FRESHWATER HABITAT, SALMON PRODUCED, and ESCAPEMENTS FOR NATURAL SPAWNING along the PACIFIC COAST of the U.S.

A report prepared by the
Anadromous Salmonid Environmental Task Force
of the
PACIFIC FISHERY MANAGEMENT COUNCIL

JUNE 1979

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TABLE OF CONTENTS

ABSTRACT

The amount of habitat presently available to salmon along the Pacific Coast of the United States (excluding Alaska) has been drastically reduced during the 20th century in some drainages, but maintained and even increased in a few drainages. The Sacramento-San Joaquin drainages and the Columbia River drainages upstream from Bonneville Dam have suffered the largest losses of habitat, primarily from the construction of dams. Less habitat has been lost in the Willamette River and most coastal drainages, but salmon production has been reduced because the available habitat in many streams has been degraded. The potential for increasing the amount of habitat through various enhancement programs is limited coast-wide (5-10%), although significant additions to habitat can be accomplished in some drainages.

Fish production from the natural habitat is reduced in nearly all areas. Major reductions in salmon production have been caused by habitat losses, degradation of existing habitat, and inadequate spawning escapements. With habitat enhancement and adequate spawning escapements, managers predict salmon production from natural areas can be increased as much as 30 percent in the next 10 to 20 years. If the present trend of habitat loss and degradation continues, salmon production will decline an additional 10 percent in the same period. Spawning escapements should be increased coast-wide by 40 percent over present numbers to fully use habitat presently available.

INTRODUCTION

In 1978, the Pacific Fisheries Management Council established an Anadromous Salmonid Environmental Task Force to assess the status of freshwater salmon habitat along the Pacific Coast of the United States, not including Alaska. Information on the amount and quality of habitat presently used by salmon, the number of fish produced naturally in that habitat, and the number of salmon spawning in the streams was needed in environmental impact statements and management plans prepared under Council direction.

In this report, members of the Task Force have summarized data from agency files and estimated, when possible, the past, present and future amounts of habitat, fish produced and salmon required for spawning.

Estimates of habitat available and fish produced prior to water use developments were made to place present habitat abundance and fish production in a historical perspective. Estimates for the future (10-20 years) are speculative, but not unrealistic. With the past, present and future estimates, the Council can evaluate the potential for improving natural salmon production in freshwater habitat versus increasing production with artificial propagation programs.

Estimates of habitat available, fish produced and spawning escapements were prepared for major drainage areas (Fig. 1 and Table 1). Numbers of fish listed under escapements (Table 1) are (1) the number of fish that have escaped for natural spawning in recent years, and (2) the estimated number of fish that would be needed to fully utilize existing spawning and rearing habitat. If additional habitat were made available in the future, escapements would have to be proportionately larger. Present management goals for escapements may not be the same as escapements needed to fully utilize the present habitat because of problems in harvesting mixed wild-hatchery fish stocks, reintroduced stocks have not recovered sufficiently to fully use all the habitat available, fish passage problems at the dams, and socio-economic reasons.

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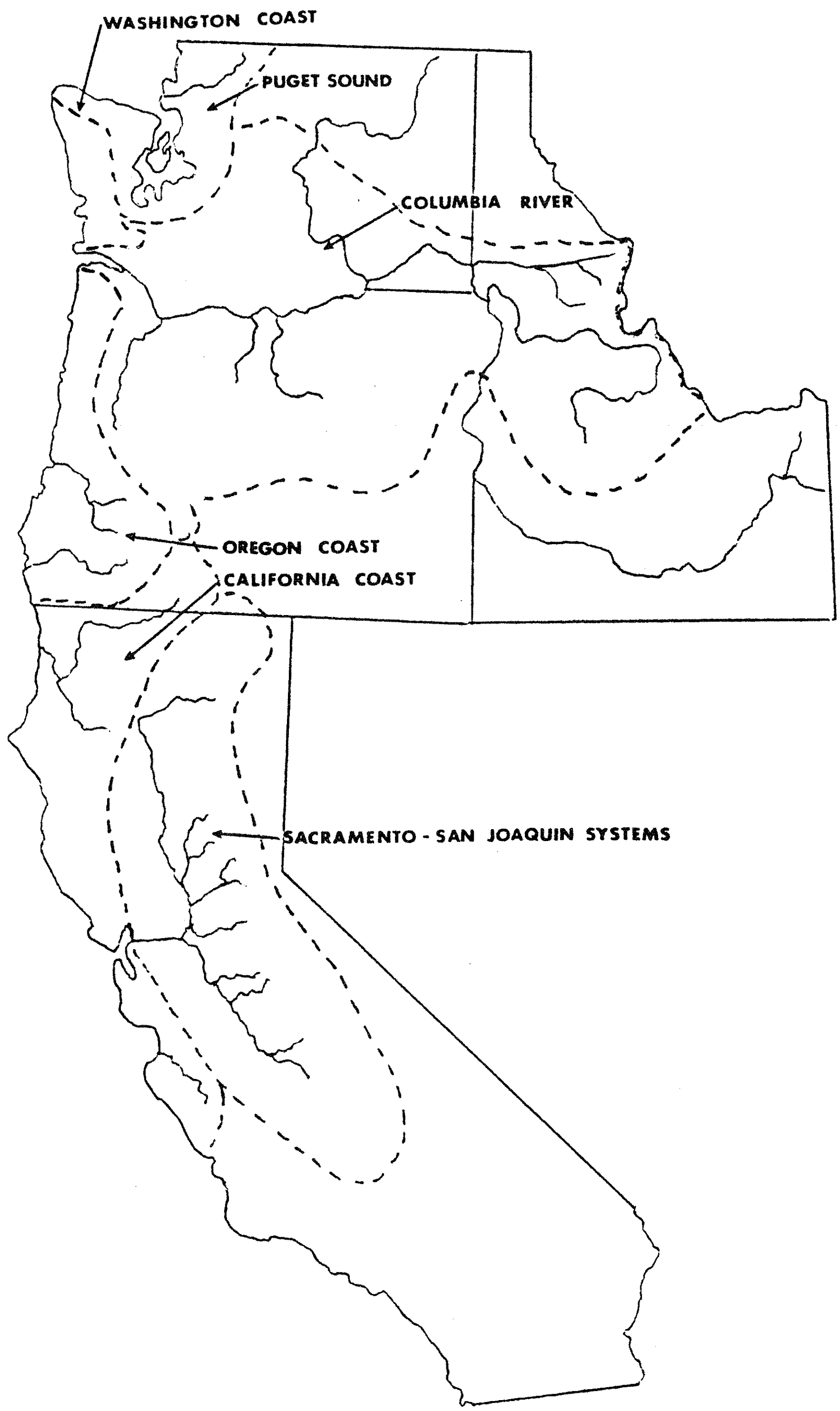

Fig. 1. Geographical areas covered in this report.

Table 1. Habitat available, salmon produced from the natural habitat and spawning escapements along the Pacific coast of the United States (excluding Alaska). "Formerly" refers to the time before water developments blocked access to streams and before habitat was degraded. Escapements are the number of fish allowed to escape for natural spawning in recent years and the number needed to fully use the present habitat.

Geographical area and species	*Habitat available (miles of stream)*				*Fish produced (thousands)*				*Escapement (thousands)*	
			Future (10-20 yrs)				*Future (10-20 yrs)*			
	Formerly	*Present time*	*With present trend*	*With enhancement*	*Formerly*	*Present time*	*With present trend*	*With enhancement*	*Recent years*	*Fill present habitat*
California Central Valley										
Sacramento										
Chinook	5,650	740	658	658	868[a]	699[b]	550	935	254[b]	340
San Joaquin										
Chinook	350	210	210	210	434[a]	22[b]	22	41-132	8[b]	11
California Coastal Streams										
Chinook	–[c]	2,300[d]	Down	–	–	–	–	–	< 256	256[d]
Coho	–	3,700	Down	–	–	–	–	–	< 99	99
Columbia River Drainage										
Downstream from Bonneville Dam										
Willamette River										
Chinook	1,400	600	600	1,000	40	131	131	168	28	40
Coho	250	1,600	1,600	1,800	1	48	48	60	8	8
Columbia River mainstem and tributaries (not including Willamette River)										
Chinook	709	552	552	–	1,000	< 400[e]	< 400	500	< 75[f]	> 100
Coho	903	703	703	–	900	< 400[g]	< 400	> 500	< 50	> 100
Chum	250	144	144	–	950	15	< 15	150	5	50
Upstream from Bonneville Dam										
Snake River										
Chinook	7,739	4,182	4,000	4,257	1,400	113[e]	75	419	30[h]	124[h]
Sockeye	1,716[i]	1,391	1,391	1,391	150	1	0	15	< 1[j]	5
Coho	600	400	350	425	200	5	0	35	< 1[j]	5
Columbia River mainstem and tributaries (not including Snake River)										
Chinook	2,098	1,030	1,030	1,400	1,000	< 500[e]	300	> 500	< 100[k]	> 100
Sockeye	824	193	193	500	500	80	60	150	50	80
Coho	754	705	705	705	> 100	< 80[g]	< 80	> 100	< 10	20

Table 1. Continued.

Geographical area and species	Habitat available (miles of stream)				Fish produced (thousands)				Escapement (thousands)	
			Future (10-20 yrs)				Future (10-20 yrs)			
	Formerly	Present time	With present trend	With enhancement	Formerly	Present time	With present trend	With enhancement	Recent yrs.	Fill present habitat
Oregon Coastal Streams										
Chinook	2,500	2,500	2,500	2,500	–	< 850[l]	< 850	< 1,000	< 160[m]	250
Coho	6,100	6,100	6,100	6,100	–	< 600[n]	< 600	> 600	< 100	250
Chum	400	300	300	330	700	20	20	40	20	40
Washington Coastal Streams										
Chinook	–	2,900	–[o]	–[o]	–	–	–	–	25	> 39
Coho	–	2,900	–	–	–	–	–	–	56	> 104
Sockeye	–	2,900	–	–	–	–	–	–	32	36
Chum	–	2,900	–	–	–	–	–	–	39	68
Puget Sound Streams										
Chinook	–	3,600	–	–	–	–	–	–	50	52
Coho	–	3,600	–	–	–	–	–	–	139	196
Sockeye	–	3,600	–	–	–	–	–	–	235	355
Pink	–	3,600	–	–	–	–	–	–	645	900
Chum	–	3,600	–	–	–	–	–	–	214	346[p]

a 1943-47 period assuming a catch:escapement ratio of 1.17:1.
b 1972-76 period assuming a catch:escapement ratio of 1.75:1.
c No estimate available when dash used.
d California Fish and Wildlife Plan (1965).
e Based on catch:escapement ratios: fall chinook 6:1, spring and summer chinook 2:1.
f Escapements of about 50,000 fall chinook and more than 5,000 spring chinook.
g Based on 7:1 catch:escapement ratio.
h Escapement to fill present habitat equal to enhanced fish production ÷ catch:escapement ratios in footnote e. Assumes full use of Clearwater River drainage.
i Mostly migration route.
j 1972-76 average.
k Escapements of about 50,000 fall chinook, 25,000 spring chinook and 10,000 summer chinook.
l Based on catch:escapement ratios: fall chinook 5:1, spring chinook 2:1.
m Escapements of < 125,000 fall chinook and < 35,000 spring chinook.
n Based on catch:escapement ratio of 5:1.
o Not available, see text.
p **Starting in 1979, chum salmon escapement goals in odd years will be reduced because of interaction with pink salmon.**

SACRAMENTO-SAN JOAQUIN RIVER SYSTEMS

Sacramento River Drainage

Availability and Quality of Salmon Habitat

Salmon spawning habitat in California's Central Valley before water development was estimated by Clark (1925) at 6,000 miles, most of which was in the Sacramento River drainage. Losses of habitat resulted almost entirely from dams constructed in streams, preventing access to many spawning areas. The reduction in chinook salmon produced was not as great as the reduction in stream miles of habitat. Most dams were constructed at middle foothill elevations, and large amounts of high quality spawning and rearing area are still available in the lower foothills and valley floor.

