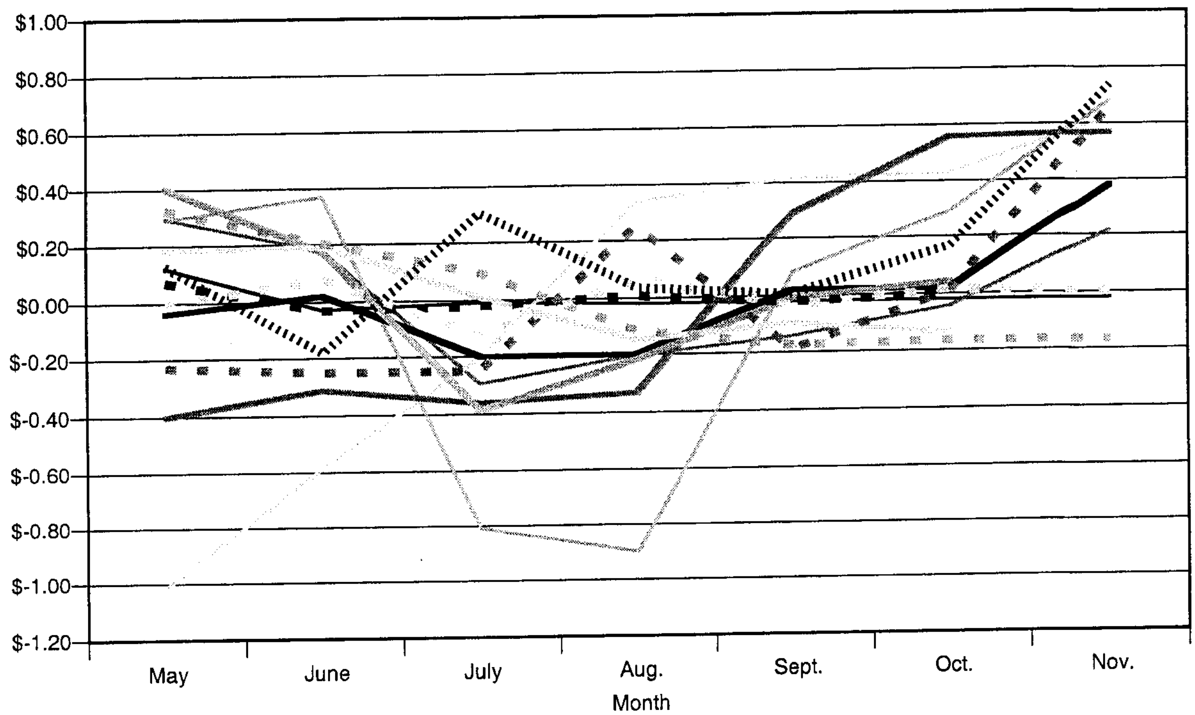
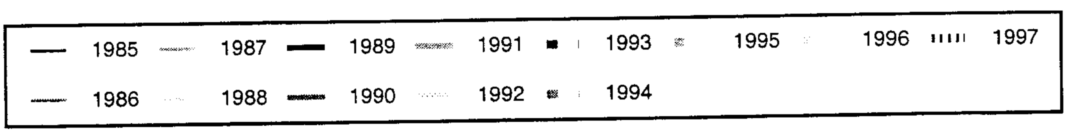


FIGURE B-11. Inseason exvessel price fluctuations for small chinook (Oregon).