The Sacramento River system presently has about 740 stream miles of chinook habitat, including about 250 miles suitable for spawning. Many miles of stream habitat have been lost, but most of the spawning gravel (and hence spawners) has always been at sites downstream from the dams. Salmon are produced in three hatcheries to mitigate habitat lost above the three major dams in the system. Except in the main stem of the upper Sacramento River, the amount of spawning gravel presently available in the system can support spawning runs equal to those in the pre-water development era.

Without corrective programs, the quality and quantity of habitat will continue to decrease in the future. The greatest threat is additional water development, particularly in the Delta area.

The proposed Peripheral Canal has the potential to correct existing problems in the Delta and to overcome worsening conditions anticipated with increased water export. However, benefits attainable with the Peripheral Canal are contingent upon the federal government, particularly the Bureau of Reclamation, recognizing the water quality necessary to protect fish and wildlife, and that maintenance of these resources is a valid project purpose.

The only projects anticipated in the next 10 to 20 years that will eliminate additional habitat are the Cottonwood Creek dams, authorized for construction by the Corps of Engineers. These dams will reduce chinook habitat by 82 miles to a total of 658 stream miles available in the drainage. No increase in the amount of habitat available is predicted for the future (10-20 years). No change is anticipated in the operation of existing water development projects.

Fish Produced and Spawning Escapements

Estimates of the number of salmon spawning in the Sacramento River drainage are not based on solid data. The average annual escapement might have been 300,000 to 500,000 chinook salmon, and an escapement of 400,000 adults is used in this report.

Chinook salmon landings in California averaged 697,000 fish for the 30-year period 1947-1976. The landings for an early 5-year period (1943-1947) averaged 710,000 fish, while for the last 5-year period (1972-1976) the landings averaged 723,000. Not all fish caught came from the Sacramento system, and a catch-to-escapement ratio (C/E) of 1.17/1.0 was used to estimate the proportion of the fish originating from the Sacramento system prior to water developments.

With an escapement of 400,000 adults and a C/E ratio of 1.17/1.0 the catch would have been 468,000 chinook, for a total production (catch and escapement) from the Sacramento system of 868,000 fish.

Spawning escapements of fall-spawning salmon (spring and fall run) to the Sacramento River system have averaged 213,400 fish for the 10-year period 1967-1976, 264,000 fish for the 10-year period 1957-1966 and 210,000 fish for the 5-year period 1972-1976.

The decline in escapement from 400,000 to about 210,000 fish is due entirely to a decreasing population in the upper Sacramento River above the Feather River (Hallock 1977), rather than in the other principal spawning areas in the Feather, Yuba and American rivers.

Spawning escapement data for late fall and winter run chinook have become available only since 1970, when counts at the Red Bluff Diversion Dam began. Escapements fluctuated between 25,000 and 60,000 annually during 1972-1976, with a 5-year average of 44,000 fish. These figures, in most instances, are only partial counts because of periods of high and turbid water conditions.

The average escapement to the Sacramento River drainage for the period 1972-1976 was about 254,000 fish. With a catch-to-escapement ratio of 1.75/1.0 (Hallock 1977), the catch of Sacramento system fish would have been 445,000 chinook salmon, with a total of 699,000 fish produced in the drainage in recent years.

If the present trend continues, the number of chinook salmon produced in the Sacramento River system will decline to about 550,000 or about 20 percent less than present levels. Most of the decline has occurred and will continue to occur among upper Sacramento River stocks.

In the last 15 years the chinook population in the upper Sacramento River has declined by 40 percent. The decline will likely continue unless the problems can be identified and corrected.

Several potentially critical problems affecting only or primarily the upper Sacramento River salmon populations have been identified:

1. loss of spawning gravels below Keswick Dam,
2. heavy metal contamination below Keswick Dam,
3. altered fish passage at Red Bluff Diversion Dam, and
4. streamflow manipulation and/or fluctuation below Keswick Dam.

The four problems are currently being addressed by various fish and wildlife agencies. It is probable that the cause of upper river population decline is one or more of these problems, and correction will restore much of the decline observed among these populations since the mid-1960s.

A variety of other potential problems exist, but these were judged either to have comparatively minor impact or to affect all Sacramento River salmon populations equally. They include

1. water quality impairment from other then heavy metals,
2. predation by other fish species,
3. losses of streamside habitat, and
4. losses of downstream migrants in unscreened diversions.

Each of the potential problems is in large measure associated with facilities or operations of the Bureau of Reclamation, and none will be solved without the cooperation of that agency.

The goal for Sacramento River system production is 935,000 adult salmon. To achieve this goal the Sacramento system escapement will have to be increased from present levels by approximately 86,000 fish. If present C/E ratios continue, the additional escapement will provide 150,000 more adults to the ocean fishery.

The increased number of fish could be produced in the upper Sacramento River by correcting the potential habitat problems previously discussed. The salmon runs in the remaining parts of the system are expected to maintain themselves at present levels.

The present (1972-1976) spawning escapement in the Sacramento River system has averaged 254,000 fish annually, with a goal of 340,000 when the problems in the upper river are solved.

San Joaquin River Drainage

Availability and Quality of Habitat

Before water developments, the San Joaquin system had about 350 miles of salmon habitat and supported both fall and spring run chinook salmon. Construction of Friant Dam in the mid-1940s eliminated the spring run from the system and reduced the amount of spawning area by 36 percent. Spawning habitat was available downstream from the dam, but inadequate water releases from the project resulted in the loss of the 100,000-fish spring run.

The San Joaquin system presently has about 210 stream miles of chinook habitat, 60 percent of the historical amount. The fall run populations are restricted to lower tributaries such as the Merced, Stanislaus, Tuolumne, Mokelumne and Cosumnes Rivers. Except for the Cosumnes, these rivers have large dams. Habitat quality has been reduced significantly by insufficient water releases, high water temperatures and generally poor water quality. Salmon populations in the San Joaquin system are further impaired by conditions in the Sacramento-San Joaquin Delta area. Flow reversal and low concentrations of dissolved oxygen in the water are problems in the fall in San Joaquin River channels. Export of Sacramento River water from the southeastern Delta by pumps causes problems for both upstream and downstream migrant salmon. In the spring, total outflow from the system has been reduced to the point that juveniles migrating seaward are influenced by the pumping, which draws them away from normal migration routes, exposes them to fish screens that are less than perfect, and requires that they be salvaged and transported to points downstream from the influence of the pumps.

The major factor limiting salmon production in the San Joaquin system is the inadequate water releases from storage reservoirs. In all likelihood this condition will not change in the foreseeable future. Therefore, the existing 210 miles of salmon habitat will not be increased.

Fish Produced and Spawning Escapements

Little is known of the total spawning escapement in the San Joaquin system in pre-water development years. Escapements probably ranged from 100,000 to 300,000 fish each year. Before water developments, we estimate the San Joaquin system produced 434,000 salmon--200,000 spawners and 234,000 fish taken in the fishery.

The present fall run chinook population in the San Joaquin system has averaged 8000 spawners annually for the last 5 years (1972-1976). With a 1.75/1.0 catch-to-escapement ratio, an estimated 14,000 fish were taken in the ocean fishery and total production is about 22,000 adult salmon annually.

Inadequate streamflows limit salmon production in the San Joaquin system. Improvement in the existing situation will require major changes in water distribution and use, and the cooperation of government and the multi-billion dollar agriculture industry. Without such changes, the number of salmon produced will remain at or below 22,000 fish. A modest increase in fish production, perhaps 10 to 20 percent, is anticipated with completion of the Peripheral Canal, as well as with elimination of migration problems caused by present pumped water export from the Delta.

Additional flow during the months of March through June would increase salmon production in the Merced, Tuolumne and Stanislaus rivers as follows:

Additional acre-foot spring outflow	Additional spawners that could be accommodated
100,000	15,400
200,000	24,400
300,000	31,500
400,000	37,200
500,000	42,600
600,000	47,800

With increased spawning escapements, 26,000 to 84,000 additional fish would be available to the ocean fishery.

While it is easy to visualize the increases in salmon production if flows were augmented, it is less apparent how that augmentation can be achieved. Most of the water rights in the drainage have been allocated for domestic and irrigation use. About 5 percent of the average annual unimpaired runoff is legally allocated for fishery preservation.

Additional, but smaller, increases in salmon populations could be achieved by providing more spring outflow in the smaller northern San Joaquin tributaries: the Mokelumne, Cosumnes and Calaveras Rivers. Negotiations to provide this water are under way, and depend to some extent on the cooperation of the Bureau of Reclamation.

During the 5-year period 1972-1976, an average of 8000 fall run chinook spawned in the San Joaquin system, compared with 20,000 spawners during the 10-year period of 1967-1976. The last 8-year period has been one of water deficiency in the San Joaquin Valley, with particularly low outflows during the spring months, causing the low escapements in the last 5 years. Because of the recent drought, we expect this trend to continue at least until 1980. With normal precipitation, we expect spawning escapements of around 15,000 fish, the goal set for the San Joaquin system.

CALIFORNIA COASTAL STREAMS

Availability and Quality of Habitat

The first inventory of salmon habitat in California coastal streams was made in 1965. At that time, chinook and coho salmon habitat was estimated at 2300 and 3700 miles, respectively. Although this inventory was made recently, total available habitat at that time was probably not too different from that available in the early 1800s. Few dams have been constructed on the north coast of California, and habitat loss from this cause is not nearly so significant as in the Central Valley. Salmon populations have declined, however, from degradation of rather than loss of habitat.

The causes of habitat degradation have been logging, road-building, water diversions, streambed disturbances or alterations, and unfavorable land use practices. The rate of habitat degradation has declined in recent years as land and forest managers have initiated land use practices that afford some protection to fishery resources.

Continued growth of California's human population will interfere with salmon production. Losses associated with this growth are not expected to be disastrous in any one instance, and where such impacts are anticipated, mitigation can be provided. The major loss will occur gradually, and will be the cumulative effect of myriad minor problems that are individually insignificant.

An effective solution lies in providing the best protection possible, and at the same time improving conditions in areas where direct losses accompany human population. The most serious of these losses will continue to be associated with removal of water from the streams and with pollution.

The only major water project scheduled for construction in the next 10 or 20 years that will directly eliminate habitat for salmon will be the Corps of Engineers' Warm Springs project in the Russian River drainage. A hatchery is planned to mitigate the loss of coho and steelhead habitat and to enhance the chinook population.

Habitat that has been degraded over the years due to logging, road-building, water extraction, etc., can in many cases be improved. However, it is difficult to estimate, without a complete mile-by-mile survey of every stream, what can be improved and the value of the work in terms of increased fish production.

Most of the habitat improvement work done to date by the California Department of Fish and Game has been on a piecemeal basis. The Department devotes a significant portion of regional anadromous fisheries management manpower to stream surveys. Surveys identify barriers to salmon and steelhead migration, water quality problem areas and other specific habitat problems. In spite of on-going efforts, many coastal streams are not given adequate coverage.

A 5-year program of habitat improvement, with details for the initial 2 years, is outlined in a plan that was developed in 1975 and revised in 1978. Habitat improvement projects on salmon and steelhead streams would cost $779,000 the first year and $1,195,500 the second year (see project details in Appendix II). Congress, so far, has not appropriated funds to carry out the projects. Only $58,450 was received by the USDA, Forest Service in fiscal year 1978 for salmon and steelhead work and the outlook is not bright for fiscal year 1979.

Fish Produced and Spawning Escapements

Estimates made during the 1965 habitat inventory put coastal chinook salmon populations at 250,000 and coho at 100,000 fish. Salmon populations in the early 1900s were at least twice as large as those estimated in 1965, according to population trends established from long-term fish counts at several widely scattered north coast stations.

Reliable estimates of past and present spawning escapements for coastal streams are not available, nor do we know at what rates coastal salmon contribute to the ocean fishery. Studies are now under way to determine the abundance of salmon in the Klamath River system and their contribution to the ocean fishery, starting in 1979. Estimates of fish produced in other coastal streams can be made once the production of the Klamath system is known.

In 1965, it was estimated that 256,000 chinook and 99,400 coho salmon spawned annually in the coastal streams. Spawning populations may have declined since 1965, but escapement goal for coastal streams was set at 256,000 chinook and 99,000 coho.

COLUMBIA RIVER SYSTEM

Chinook salmon have always been the most important species for both sport and commercial fisheries in the Columbia River system. Commercial chinook salmon fishing initially was confined almost solely to the spring and summer runs, and the harvest was largest in 1883, when 42.9 million pounds of this species were taken.

The chinook runs began to decline in the late 1800s. Major producing areas were either cut off or rendered unusable, usually by water development projects. Some of the more important spawning areas for chinook salmon that are no longer in production include major portions of the Cowlitz, Lewis, Deschutes, Walla Walla, Yakima, Okanogan and Clearwater rivers; the entire area above Chief Joseph Dam, including the main stem of the Columbia, San Poil, Spokane, Kettle, Pend Oreille, and Kootenai rivers; and the entire area above Hells Canyon Dam, including the Snake, Weiser, Powder, Payette, Boise, Owyhee and Malheur rivers. Before the turn of the century, a major portion of the 30 to 40 million-pound annual harvests came from the upper Columbia and Snake River races of spring and summer chinook.

Historically, sockeye spawned and the young developed in eight systems of lakes in the Columbia River. Today only two areas, Lakes Wenatchee and Osoyoos, produce any significant numbers of sockeye. Dam construction eliminated Arrow Lakes (Canada), Yakima, Payette, Wallowa and Suttle lakes as sockeye salmon production areas. A remnant run is still produced in Redfish Lake, Idaho.

Before the turn of the century, sockeye were fished commercially in many areas, including Redfish, Payette and Wallowa lakes. In 1873, one firm processed 75,000 sockeye from Payette Lake. The peak of the fishery in the lower Columbia River occurred in 1889, when over 4.5 million pounds were caught.

Coho salmon spawned and the young developed predominantly in the lower river tributaries, but historically, some runs of coho migrated as far inland as the Spokane River, some 1126 miles from the ocean. The upriver races, including small runs in the Methow and Entiat rivers, were eliminated before major dam construction occurred. Their demise probably resulted from overfishing and losses of juveniles in irrigation diversions. The large coho-producing areas in the lower river were blocked by dam construction on the Lewis and Cowlitz rivers. Catches of naturally produced coho by the lower river fisheries were highest in the 1920s and peaked in 1925, when 7.2 million pounds of canned and mild-cured coho were processed.

Chum salmon used only the lower tributaries of the Columbia River below the Dalles. The major portion of the spawning area is still available and of good quality, with only minor sections destroyed when the Bonneville pool was formed.

Chum salmon were formerly quite abundant, with a record catch of 8.5 million pounds made in 1928. The landings declined drastically in the following years and today only a few thousand pounds of chum are landed annually. Reasons for the chum salmon losses are not known. River fishing for chum has been practically eliminated and chum are not taken in large numbers by the ocean fisheries. A similar decline of this species occurred along the entire Pacific Coast, but in contrast to the Columbia River runs, other stocks have responded to fishing closures and have increased in abundance.

Willamette River Drainage

Availability and Quality of Habitat

The Willamette River drainage has 8600 miles of streams, with 600 miles presently used by chinook salmon and 1600 miles used by coho salmon. Chinooks formerly used 1700 miles and coho 250 miles of habitat. The problems of passage over most of the numerous small dams and natural barriers which formerly blocked fish have been corrected or are being resolved. Losses at Willamette Falls have been reduced through agreements with the companies responsible for turbine operations.

Prior to major settlement by white men in the Willamette Basin, nearly ideal conditions of streamside cover, flows and cold water prevailed there. Late in the nineteenth century, man began to affect fish habitat through logging, dam construction and other developments.

Logging practices employed in the early years were damaging to fish runs. Splash and roll dams, together with the debris from logging activities, brought about blockage of streams, ruination of spawning areas, and other undesirable results. Improved logging systems have reduced the amounts of debris entering streams, but erosion from forest roads still contributes excessive amounts of silt to basin streams.

Since 1900, a considerable number of dams and reservoirs have been constructed in the basin. Some furnish cooler water downstream and augment normal flows during the summer. Flood control through dam construction and reservoir manipulation has resulted in some reduction in siltation and the preservation of downstream migrants. On the other hand, many miles of excellent anadromous spawning and rearing areas were cut off by dams and are no longer accessible except where fish passage has been provided. Flooding or drying out of spawning areas, raising of water temperatures, and losses of downstream migrants have also occurred as a result of some reservoir operations.

The effect of pollution on fish and other aquatic organisms was, until the mid-1960s, more critical in the Willamette River than in any other large Oregon stream. Pollution sources were most numerous in the area from Willamette Falls to the river mouth, and cumulative effects of pollution became progressively more severe toward the mouth. Many pollutants were present, including but not limited to, fine sediments, sawmill and cannery wastes, raw sewage, and sulphite pulp liquor--the latter being the most important pollutant affecting fishery resources.

The most detrimental effect of this pollution upon fish was the depletion of the water's dissolved oxygen content. Dissolved oxygen concentrations less than five parts per million, the minimum for proper survival of salmonids, occurred for extensive periods each year. Prolonged periods of below-minimum oxygen concentration were common in the Portland harbor, where these conditions extended through most of July, August and September--often from June into October. These low levels influenced health and survival of all fish and limited or delayed entry of anadromous fish, particularly coho salmon, into the river system. Development of runs of summer steelhead and fall chinook in Willamette basin streams was precluded until pollution was reduced in the late 1960s.

While the most obvious pollution problem was associated with the Willamette River, numerous other streams such as the Calapooia, Pudding, Tualatin, Yamhill, Santiam, South Santiam and Long Tom rivers, Lower Scappoose and Rickreall creeks and other streams of the basin also exhibited gross pollution.

Willamette Falls, located near Oregon City at RM 26.8, historically blocked passage of fall chinook and coho salmon and summer steelhead and partially obstructed the migrations of other species. As water-powered industry developed at the falls and concern for the preservation of salmon and steelhead runs increased, fishways were constructed. The first fish ladder, constructed in 1885, was inadequate. Fish passage has improved since then through structural modifications to the fishway and entrance, and the present fishway, completed in 1971, has made possible the development of summer and fall runs of anadromous fish.

Dams, culverts and other man-made obstacles throughout the basin posed complete or partial blocks to fish passage. Casadero Dam at RM 28 on the Clackamas River, constructed in 1904, completely blocked fish passage until a fish ladder was added in 1939.

Numerous natural falls blocked fish passage to headwater spawning and rearing areas in the Clackamas and several other basin streams. However, all fish problems were not associated with upstream passage. Installation of turbines for power generation at Willamette Falls increased injuries and mortalities to downstream migrant fish since a major portion of the river flow passes through the power turbines at the time juveniles are migrating downstream. Losses of from 10 to 30 percent of the juvenile spring chinook salmon passing through the turbines were recorded in tests conducted in 1960 and 1961.

Several hundred miles of spawning and rearing habitat for spring chinook salmon have been lost as a result of dam construction. Fish passage has been provided at several of these barriers, but much of the habitat was inundated by the reservoirs and spring chinook have been displaced into sites where spawning and rearing habitat are often less favorable. In the past, fall chinook and coho were excluded from the basin by Willamette Falls and only in recent years have these species become established in the upper basin.

Urban growth, industrial and agricultural developments, and other land uses pose a continuous threat to maintenance of quality natural production areas. Sediment deposition in spawning and rearing areas is a direct and inevitable result of man's activities in the basin and is a major cause of habitat loss. The extent of these habitat losses is being reduced as a result of recent environmental legislation such as Oregon's fill and removal laws and the Oregon Forest Practices Act. (See Problems 3 through 5 and 8 through 11 in Appendix I for further discussion of habitat, fish passage, escapement and related problems.)

Low summer flows occur throughout the basin, but are more critical in west side streams draining the Coast Range than in east side tributaries with headwaters in the snow-fed Cascade Range. Improved scheduling of flow releases from basin reservoirs to recognize fish needs has improved some low summer flows and reduced impacts of major floods. (See Problem 7 in Appendix I for further discussion of streamflow problems.)

High water temperatures are a problem in many basin streams. Elevated temperatures occur as a result of depleted streamflows and low stream gradients on the Willamette Valley floor that extend the exposure time of streams to warm weather conditions. Critical stream temperatures near or above $20^{\circ}C$ ($68^{\circ}F$) occur frequently on the Tualatin and other west side (Coast Range) tributaries of the Willamette. High temperatures have also been recorded on the Santiam River and on lower Thomas Creek. Stream temperatures in several other basin waters are warmer than desirable for optimum salmon production.

Gravel removal operations currently have less impact on fish production than in the past. Increased environmental concern and strengthened environmental legislation have made it possible to maintain reasonable levels of water quality.

Silt deposition is a major factor limiting salmon production in many streams. Excessive silt loads smother eggs in the gravel and reduce insect production (fish food) in riffle areas. Gill irritation and fungus infections result from prolonged exposure to silt-laden water.

Agricultural pollution is primarily from irrigation return flows containing various chemicals and from "accidental" spraying of streams. Occasional spills of agricultural chemicals have resulted in fish losses. (See Problems 3 and 6 in Appendix I for further discussion of water quality problems.)

Passage of upstream adult salmon at Willamette Falls is generally satisfactory in all but high-flow years, when losses of spring chinook have occurred. However, attraction flows and other fishway characteristics are being continually tested and improved to further enhance passage.

Losses of downstream migrants have been reduced substantially through agreements between the fishery agencies and the companies with facilities at Willamette Falls. Agreements prescribe temporary shutdowns of turbines during periods of heavy fish passage. Testing of a fish screen to shunt migrants from turbine intakes is also currently under way. (See Problems 1 and 2 in Appendix I for further discussion of fish passage problems at Willamette Falls.)

Strengthened environmental legislation and more effective management of fish habitat at both state and federal levels has slowed the rate of habitat degradation in the Willamette basin. Personnel of the National Marine Fisheries Service[1/] and Oregon Department of Fish and Wildlife estimate that, with continued attention to habitat protection, at least the present quantity of spawning and rearing area can be maintained. Significant improvements in quality of habitat are possible in some areas and could result in modest increases in salmon production. Major habitat needs include improved streamflows, reduction in fish passage losses of both adults and juveniles at Willamette Falls, and general improvements in stream habitat. A more detailed discussion of the problems which must be overcome to realize salmon production potentials, together with ongoing and proposed actions addressing these problems, is presented in Appendix I. Maintaining and increasing the natural production of salmon will depend primarily on the adequacy of fish passage at barriers and especially at Willamette Falls, on quality of habitat, and on whether or not escapement is adequate to fully use available habitat.

[1/] Personal communication--Richard Pressey, Director of Columbia River Fisheries Development Program--NMFS, 14 August, 1978.

Fish Produced and Spawning Escapements

Annual natural production of salmon in the Willamette River drainage totals about 180,000 fish at the present time (Table 2) compared to only 40,000 prior to improvement of fish passage at Willamette Falls (Table 1). Fish produced naturally plus those from hatcheries total about 306,000 at present.