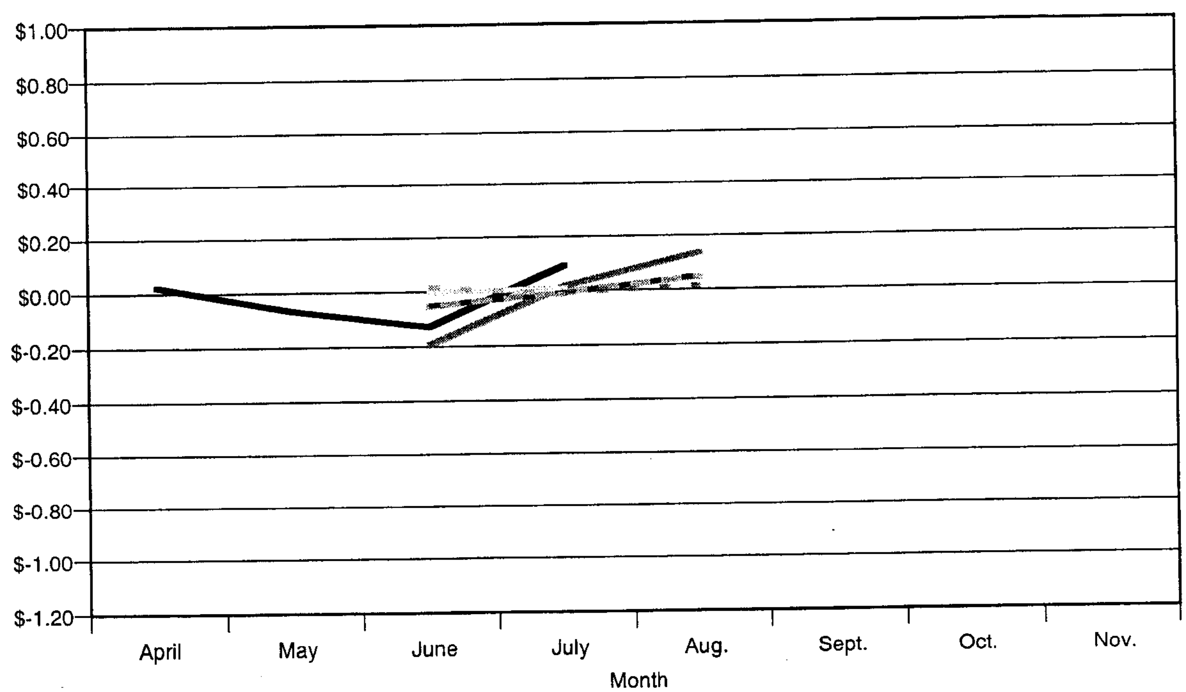


FIGURE B-12. Inseason exvessel price fluctuations for mixed coho (Washington).