Table 2. Estimated total of naturally produced salmon from the Willamette Basin.

	Fish Produced		
Species/race	*Catch*	*Escapement*	*Total*
Spring chinook[1]	25,900	12,950	38,850
Fall chinook[2]	76,625	15,325	91,950
Coho[3]	40,250	8,050	48,300
Totals	142,775	36,325	179,100

1 Escapement based on average passage at Willamette Falls plus Clackamas River escapement for 1974-78 (37,015) x 0.35 (the estimated % of spring chinook produced naturally and from rearing ponds = 12,950). Catch based on 2:1 catch to escapement ratio.

2 Escapement based on average passage at Willamette Falls for 1973-77 (29,300) plus average of Clackamas River fall chinook escapement for same period (1,350). Roy Sams (ODFW), estimates 50% of this total is produced naturally. Catch based on 5:1 catch to escapement ratio.

3 Escapement based on 1976 Willamette Falls counts (4,550) plus estimated spawning escapement below Willamette Falls and in Clackamas River (3,500). A single year's data was used because lower Willamette/Clackamas data available for only 1976. All coho are assumed to be from natural production. Catch based on 5:1 catch to escapement ratio.

If the salmon habitat is enhanced as outlined in Table 3, and adequate escapement assured, the total salmon catch from natural production could increase from 143,000 to 191,000 (Table 4). Opportunities to increase the natural production of spring chinook significantly appear limited. If losses to downstream migrants passing Willamette Falls were reduced, a modest increase in catch over the present level could occur.

Table 3. Two scenarios depicting future salmon catch in 10-20 years based on two levels of habitat management.

Activity impacting streams	*Level of management*	
	Present level	*Enhancement level*
Passage of downstream migrants and adults at Willamette Falls	Gain no improvements over existing conditions.	Reduce delays and losses to a minor problem.
Streamflows	Gain no additional minimum flow protection.	Significantly increase present level of stream-flow protection.
Pollution	Maintain no more than existing level of pollution reporting, control and enforcements.	Strengthen pollution control and conduct research to understand impacts of new chemicals on environments.
Stream alterations, logging and road construction	Maintain present level of control of these activities.	Strengthen laws and penalties for stream alterations. Increase surveillance of riparian activities. Develop new techniques to reduce impacts of streamside disturbances.
Filling and removal of materials in waterways	Maintain present level of control.	Increase surveillance of fill/removal activities. Strengthen enforcement and increase penalties for infraction of rules.
Stream improvement	Maintain present level of chemical rehabilitation and stream improvement.	Step up level of chemical control of unwanted and competing species. Expand existing program of stream improvement (gabians, pool developments) and develop new techniques to increase natural production.
Fish passage	Maintain present level of correcting fish passage problems.	Correct fish passage problems more rapidly.
Anticipated catch	142,775 (present level) to 128,500 (a 10% reduction).	142,775 present level to 191,000 (a 34% increase).

Table 4. Potential increase in catch of naturally produced salmon from Willamette Basin streams.

Species/race	*Present*	*Catch Dates*	*By 1990*
Spring chinook	25,900	(1974-78)	27,000
Fall chinook	76,625	(1973-77)	104,000
Coho	40,250	(1976)	60,000
Totals	142,775		191,000

Some increases in the fall chinook catch are possible if losses to downstream migrants passing Willamette Falls are reduced and other limiting factors identified and corrected. However, substantial increases in catch are dependent on larger escapements. Increased escapement would more fully utilize available spawning and rearing areas that are currently under-used. Unfortunately, we are unable to forecast with certainty the relationship between increasing escapements and production for future years.

The coho catch could be increased through such habitat improvements as better fish passage on some small streams and better streamflows and water quality.

Trends in salmon production were determined by analysis of records on fish passage over Willamette Falls. These data combine both naturally produced fish and those of hatchery origin, and are reported annually in special reports by the Oregon Department of Fish and Wildlife. Estimates of wild production as a percentage of the total passage over Willamette Falls were developed for each salmon species/race, as already explained in Table 2. Estimates of the percentage of wild fish in the run have not been available in the past; therefore, trends in wild fish production could not be developed. Generally, escapements of spring chinook appear to be relatively stable, with about 10,000 to 15,000 fish annually passing over Willamette Falls. There is no historical documentation of a fall chinook run above Willamette Falls. The present run stems from massive releases of fish from stocks obtained at lower Columbia River hatcheries, mainly Bonneville. Although some fish were hatchery-reared for a period of time, most have been produced in supplemental rearing ponds within the basin. Escapements for natural spawning fall chinook are now believed to be about 15,000 fish annually and increasing. Coho are at least maintaining themselves in the Basin, with a total annual escapement above and below Willamette Falls of about 8000 fish annually.

Firm estimates of the number of wild fish needed in escapements have not been established for the Willamette basin. Goals will be defined upon completion of several stock assessment studies under way and development of operational plans for each of the Willamette sub-basins. In the interim, the tentative escapement goal for spring chinook is 15,000 adults, for fall chinook 25,000 adults, and for coho 8000 adults (Table 1).

Columbia River Main Stem and Tributaries Downstream from Bonneville Dam

Availability and Quality of Habitat

Habitat for salmon in the Columbia River and tributaries downstream from Bonneville Dam excluding the Willamette system has declined from 709 to 552 miles for chinook salmon, 903 to 703 miles for coho salmon and 250 to 144 miles for chum salmon (Table 1). The amount of habitat will not change in the future with the present trend and no enhancement is visualized to increase the amount of habitat.

Fish Produced and Spawning Escapements

Chinook Salmon: Prior to water developments, about 1 million chinook salmon were produced in the Columbia River and tributaries downstream from Bonneville Dam (Table 1). At present, production of wild chinook salmon averages less than 400,000 fish per year and probably will not change with the present trend. With enhancement (mainly increased spawning escapements), production could increase to about 500,000 fish.

The present annual average escapement of chinook salmon is less than the 100,000 fish managers believe are necessary to fully seed the habitat.

Coho Salmon: Production of coho salmon in the lower Columbia River and tributaries amounts to fewer than 400,000 fish at present, compared to 900,000 prior to water developments. Production will remain at the 400,000 fish level if the present trend continues and could increase to over 500,000 fish with larger escapements (Table 1).

Present spawning escapements average under 50,000 fish annually and managers believe that more than 100,000 fish are needed for full utilization of the present habitat.

Chum Salmon: Chum salmon spawn in lower Columbia River tributaries such as Hamilton, Germany and Abernathy creeks, and the Grays River system. Chum salmon are the least abundant of the salmon in the Columbia River system. Since the early 1950's, index counts in Washington tributaries dropped from 800 fish per mile to 50 fish per mile in 1975. Natural spawning areas for chum salmon have been reduced to about 63 percent of the area formerly accessible.

Prior to water developments, an estimated 950,000 chum salmon were produced annually in the lower Columbia River and tributaries. At the present time annual production is only 15,000 fish and will drop if the present trend continues. With larger escapements and some habitat enhancement, production could reach 150,000 fish (Table 1).

Escapements for spawning are presently about 5000 fish, compared to the 50,000 managers believe are needed to fully use the habitat presently available.

Snake River Drainage

Availability and Quality of Habitat

In its original condition, the Snake River drainage provided an estimated 7739 miles of spawning, rearing and migration habitat for salmon (Table 1). Except for localized and temporary adverse conditions occasionally resulting from natural phenomena, the quality of habitat used by salmon was excellent. Some natural obstructions were present that could have impeded adult upstream passage into a few of the tributary streams during certain water conditions, but there were no known impediments or factors that would have created critical conditions for downstream migrating smolts.

Approximately 46 percent of the habitat originally present in the Snake River drainage is no longer available to salmon (71 percent for fall run chinook). The largest losses resulted from the construction of dams that prevent access to historical spawning and rearing areas. Lesser but still significant elimination and degradation of habitat have occurred as a result of water diversion, water pollution, and dredging, diking and channelization (Table 5).

Table 5. Salmon habitat lost in the Snake River and tributaries, primary cause of loss, and remaining habitat presently available, by major drainage.

Major drainage	*Miles of lost habitat*	*Primary cause of lost habitat*	*Miles of habitat presently available*
Main stem Snake and minor tributaries	440	Dams, diversion	175
Walla Walla	126	Diversion, channelization	0
Tucannon	0		55
Clearwater	627	Dam	1,248
Grande Ronde	0		647
Salmon	88	Pollution	1,834
Imnaha	0		223
Powder	200	Dams	0
Burnt	140	Dams	0
Weiser	256	Dams	0
Payette	470	Dams	0
Boise	520	Dams	0
Owyhee	485	Dams	0
Malheur	205	Dams	0
Total	3,557		4,182

Factors adversely affecting the quality of presently available salmon habitat are categorized and defined in "Comprehensive Salmon Management Plan, Background Documents, 1977-78. Environmental Factors, Factors Affecting the Columbia River Chinook and Coho Salmon Resources in Fresh Water," Pacific Fisheries Management Council.

Some or all of these factors (e.g., fish passage, water diversion, water quality, dredging, diking and channelization) are adversely affecting salmon habitat to varying degrees wherever development has occurred in the drainage. Specific areas with major problems are listed in Table 6.

Table 6. Streams presently available to salmon with the major problems listed.

Stream	*Problem category*
Mainstem Snake River	Fish passage
Alpowa Creek	Diversion
Tucannon River	Channelization
South Fork Clearwater	Channelization
Grande Ronde River	Diversion and channelization
Joseph Creek	Water quality
Wallowa River	Channelization
Bear Valley Creek	Dredging
South Fork Salmon River	Water quality
East Fork Salmon River	Water quality
Yankee Fork Salmon River	Dredging
Upper Mainstem Salmon River	Diversion

Based on present information, salmon habitat in the Snake River drainage will not be further reduced by new dam construction during the next 10 to 20 years. Substantial portions of presently available habitat can be lost or further degraded if water and land use planning and management programs involving water diversion, logging and mining do not give adequate consideration to salmon habitat. To reverse the current trend of declining habitat quality, a number of ongoing programs must be continued, new programs initiated, and certain issues resolved. To accomplish this, concerted action will be necessary by appropriate legislative bodies, state and local political subdivisions, and state and federal agencies.

Actions to solve current habitat problems can be classified into two categories--improvement of poor quality habitat and preservation of good quality habitat.

Improvement: The upstream and downstream fish passage problems created by the lower Snake and Columbia river dams are the single most adverse factor affecting Snake River salmon runs. Direct and indirect losses are severe and all runs are subject to these losses.

Structural modifications and improvements to facilitate passage at these dams are under way. There is an ongoing program to collect and transport downstream migrants around Snake and Columbia river dams when necessary. Flow regulation programs to aid both upstream and downstream migration have recently been initiated and must be expanded. Necessary additional research on fish passage is in progress or proposed. The continuation and successful execution of all of the above programs are essential to the maintenance of wild salmon stocks and will complement mitigation programs involving hatchery-produced salmon.

Many miles of habitat have been made available to salmon through removal of natural stream barriers such as minor falls and log jams. In some areas, this program is now being carried out by federal land management agencies as a part of their comprehensive habitat management program. If problems at the dams can be resolved and larger numbers of salmon produced through increased survival of migrants, the additional spawning and rearing areas will lead to a long-term increase in salmon runs.

An extensive program of screening downstream migrating salmon from irrigation diversions has been in effect for many years in almost all areas of salmon habitat where irrigated agriculture takes place. Without this program, salmon runs into many streams would have been greatly reduced or eliminated.

Preservation: Studies are under way and decisions are currently being made that could designate portions of national forest lands as wilderness areas and establish wild and scenic rivers. Certain areas under consideration contain critical high-quality salmon habitat and should receive wilderness or wild and scenic river classification to assure preservation of this habitat.

A mineral withdrawal has been filed by the U.S. Fish and Wildlife Service on certain lands in headwaters of the Middle Fork Salmon River to protect critical salmon spawning and rearing areas from further degradation by mining activity. The granting of this withdrawal is critical to the preservation of a major salmon production area.

Successful conclusion of both these issues would result in the maintenance of existing salmon production and lead to increased future production if downstream fish passage problems are resolved.

State and federal fishery agencies are involved on a continuing basis with review and comment on state and federal stream alteration and discharge permits, proposed mining, logging and grazing programs, and comprehensive land management plans, to ensure that salmon habitat is protected to the extent possible. These and other similar efforts will continue to preserve much salmon habitat that would otherwise be severely degraded or eliminated.

Fish Produced and Spawning Escapements

Chinook: Three races of chinook salmon are present in the Snake River drainage--spring run, summer run and fall run. Although there are some exceptions and overlaps, generally speaking, spring chinook spawn in smaller tributaries and upper reaches of principal tributaries and summer chinook spawn in the mid-portions of larger tributaries. Fall chinook spawning is apparently confined to the accessible portion of the main Snake River. Available records indicate that chinook spawn in all suitable, accessible waters throughout the drainage.

Records and accounts relating to pre-development numbers of chinook are sparse and rather vague. A rough estimate of these numbers has been arrived at by using what records are available, relating them to the earliest definitive fish counts, and extrapolating to habitat available prior to water developments (Table 1). On this basis, an estimated 1.4 million chinook salmon were produced in the Snake River drainage prior to development activities.

At the present time, only about 113,000 chinook salmon are being produced in the Snake River drainage (Table 1). If the present trend continues, production will decrease to 75,000 or fewer fish. Fall and summer chinook are at dangerously low levels. Only spring chinook are still relatively abundant, but their existence is threatened.

Three major factors are affecting present-day salmon production in the Snake River drainage: 1) improvements for fish passage completed or being implemented at lower Snake River dams are improving the chances of maintaining viable salmon populations; 2) consumptive water diversions and 3) flow regulation are exerting a negative influence, along with continued degradation of spawning and rearing habitat. Interaction of these positive and negative influences must be considered when assessing the potential for future salmon production.

If solutions to the passage problems at the dams meet our highest expectations and existing habitat is maintained in good condition, chinook salmon production could increase to 419,000 fish (Table 1). If migration past the dams continues to cause higher than normal mortality, the naturally produced stocks of fish may not be able to maintain themselves above remnant status and may even cease to exist. It may become necessary to supplement the naturally produced runs of fish with hatchery-reared smolts to maintain production at levels that will support sport and commercial fisheries. Escapements of chinook salmon are presently averaging 30,000 fish per year, but 124,000 fish would be needed annually to fully use present habitat.

Sockeye: Sockeye salmon production areas were never abundant in the Snake River drainage. Spawning runs entered Wallowa Lake in the Grande Ronde River drainage, Payette Lake in the Payette River drainage and Redfish, Pettit, Alturas and Yellowbelly lakes in the Upper Salmon River drainage.

Old records contain some isolated catch records and references to relative abundance of sockeye in the three lake systems. From this information we estimate 150,000 sockeye salmon were produced in the Snake River drainage prior to development (Table 1). Sockeye salmon are barely holding on in the Snake River drainage at present and will probably cease to exist if actions are not taken immediately. Escapements are 300 fish or less at present, with an estimated 5000 fish needed to fully seed rearing areas (Table 1).

Coho: According to past records, the lower Snake River tributaries, Clearwater River and Grande Ronde River drainages supported the bulk of the coho produced in the Snake River drainage prior to water developments. Coho appear to have been most abundant in the Grande Ronde River drainage.

No catch records or descriptions of relative abundance in the 19th and 20th centuries were found. Estimates of total numbers prior to developments are deduced from relatively recent dam counts and the nature and amount of habitat formerly used. We estimate that 200,000 coho salmon were produced in the Snake River drainage prior to water developments (Table 1).

At the present time, only about 5000 coho salmon are produced in the Snake River drainage. With enhanced passage at the dams and improved habitat, an estimated 30,000 fish could be produced. Escapements average about 900 fish annually at present, with an estimated 5000 fish needed to fully use the available habitat (Table 1).

Columbia River Mainstem and Tributaries Upstream from Bonneville Dam

Availability and Quality of Habitat

Habitat for salmon in the Columbia River and its tributaries (excluding the Snake River) upstream from Bonneville Dam has declined from 2098 to 1030 miles for chinook salmon, 824 to 193 miles for sockeye salmon, and 754 to 705 miles for coho salmon (Table 1).

Water development projects on the Columbia River and its tributaries are the primary causes of the loss of natural spawning and rearing areas. The only remaining natural spawning ground for salmon in the mainstem Columbia River is a portion of the 50-mile stretch of free-flowing river between the upstream end of McNary Reservoir and Priest Rapids Dam. This free-flowing reach of the mainstem Columbia River supports a remnant fall chinook spawning population that ranges from 22,000 to 32,000 fish annually. An estimated 10,000 steelhead trout also spawn in this reach of the river.

Natural spawning and rearing habitat for salmon is still available in most of the Columbia River tributaries below Chief Joseph Dam; however, dams on several of these tributaries have blocked access or inundated areas formerly used for spawning and rearing.

With proper enhancement, the amount of habitat could be increased to 1400 miles for chinook salmon and 500 miles for sockeye salmon (Table 1). No plans are being made to increase coho habitat.

Fish Produced and Spawning Escapements

Chinook Salmon: Prior to water developments, the Columbia River and tributaries upstream from Bonneville Dam produced an estimated 1 million chinook salmon annually (Table 1). At the present time under 500,000 chinook are produced naturally in that section of the drainage, but production will drop to about 300,000 fish if the present trend continues. With habitat enhancement, natural production could be increased to over 500,000 fish.

The present escapement of chinook salmon into Columbia River and tributaries above Bonneville Dam for natural spawning is estimated to be less than 100,000 fish (Table 1). An escapement of more than 100,000 adults is needed to get maximum production.

The upriver run of spring chinook salmon has been severely affected by loss and degradation of habitat and mortalities at main-stem dams. Spring chinook salmon spawn in several tributaries of the upper Columbia River such as the Methow, Entiat, Wenatchee, Yakima, noted separately Klickitat, Deschutes, Wind, in addition to the Snake River. Except for 1974 and 1975, production levels have been above 1.5 fish returning per spawner since 1953. From 1957 through 1974, upriver spring chinook runs from all areas including the Snake River averaged 181,200 fish. To protect the upriver run of spring chinook, no commercial or sport fishery was allowed in the lower Columbia River during the spring of 1975.

Summer chinook salmon have also been severely affected by loss and degradation of habitat and mortalities at main-stem dams. From 1959 to 1972, production rates for combined upriver stocks had dropped to barely more than one fish returning per spawner. Since 1972, these stocks have not been able to maintain a viable level of production. Because of the low production level, no commercial fishery for summer chinook has been allowed in the Columbia River since 1964. In 1974, the total upriver run of summer chinook as measured by the count at Bonneville Dam was 34,000 fish, the smallest run on record.

Summer chinook salmon in the upper Columbia exclusive of the Snake River spawn in primarily the Okanogan, Methow, Entiat and Wenatchee river systems. Natural spawning and rearing areas are presently restricted to about 35 percent of the area formerly accessible.

Fall chinook salmon spawn in several tributaries of the upper Columbia River such as the Yakima, Deschutes, Klickitat, White Salmon and Wind rivers, and in the main-stem of the Columbia River. Natural spawning and rearing areas for fall chinook in the Columbia River system have decreased from the formerly accessible areas primarily because of the construction of dams which inundated spawning and rearing areas.

Sockeye Salmon: At the present time, only about 80,000 sockeye salmon are produced in the Columbia River and tributaries upstream from Bonneville Dam (Table 1). Before water development activities blocked access to major sockeye production drainages, about 500,000 fish were produced annually. If the present trend continues, we expect the sockeye population to decline to about 60,000 fish. If some presently unavailable habitat is restored, sockeye production could be increased to about 150,000 fish annually.

Escapement for spawning has averaged about 50,000 fish in recent years, but 80,000 fish are needed for full seeding of existing rearing areas.

Sockeye salmon migrate primarily to the upper Columbia River and spawn in the Okanogan and Wenatchee River systems. In 1975, the Columbia River sockeye run contained an estimated 55,400 fish counted at Priest Rapids Dam compared to the 1957 to 1974 average of 124,000 fish. Natural spawning and rearing areas for sockeye salmon in the Columbia River system have been reduced to about 22 percent of the area formerly accessible. No commercial fishery for sockeye salmon has been allowed in the lower Columbia River since 1972.

Coho Salmon: At the present time, an average of less than 80,000 coho salmon are naturally produced each year in the Columbia River and tributaries upstream from Bonneville Dam. Before water developments, only about 35,000 coho were produced (Table 1). With some enhancement of the habitat production could be increased to over 100,000 fish.

Present spawning escapements average under 10,000 fish per year and 40,000 is the estimated number needed to fully seed the natural habitat (Table 1).

OREGON COASTAL STREAMS

Availability and Quality of Habitat

Prior to settlement of coastal watersheds, streamside cover, flows and water quality were ideal for salmon production. Early settlers had little impact on these pristine conditions. However, by the mid-1900s, natural stream conditions had been altered and natural salmon production significantly reduced.

Major losses in salmon production have occurred as a result of deterioration in quality of habitat rather than physical barriers to fish passage. Probably no more than 1 percent of the total miles of streams in coastal basins have become inaccessible to fish production because of developments (Table 1). Fish passage provided around natural barriers has added spawning and rearing habitat at least equal to the areas lost because of man-made barriers. Mining was one of the first activities that had a detrimental impact on fish populations. Siltation from mining operations smothered eggs in the gravel and reduced fish food production. Logging of entire watersheds in one continuous operation was common in the past and usually resulted in widespread and severe siltation, log and debris jams, landslides and high water temperatures. Splash dams were common on the Umpqua, Coos and Coquille rivers and their use scoured stream beds of spawning gravels and blocked fish runs. Agricultural development removed water and increased siltation and water temperatures, particularly in smaller streams. Waste discharge from industrial and municipal developments further reduced water quality. Land fills and other developments in estuaries have reduced productivity of fish rearing areas.

Currently, over half the estimated 11,700 miles of Oregon coastal streams are available to salmon (Table 7). The remaining stream areas are generally steep headwater tributaries unsuited for spawning and rearing. Many coastal streams had impassable falls but fish passage has been provided in most streams with suitable habitat above the barriers, except where construction costs are prohibitive. Salmon adults or fry are often released above the remaining barriers. The few dams on coastal streams are responsible for only a small part of the stream miles presently inaccessible to salmon. The largest dam (Lost Creek) is on the upper Rogue River and a hatchery was built to mitigate for loss of natural fish production. Savage Rapids and Gold Ray dams on the Rogue River, near Grants Pass, and Winchester Dam on the North Fork of the Umpqua, near Roseburg, are equipped with fishways. Savage Rapids Dam has inadequate fishways that cause delays and losses to migrating fish but renovation is under way. Most of the smaller dams on coastal streams are equipped with fishways, although some need improvement.

Table 7. Miles of stream habitat available to salmon in Oregon Coastal Basins.