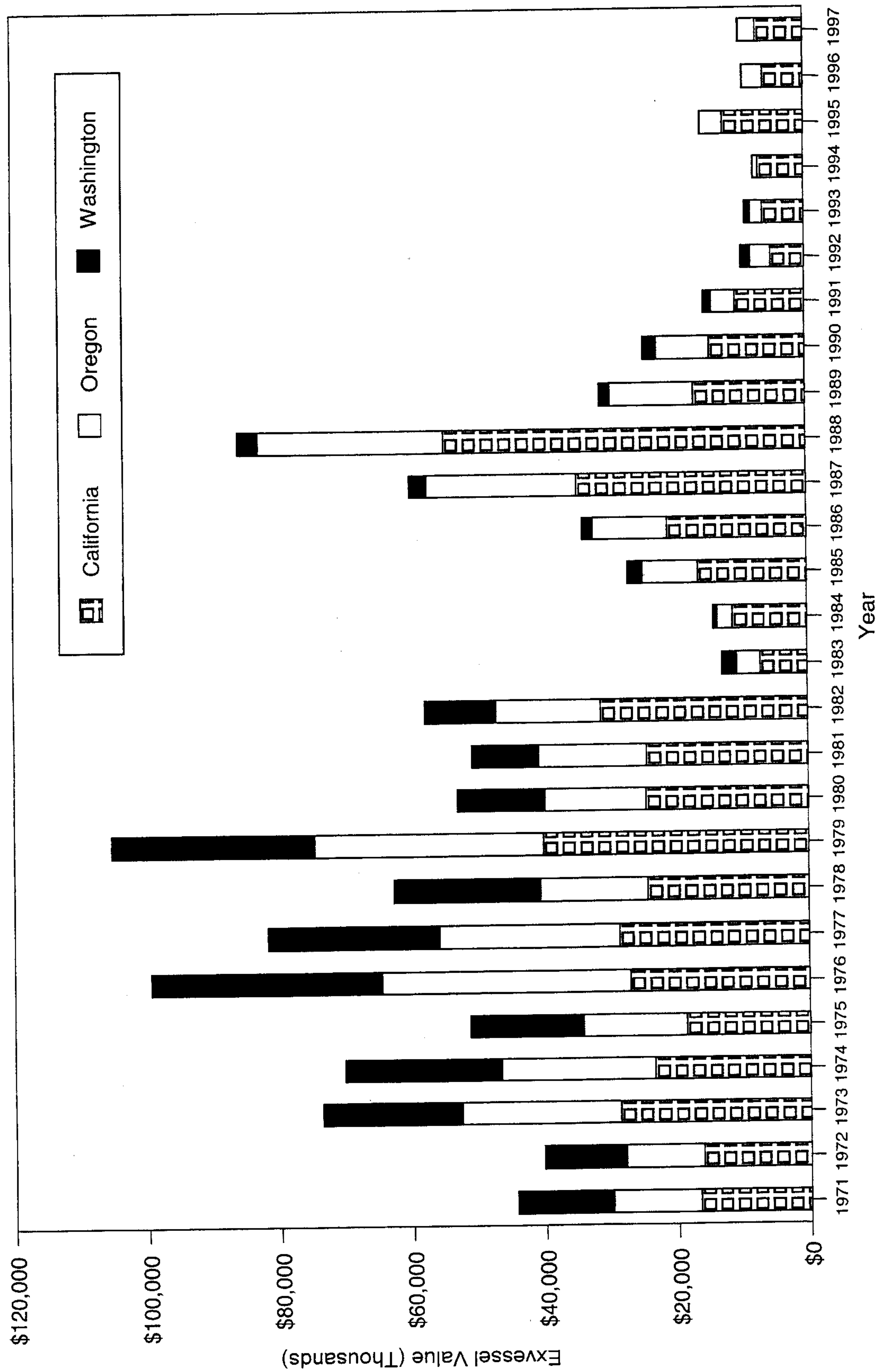


FIGURE B-13. Exvessel value of troll chinook and coho landings by state of landing (1997 dollars).