		Number of stream miles used by:			
Basin	*Stream miles in Basin*	*Spring chinook*	*Fall chinook*	*Coho*	*Chum*
North coast	1,500	200	400	1,200	220
Central coast	2,500	200	700	1,900	65
South coast[1]	7,700	600	1,400	3,000	25
Totals	11,700	1,000	2,500	6,100	310

1 Includes Umpqua and Rogue basins.

The most obvious loss of habitat in coastal streams is the result of water withdrawals for agriculture and other purposes. Less obvious but probably the greatest single source of habitat degradation is the smothering of spawning and rearing areas by the deposition of fine sediment. Channelization of streams for road construction, particularly where the channel is straightened and all cover removed, reduces fish production. Land clearing adjacent to streams often result in significant increases in temperatures and unstable stream channels. Logging debris was formerly a major problem in coastal streams but improved utilization of wood products, more stringent laws relating to forest practices, and prompt removal of debris when it does occur, have greatly reduced this problem. (See Problems 2, 4, 5, 6, 7 and 8 in APPENDIX III for further discussion of habitat and fish passage problems.)

Coastal streams have widely fluctuating water flows because most of the precipitation is rain. There are no large snow fields such as occur in the Cascades to maintain summer streamflows. Low summer flows limit the carrying capacity of many coastal streams by reducing fish rearing areas, fish food production areas, and by increasing stream temperatures.

Lost Creek project on the Rogue River is designed to store winter flows for release later in the year for power and irrigation. Increased streamflows downstream of this project, if properly scheduled, will benefit fish life in the main Rogue River. Storage reservoirs on the North Fork Umpqua River are used to maintain flows in that stream below the project. Flood control reservoirs are planned for the South Fork Umpqua and the Applegate River, a Rogue tributary. Flow release schedules from these projects can be designed to benefit fish production.

Water diversions for irrigation in the Rogue and Umpqua basins reduce fish production. Some Rogue tributaries are completely diverted for irrigation and many others partially diverted. Fish screens have been installed throughout the upper Rogue Basin to prevent fish loss in irrigation canals. (See Problem 4 in APPENDIX III for further discussion of streamflow problem.)

Summer water temperatures reach critical levels in many of the coastal streams because of low flows and lack of streamside cover. For salmonid rearing, stream temperatures should not exceed 18 C but temperatures over 25 C have been recorded. Outbreaks of diseases, including _Columnaris_ and _Furunculosis_ have been triggered by high temperatures. Upstream migration of adults may also be delayed by high temperatures when adults are forced into cooler tributaries until main stem temperatures drop.

Silt deposition is one of the major limiting factors of salmon production in Oregon coastal streams. Excessive silt loads smother eggs in the gravel and reduce insect production (fish food) in riffle areas. Gill irritation and fungus infections also can result from prolonged exposure to silt-laden water. Silt deposition on low gradient chum spawning areas is believed to be a major reason for the decline in production of that species.

Much of the industrial pollution in coastal streams and estuaries is associated with the lumber industry. Log pond discharges and glue wastes from plywood mills have serious effects on fish production in some of the smaller streams. However, these problems are generally being corrected through more stringent water quality laws and discontinued use of many small log ponds. Log rafting in estuaries results in bark and debris deposits settling on the bottom and smothering fish foods. Cannery wastes in the upper Rogue River Valley also contribute to stream pollution and depress fish production.

Agricultural pollution is primarily from irrigation runoff containing various chemicals entering streams and from "accidental" spraying of streams. Occasional spills of agricultural chemicals have also resulted in fish losses. (See Problems 2 and 3 in APPENDIX II for further discussion of water quality problems.)

Strengthened environmental legislation and more effective management of fish habitat at both state and federal levels has slowed the rate of habitat degradation in Oregon's coastal basins. Increases in salmon production are possible with improvements in spawning and rearing habitat (Table 8). Improved streamflows through flow augmentation and increased allocation of these flows for fisheries is a major need. There is little opportunity to increase the number of stream miles available to salmon. Increases in production are possible with improvements in quality of the habitat if spawning escapements are adequate to fully use that habitat. A more detailed discussion of the problems that must be overcome to realize full salmon production together with ongoing and proposed actions is presented in APPENDIX III.

Fish Produced and Spawning Escapements

Coast-wide production from wild Oregon salmon stocks was not estimated prior to 1977. In 1977, coastal biologists were asked to estimate spring and fall chinook and coho salmon escapements in all major coastal basins. Estimates were based on fish counts at dams, surveys of spawning salmon, and available habitat. These escapement estimates were modified for use in this report after considering ocean harvest data, catch to escapement ratios and relationships between wild and hatchery stocks. Escapement and production estimates for Oregon coastal salmon stocks are presented in Table 1.

With improvements in salmon habitat and adequate escapements, the total salmon catch could increase by approximately 10 percent. However, satisfactory resolution of all or a major portion of the problems identified in APPENDIX II and Table 8 is needed to achieve a significant increase in catch over the current level. It may be necessary to restrict the harvest to assure adequate escapements to fully use available habitat.

The best indicator of trends in natural salmon production is found in the number of spawning salmon counted on standard area stream surveys. Ten survey units for coho and 12 for fall chinook have been counted annually on coastal streams since 1950 by Department of Fish and Wildlife

Table 8. Two scenarios depicting future salmon catch in 10-20 years based on two levels of habitat management.

Activity impacting stream	*Level of management*	
	Present level	*Enhancement level*
Streamflows	Gain no additional minimum flow protection.	Significantly increase present level of streamflow protection.
Pollution	Maintain no more than existing level of pollution reporting, control and enforcement.	Strengthen pollution control and conduct research to understand impacts of new chemicals on environments.
Stream alterations, logging, and road construction	Maintain present level of control of these activities.	Strengthen laws, enforcement and penalties for stream alterations. Increase surveillance of riparian activities. Develop new techniques to reduce impacts of streamside disturbances.
Filling and removal of materials in waterways	Maintain present level of control.	Increase surveillance of fill/removal activities. Strengthen enforcement and increase penalties for infraction of rules.
Stream improvement	Maintain present level of chemical rehabilitation and stream improvement.	Step up level of chemical control of unwanted and competing species. Expand existing program of stream improvement (gabians, pool developments) and develop new techniques to increase natural production.
Fish passage	Maintain present level of correcting fish passage problems.	Correct fish passage problems more rapidly.
Anticipated catch	A 20% reduction	A 10% increase

personnel. Numbers of fish observed in individual index areas have varied considerably, but the number of spawning coho has declined since 1971 (Figure 2). Low counts of spawning coho in recent years are believed to be a reflection of excessive ocean harvest of wild fish, inadequate escapements and reduced production from degraded freshwater environment. Counts of spawning chinook salmon, although variable from year to year, have not shown a pronounced trend.

Escapement goals for wild fish in Oregon coastal streams have not been established but will be required to implement the Fish and Wildlife Commission's recently adopted Wild Fish Management Policy. A major research effort is just beginning. The initial thrust will be to examine coho escapement in coastal streams and the general levels of escapement necessary for optimum production. Later effort will be directed to other salmon stocks. Until research results become available, tentative escapement goals have been established as shown in Table 1. These goals may differ slightly from those presented in the Pacific Fishery Management Council's 1978 Fishery Management Plan for ocean salmon fisheries (p. 141).

WASHINGTON COASTAL STREAMS AND PUGET SOUND

The Washington coast and Puget Sound are divided for management purposes and this report into six major geographical units. Much of the information presented herein is available in more detail in Williams, Laramie and Ames (1975) and in Phinney and Bucknell (Williams, ed. 1975).

The amount of spawning and rearing area historically available and the associated level of fish production are currently being analyzed by Washington Department of Fisheries personnel as a major aspect of the current litigation of Phase II, U.S. vs. Washington (Boldt Decision), and estimates cannot be presented at this time. There is no doubt that available area and production have declined, but the extent of such decline is as yet undetermined.

Estimation of historic production is complicated by recent increases in ocean fishery interceptions, increased hatchery production, opening of previously inaccessible areas, straying of hatchery fish, outplants of hatchery production, and other factors. Further, some salmon stocks, such as chum salmon, have shown broad coastwide declines that cannot be explained completely by over-fishing or environmental damage.

For the same reasons, estimates of future available habitat cannot be made at this time. It is safe to assume, however, that removing existing blocks to migration or providing for transportation of adults around such blocks could increase the amount of suitable habitat. Such action would increase coho production by about 10 percent, but other species to a lesser degree, as the habitat above such blocks is generally less suited for other species.

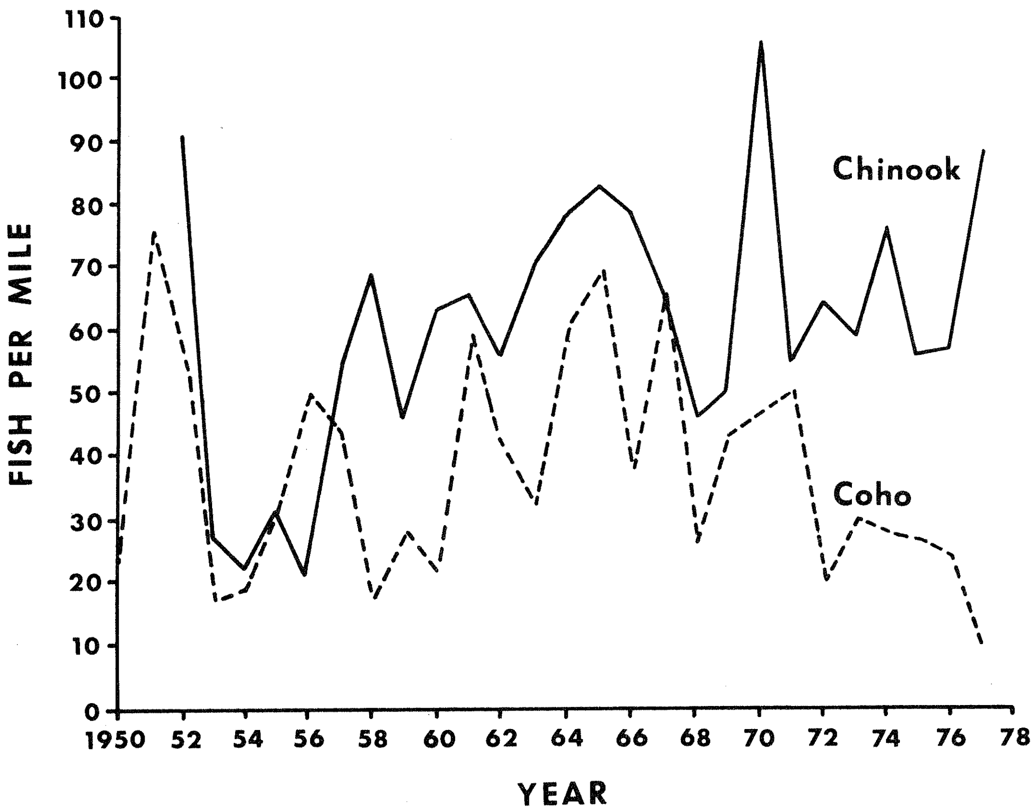

Figure 2. Counts of spawning coho and chinook salmon in Oregon coastal stream index areas, 1950-77.

Other methods of habitat improvement include gravel cleaning and stream bank stabilization. Washington Department of Fisheries personnel do not believe that such techniques have been fully demonstrated to be a cost-effective means of increasing production and have, therefore, asked the President's Task Force on Northwest Fishing Problems to fund a study to determine the efficacy of such methods.

South Coast

Availability and Quality of Habitat

The south coast consists of the Grays Harbor and Willapa Bay drainages, and produces important runs of fall chinook, coho and chum salmon. The Willapa drainage is made up of a total of 754 rivers and streams, totaling over 1470 linear miles, an estimated 630 miles of which are used for anadromous fish migration, spawning and rearing. Grays Harbor drainage contains 1391 rivers and streams totaling 3353 linear miles, an estimated 40 percent of which is utilized by anadromous fish.

Willapa Harbor is composed of several moderate sized drainages; all supporting runs of fall chinook salmon. Additionally, several small streams support important chinook runs. Coho salmon use virtually all accessible stream area, while chum salmon are found in only the lower reaches of most streams.

Major causes of habitat loss in Willapa Bay are related to logging and associated road-building. On the positive side, several Willapa streams that historically had natural blocks to migration have been cleared, opening new areas for production. No significant future developments are anticipated.

Grays Harbor drainage is composed primarily of the Chehalis River system, plus a number of smaller drainages. Fall chinook, coho and chum salmon are the major salmon resources. There is also a small run of spring chinook. Sockeye and pink salmon are rarely encountered.

Spring chinook spawn in the upper reaches of the Chehalis system. Fall chinook are present in all larger and some smaller tributaries; coho salmon occur in virtually all accessible stream areas. Chum salmon spawn primarily in the larger tributaries on the north side of Grays Harbor and tributaries entering the north side of the lower Chehalis River.

The Grays Harbor watershed suffers from more severe problems than does Willapa Bay; in addition to problems from logging and road-building, there are water quality problems in some streams and in a portion of the estuary. Sources of these water quality problems are domestic and agricultural pollutants in the streams and domestic and industrial effluents in the estuary. Water temperature problems exist during the summer low-flow period in the upper Chehalis River. Some salmon production area has been removed from the watershed by the construction of the two dams; however, these losses have been mitigated.

As in Willapa, several natural blocks have been corrected to allow fish passage, and splash dams formerly blocking many streams have been removed. One major development under construction is the Satsop Nuclear Plant on the lower Chehalis River, the impact of which is undetermined. No other major developments are anticipated.

Spawning Escapements

Total production for fall chinook, coho, sockeye and chum on the south coast has averaged 30,000, 112,000 70,000 and 108,000, respectively. Natural chinook escapement has averaged 6100 fish annually. Coho escapement estimates for Grays Harbor and Willapa Bay are about 28,000. Willapa Bay chum escapement averages about 24,000 fish annually; Grays Harbor chum escapement estimates are not available, but may be about half those of Willapa Bay. Estimates of escapement and production for the south coast spring chinook run are not available.

North Coast

Availability and Quality of Habitat

The north coast includes all coastal drainages north of Grays Harbor. It is divided into the Queets-Quinault and Soleduck-Hoh basins.

Major watersheds of the Queets-Quinault basin are the Queets, Raft, Quinault, Moclips and Copalis rivers. There are 780 rivers and streams, totaling 1500 linear stream miles, over 370 miles of which support anadromous fish runs.

All five species of salmon are present in the basin. Spring, summer and fall chinook occur in the Queets and Quinault rivers. Coho salmon spawn in virtually all accessible streams. Remnant chum runs also exist in the Quinault and Queets rivers. The Quinault River produces a significant sockeye run, and a few sockeye spawn in the Queets. A small number of pink salmon occur in each of these two major rivers in odd-numbered years.

Commercial catches of salmon are taken in the Queets and Quinault rivers by Quinault Indians. The Moclips and Raft rivers formerly supported fisheries, but runs have declined and the fisheries were discontinued.

Major obstacles to natural fish production are related to logging and road-building activities. As in the south coast, a number of natural fish passage blocks have been removed.

Major watersheds of the Soleduck-Hoh basin are the Suez, Ozette, Quillayute and Hoh rivers; a number of smaller drainages enter directly into the ocean. There are 569 rivers and streams containing 1355 stream miles, over 600 miles of which are open to salmon production.

All five species of salmon spawn in basin streams. Spring and summer chinook are found primarily in the upper Soleduck and its north fork and in the Hoh River. Fall chinook spawn throughout the Quillayute system and in the Hoh, Suez and Ozette rivers. Coho are found in most accessible streams. Chum salmon distribution is greatly reduced over former levels, with the largest runs occurring in the Suez and Ozette rivers. Pink salmon runs are negligible. Small sockeye runs occur in several areas, predominantly the Ozette River.

Most habitat problems in the Soleduck-Hoh basin are related to logging and road-building. Siltation and debris are the most common problems, with some channel changes. Improperly installed culverts block migration in some small tributaries, and many tributaries have natural blocks to anadromous fish migration, some of which have been corrected. No major future developments are anticipated.

Spawning Escapement

Total production for chinook and coho on the north coast has averaged 30,000 and 80,000 respectively, in recent years. Escapement for north coast chinook is not well documented, but may be of the magnitude of 4000 to 8000, with coho escapement ranging from 15,000 to 25,000. Escapements for both species are a fraction of the potential capacity because of high ocean fishing rates.

Strait of Juan de Fuca

Availability and Quality of Habitat

The Strait of Juan de Fuca includes the Lyre-Hoko and Elwha-Dungeness basins. There are seven large streams, plus many lesser ones, totaling 1520 linear stream miles, of which 374 miles are accessible to salmon. Chinook, coho, chum, and pink all are found in these basins.

The Pysht, Hoko and Elwha rivers are the primary fall chinook production streams; however, fall chinook are present in lesser numbers in all larger and some smaller tributaries. Remnant spring chinook runs spawn in the Hoko, Elwha and Dungeness rivers. Coho salmon occur in virtually all accessible stream areas. Chum salmon spawn in the lower reaches of most of the larger streams and their lower tributaries. Pink salmon use the Elwha and Dungeness rivers.

Major habitat losses are caused by logging, seasonal flooding, low summer flows, irrigation, municipal water demands, physical barriers, and water quality problems throughout the area. The development of power dams on the Elwha River is probably the most significant factor limiting fish production within the entire basin; the lower dam at RM 3.4 blocks all upstream migration. This loss has been mitigated. No significant future developments are anticipated.

Spawning Escapement

Total production for coho, chum, pink and chinook salmon has averaged 17,000, 12,000, 114,000 and 8000, respectively, in recent years, with natural escapements of 4300, 4000, 56,900, and 1600. Except for spring chinook, escapements are generally consistent with available habitat.

Hood Canal

Availability and Quality of Habitat

Hood Canal includes the Hood Canal and Quilcene basins and a portion of the Kitsap basin. There are 963 streams totaling 1526 miles, of which 331 miles are accessible to salmon.

The four principle river systems in the Hood Canal basin are the Skokomish, Hamma Hamma, Duckabush and Dosewallips. Stream gradient throughout the basin is relatively steep. On a number of these streams anadromous fish migration is limited by falls, cascades, or the overall steep terrain.

Four species of Pacific salmon are found here: chinook, coho, pink and chum. Fall chinook are found primarily in the four larger rivers. There are small runs of spring chinook in a few of the larger rivers, remnants of previously larger runs. Virtually all accessible streams are inhabited by coho salmon. Odd-year pink salmon are found in the Dosewallips, Duckabush and Hamma Hamma rivers; the Skokomish River also maintains a small run. Chum salmon are found in most accessible streams in the basin.

Within the Hood Canal basin, major habitat-limiting factors include seasonal flooding, low summer flows, unstable streambeds, impassable falls and cascades, limited spawning areas, municipal and industrial water demands, and some water quality problems.

Chinook, coho, pink and chum salmon use the Quilcene basin. The Big Quilcene River is the largest system in the Quilcene basin and the only system large enough to support chinook salmon. All accessible streams are used by coho salmon and most are used by chum salmon. Major limiting factors include seasonal flooding, low summer flows, and barriers due to gradient, cascades, debris and beaver dams.

Streams of the Kitsap basin flowing into Hood Canal are fairly small and contain fall chinook, coho and chum salmon. Low summer flows and urbanization are the most important limiting factors for west Kitsap streams. The only significant development foreseen is that of the Trident Nuclear Submarine Base, being constructed in northern Hood Canal. The potential effect of that base on migrating salmon is currently being studied.

Spawning Escapement

Total production in Hood Canal for chinook, coho, chum and pink salmon has averaged 12,000, 126,000 216,000 and 166,000, respectively, in recent years. Natural escapement in Hood Canal for chinook, coho, chum and pink salmon, has averaged 2400, 31,600, 72,000 and 83,100, respectively. Except for spring chinook, escapement levels are generally adequate for the available habitat.

South Sound

Availability and Quality of Habitat

The south Puget Sound region includes the Lake Washington, Duwamish, Puyallup, Nisqually, Tacoma, Deschutes, Shelton and Kitsap basins. There are 2719 streams, totaling 4559 stream miles, 1310 miles of which are accessible to salmon. Many of these are in the heart of the state's population centers.

The Lake Washington basin includes of all waters flowing into Lake Washington. Major rivers are the Cedar and Sammamish. Chinook, coho and sockeye are found in the basin. Fall chinook salmon use the Cedar River and sections of the larger Lake Sammamish tributaries. Virtually all accessible streams are used by coho. Sockeye salmon use principally the Cedar River, plus some small drainages, as well as some lake beach areas.

Major limiting factors include low stream flows, poor water quality and concentrated watershed development. Floods in the Cedar River have frequently affected the sockeye run adversely. Landsburg Dam on the Cedar River blocks the upper watershed. Low summer flows below Landsburg are directly associated with municipal and industrial water supply demands. Encroachment of civilization has substantially reduced stream area and quality, consequently reducing fish production.

The Green-Duwamish drainage contains one large river system, the Green-Duwamish River. In addition, five smaller independent drainages enter Puget Sound. Chinook, coho and chum salmon use rivers and streams in the basin. Fall chinook are the predominant chinook stock and prefer the mainstem and lower tributaries. A remnant run of spring chinook uses the upper watershed, while virtually all accessible streams are inhabited by coho salmon. Few chum salmon use the Green-Duwamish river. The independent drainages receive limited runs of chinook, coho and chum salmon.

Industrial and urban developments of the lower Green-Duwamish River area are the most significant factors affecting the fishery resources of the basin. Water quality and suitability of the environment for fish production have been and are continuing to be degraded. Pollution, removal of natural cover and changes in the streams' natural pool-riffle character are the principal factors associated with these developments. Dams block a total of 31 linear miles of natural production area in the upper Green River watershed.

The Puyallup River basin system includes the Puyallup River with numerous tributaries, and two minor independent drainages. Chinook, coho, chum and pink salmon use the basin. Fall chinook spawning and rearing occurs throughout the Puyallup River system. A remnant run of spring chinook inhabits the upper White River. Virtually all accessible streams and tributaries are used by coho salmon. Pink salmon spawning occurs in sections of the mainstem Puyallup and its tributaries. Minor numbers of chum salmon are found throughout the basin.

Within the Puyallup basin, the major limiting factors include seasonal flooding, low summer flows, unstable streambeds, physical barriers, poor water quality and extensive tideland industrialization in the estuary.

The Nisqually River is the principal drainage in the Nisqually basin, with one independent stream. Chinook, coho, pink and chum salmon use the Nisqually basin. Fall chinook use the mainstem Nisqually and its lower tributaries. Nearly every accessible stream supports coho salmon. Pink salmon spawn principally in the mainstem Nisqually River, while chum salmon spawn in the main stem and tributaries. The independent drainage receives small runs of all four species.

Fish production suffers to some extent from low summer flows. In the mainstem Nisqually River, low flow conditions are aggravated by restricted water releases from an upstream dam and by diversion of water into a hydro-electric power canal. Over 30 miles of the upper Nisqually River suitable for use by anadromous fish are blocked by two dams. Logging is the most significant limiting factor in the upper watershed of the basin, and the glacial nature of the river may also limit production.

The Tacoma basin consists of two small drainages between the Puyallup River and the Nisqually River and is used by coho and chum salmon. Alterations to the streams in this basin from construction of roads and communities have seriously reduced stream area and water quality for fish production.

The Deschutes basin, consisting mainly of the Deschutes River, is inhabited by fall chinook and coho. Logging over the upper Deschutes River watershed is one of the major activities affecting fish habitat. This river was historically blocked by a series of natural falls at the mouth, but an extensive fish ladder system has now opened the river to salmon production.

The Shelton basin is composed of numerous small streams. Fall chinook, coho and chum use streams in the basin. Two of the larger streams contain small runs of fall chinook. All accessible streams are used by coho and chum salmon; the drainages are particularly suited to production of chum.