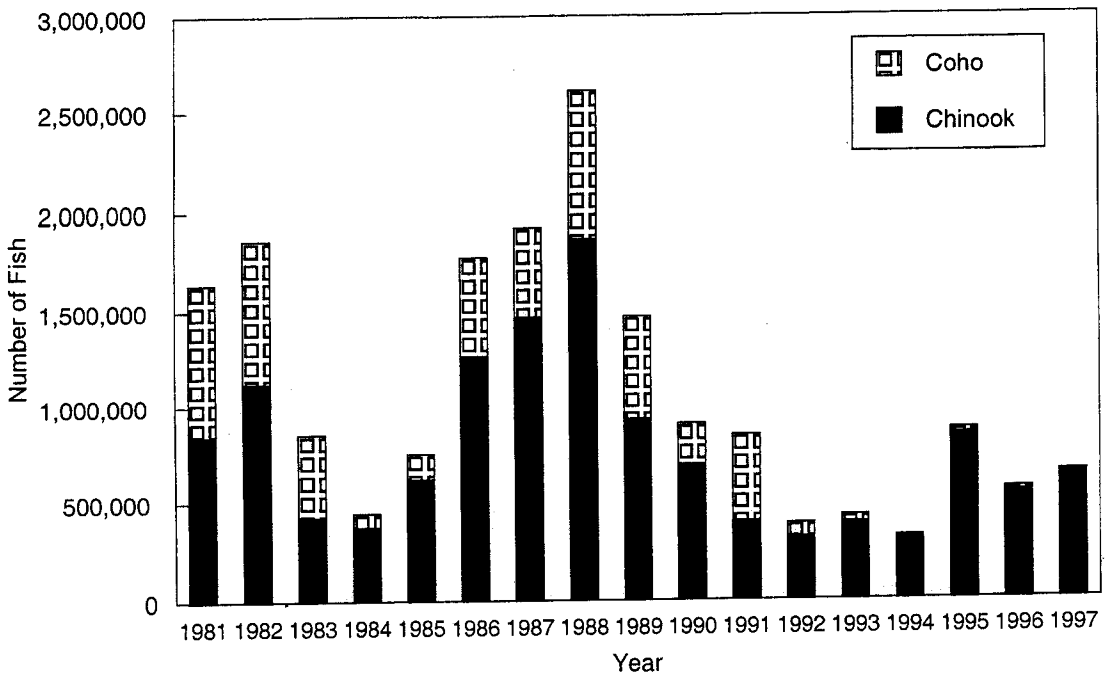


FIGURE B-14. West Coast non-Indian ocean commercial troll chinook and coho harvest.

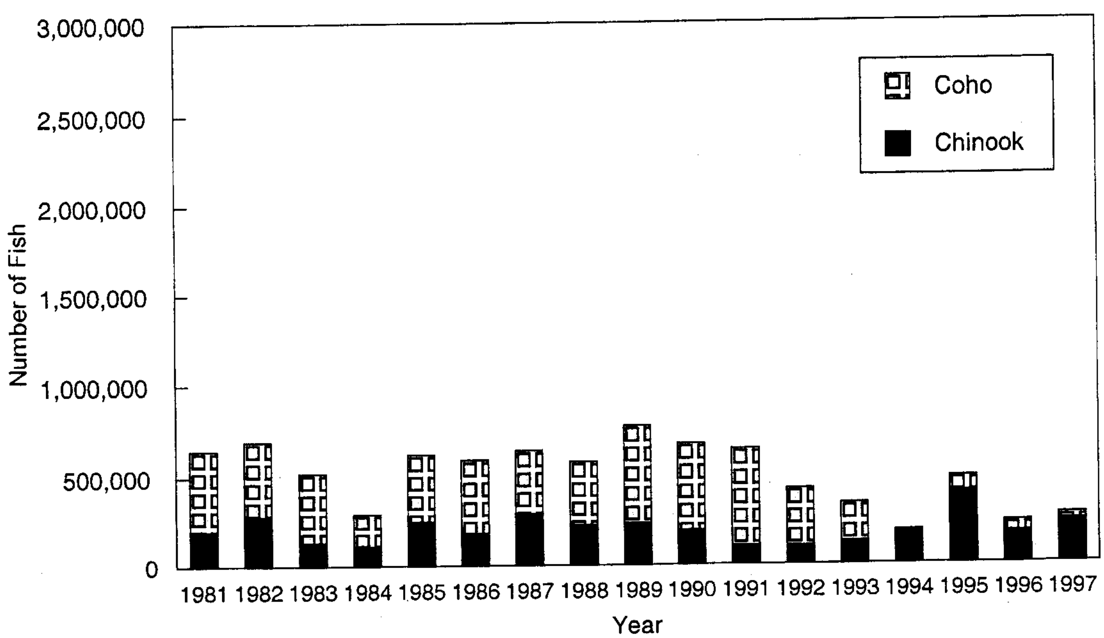


FIGURE B-15. West Coast recreational ocean chinook and coho harvest.

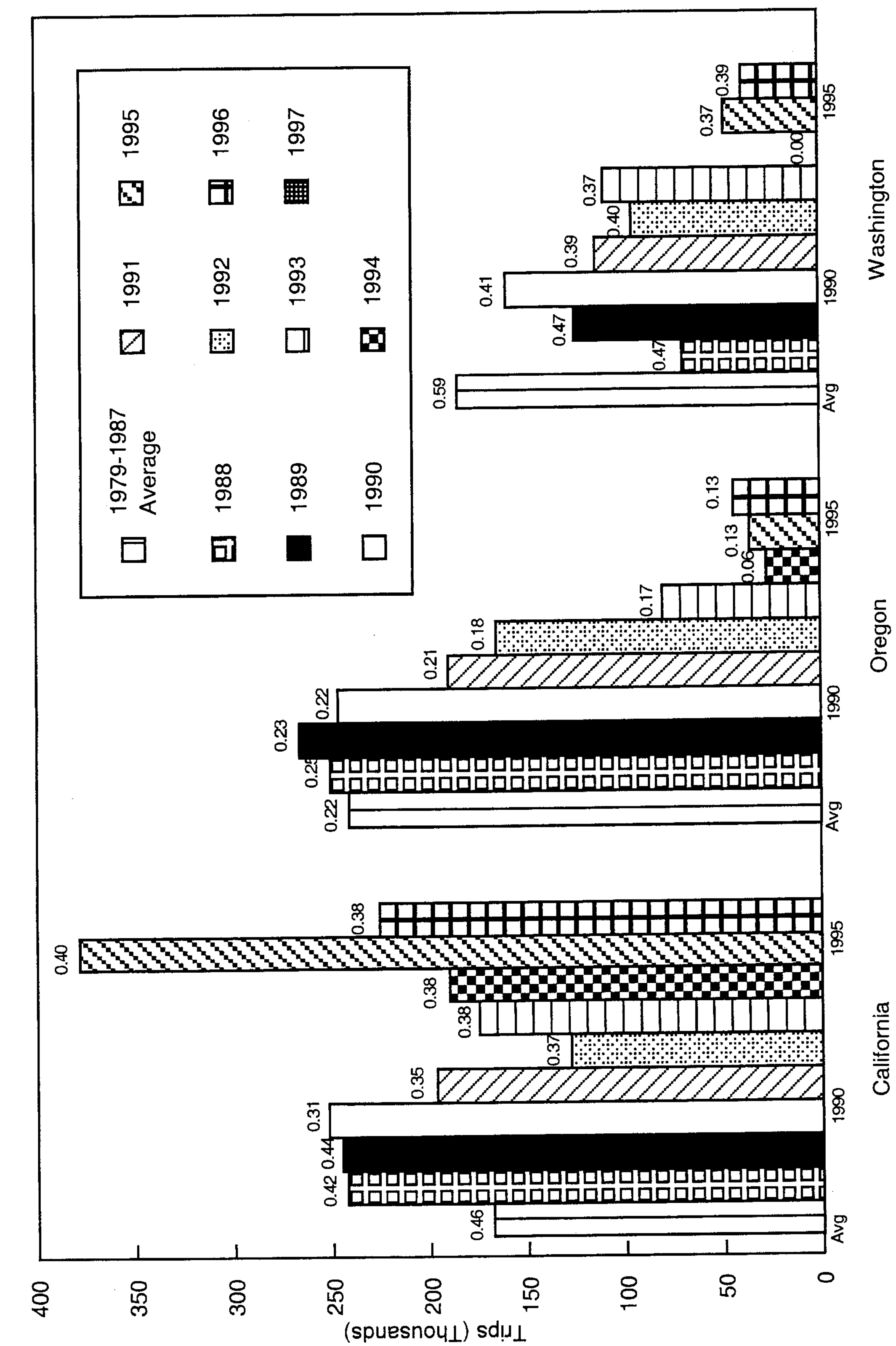


FIGURE B-16. Total recreational ocean salmon trips by state (with proportion of charter trips shown above each bar).