Major limiting factors within the Shelton basin include seasonal flooding, low summer flows, natural barriers, intermittent debris, beaver dams, polluted marine tidelands, and water quality problems associated with summer-home developers.

The Kitsap basin is characterized by small lowland streams. Fall chinook, coho, chum and pink salmon occupy Kitsap basin drainages. Fall chinook use the larger streams and some of their tributaries. All accessible streams are used by coho salmon, and excellent runs of chum salmon inhabit most streams.

Major limiting factors in the Kitsap basin include seasonal flooding, low summer flows, beaver dams, water quality problems in areas of concentrated land development, and major marine activities of the metropolitan centers. No major new developments are foreseen for the south Puget Sound. Current environmental problems will probably continue, with some, such as urbanization, becoming exaggerated.

Spawning Escapement

Total natural production of chinook, pink, sockeye, coho and chum salmon for the entire south Sound have averaged 98,000, 51,000, 312,000, 144,000 and 235,000, respectively, while respective average natural escapements have averaged 19,700, 25,700, 322,800, 36,100 and 78,300 in recent years. Except for depressed spring chinook runs, escapement levels are generally consistent with available habitat.

North Sound

Availability and Quality of Habitat

The north Puget Sound region includes Nooksack, Skagit, Stillaguamish and Snohomish basins. There are 5994 streams, totaling 9762 river miles, of which 1320 miles are accessible to salmon. This is the most important natural salmon production area in Puget Sound.

The Nooksack basin includes all streams and rivers from the Canadian border south to Samish Bay. The Nooksack River is the major system in the basin, with several independent streams.

The Nooksack River is inhabited by four species of Pacific salmon--chinook, coho, pink and chum. Only coho and chum salmon inhabit the smaller independent basin drainages. Virtually all accessible streams and tributaries draining the Nooksack basin are used by coho. Chum salmon use the mainstem Nooksack and its lower tributaries. Pink salmon spawn exclusively in the Nooksack River.

Limiting factors include spring flooding and low summer flows, which have been aggravated by extensive logging. Natural barriers, irrigation and municipal water demands are also limiting factors, as is the expansion of urban and commercial areas.

The Skagit basin represents the largest of the Puget Sound drainages and consists of the Skagit and Samish Rivers. The Skagit River receives runs of all five salmon species, including spring, summer and fall races of chinook. Nearly all accessible streams and tributaries are used by coho. Chum and pink salmon spawn in the mainstem Skagit and several tributaries. Sockeye are found in the Baker River, a major Skagit tributary. The Samish River is inhabited by chinook, coho and chum salmon.

Major limiting factors include seasonal flooding, low summer flows, extreme river fluctuations and natural barriers. Major logging activities are found throughout the basin and are characterized by extensive clearcutting. Hydro-electric power developments on Baker River and the upper Skagit, in addition to blocking access, affect anadromous fish production through alteration of such natural river conditions as flow pattern and water quality. Residential, industrial and commercial expansion in the lower Skagit Valley are increasing.

The Stillaguamish basin consists of the North and South Forks of the Stillaguamish River, which are used by chinook, coho, pink and chum salmon. Spring, summer and fall chinook races are found in the Stillaguamish and coho and pink salmon use virtually all accessible stream areas. Chum salmon are found in lower reaches.

Major limiting factors include substantial siltation, low summer flows and extensive logging activities.

The Snohomish River is the second largest drainage system within the Puget Sound region, consisting of the mainstem Snohomish and its two major forks, the Snoqualmie and Skykomish rivers. Summer and fall chinook use the upper watershed. Coho salmon occur throughout, and pink salmon spawn in the main stem and forks. Chum salmon also spawn primarily in the main stems.

Limiting factors include natural physical barriers and seasonal flooding, primarily the result of excessive intermittent runoff from extensively logged and cleared areas. Snoqualmie Falls presents a complete natural barrier to extensive potential production areas. Natural falls on the South Fork Skykomish have been bypassed. A storage and diversion dam complex exists on the Sultan River. Expanding industrial development, especially in the lower valley, is adding to pollution problems. Foreseen major developments in North Puget Sound include a proposed nuclear plant on the Skagit River, which will have minimal adverse effect, and a proposed dam at Copper Creek on the Skagit, which will eliminate about 20 miles of prime chinook, pink and chum spawning area.

Spawning Escapements

Total production for chinook, pink, sockeye, coho and chum salmon has averaged 130,000, 959,000, 4000, 268,000 and 173,000, respectively, in recent years, while respective natural escapements have averaged 26,000, 479,700, 2900, 66,900 and 57,700. Except for depressed spring chinook runs, escapement levels are generally appropriate for the available spawning and rearing area.

PROPOSED ACTIONS FOR THE PACIFIC FISHERY MANAGEMENT COUNCIL

At the present time, the PFMC could best contribute to solution of salmon habitat problems in fresh water by working to secure the positive cooperation of state and federal agencies whose operations have affected or are now adversely affecting salmon production. The Council could

1. Urge recognition by the U.S. Bureau of Reclamation of fishery resource maintenance and enhancement as a beneficial project purpose, particularly with respect to its Central Valley Project.

2. Request prompt relicensing of old Federal Power Commission (FPC) projects by the Federal Energy Regulatory Commission (FERC) to include measures for fishery mitigation ignored or unavailable at the time original licenses were issued. The original licenses of many FERC projects in California have expired. At some of these projects, potential mitigation and enhancement measures, not included in original licenses, have become apparent. The existing FERC practice of issuing temporary or annual, rather than long-term, licenses has effectively prevented incorporation of measures to benefit fish life.

3. Urge Congress to fund proposed anadromous fishery programs on national forest lands in California.

4. Encourage development of off-channel storage and headwater impoundments to increase streamflows. The Oregon Department of Fish and Wildlife recently appeared before the House Appropriations Committee Subcommittee on Public Works to support funding through the Bureau of Reclamation for construction of headwater dams on the Umatilla, John Day, Deschutes and Grande Ronde rivers. Council support for this proposal and others in a similar vein is welcome.

5. Support adoption of minimum and optimal streamflow recommendations by state and federal regulatory agencies. More rapid adoption of the streamflow recommendations developed by fishery agencies is needed. In addition, streamflows and flow release schedules adopted by regulatory agencies must be maintained at agreed upon levels (unless approved otherwise by fishery agencies under special circumstances).

6. Support adequate funding of habitat maintenance and improvement programs of the USDA Forest Service, Bureau of Land Management and other appropriate federal agencies. Provision for definitive studies of the cost effectiveness of fish habitat protection versus restoration should be included in the budget and work plans of land management agencies. A more appropriate balance of project funding may be suggested from this assessment.

7. Support studies to determine the extent of degradation of fish habitat from dredging, siltation, pollution and overgrazing. Habitat protection and enhancement is often difficult without adequate assessment of the causes and extent of the problem. Necessary studies may be delayed or never started without adequate funding.

8. Support efforts to retain presently used piscicides and seek approval for new selective chemicals for fish population control. Costs for developing selective piscicides and obtaining approval for their use by Environmental Protection Agency and Food and Drug Administration are high. Development of squoxin--selective for squawfish--is reported to have cost $1.2 million and its use has not yet been approved. Development of selective piscicides for suckers and carp is just beginning. Additional funding through one of the federal fishery agencies would permit this work to proceed more rapidly. Use of selective piscicides could reduce species competing with or preying on salmon.

9. Support ongoing fish passage structural improvements and programs at Lower Snake River dams.

10. Strongly advocate additional necessary fish passage structural improvements, flow manipulation programs and research programs at lower Snake River dams.

11. Strongly advocate the development of a region-wide water management plan for the Snake and Columbia rivers that will include adequate consideration for salmon, along with other water uses. Provide material to justify inclusion of salmon management in such a plan.

12. Support classification of certain portions of the national forest lands as Wilderness Areas or Wild and Scenic Rivers, to preserve and protect existing salmon habitat. (Specific recommendations can be obtained from state fishery agencies.)

13. Support the mineral withdrawal of certain lands in headwaters of the Middle Fork Salmon River for salmon habitat protection, as filed by the U.S. Fish and Wildlife Service.

14. Utilize its authority by effectively controlling ocean fishing rates. It makes little sense to embark on a program to increase the capacity of the habitat when the present capacity is not fully used. The information contained in Table 1 documents, that, with the exception of Puget Sound and a portion of the south Washington coast, chinook and coho escapements along the Pacific Coast are insufficient to meet the present capacity of the environment as expressed by the escapement goals. Furthermore, the trend is declining in most of these areas. There is presently an unused capacity for at least an additional 560,000 chinook and 299,000 coho spawners per year along the coast (Table 1).

15. The State of Washington, the federal government, the Washington Treaty Tribes, and various user groups are negotiating towards a settlement of Indian fishing rights issues, including habitat management authority. Until that problem is solved, the manner in which the Council's assistance might be needed is not known. Washington State personnel feel, however, that they will be able to handle internal environmental problems adequately. There may be instances in the future when Council assistance might be requested on a case-by-case basis. Washington salmon

habitat is currently protected by a variety of state, local and federal authorities. These include the State Environmental Policy Act, Forest Practices Act, Hydraulics Project Approval Law, Shorelines Management Act, State Water Quality Act, State Flood Control Act, Coastal Zone Management, and a variety of other statutes, regulations and procedures (Deschamps 1977). Effective administration of these will keep habitat losses to a minimum and ensure perpetuation of Washington's anadromous fishery resources. Additionally, the state is seeking to rehabilitate adversely affected habitat and remove fish migration blocks.

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APPENDIX I

WILLAMETTE RIVER HABITAT IMPROVEMENT PROGRAM

Habitat, fish passage and related problems affecting Willamette Drainage fish stocks that are currently addressed at the state and federal levels and do not require direct Council action are:

Problem 1

Major losses of downstream migrant salmonids occur as they pass through the industrial complex at Willamette Falls. Low streamflows magnify these losses. In 1973, a year of low flows, 81% of the juveniles passing Willamette Falls were killed.

Actions taken

a. Agreements have been made with the three companies involved with fish passage at Willamette Falls which prescribe shutdown and other details of protection.

b. One company installed a prototype fish protection facility designed to prevent juvenile salmon and steelhead from passing through turbines. Tests are under way to determine its efficiency.

Recommended actions

a. Maintain ongoing testing programs described above. Testing of the fish protection facility should follow an accelerated program to reduce losses. Seek decision as to whether to accept the facility as is or require greater protection and/or compensation.

b. Designate a coordinator with responsibility for approving hatchery releases based on best possible passage conditions.

Problem 2

Inadequate upstream passage at Willamette Falls for adult spring chinook results in migration delays and mortalities.

Delays resulted in a loss of about 20,000 adults spring chinook below the falls in 1972. Spring chinook pass the falls later now than they did before the new fishway was completed in 1971. Delays appear to have negative effects on the spring chinook run especially under high water conditions. Delayed fish jumping at the falls frequently sustain injury. Delayed fish are exposed to the sport fishery below the falls over a longer period of time. Delays at the falls result in fish arriving at upriver projects late, in poorer condition, and reluctant to pass into adult-collection facilities.

Actions taken

a. Some modifications of the new fishway have been made and an additional entrance developed to improve passage under varying water levels.

b. A fish passage specialist in the ODFW has been assigned to evaluate passage conditions and coordinate agency and company efforts.

c. Fishery agencies are negotiating with the U.S. Army Corps of Engineers to reduce excessive flows at times of fish passage by holding back water at major dams such as Green Peter, Detroit and Lookout Point. Reduced flows over the falls would make it easier for fish to locate attraction flows at fishway entrances.

d. Semipermanent flashboards are installed at strategic locations at the top of falls to divert spill away from areas where it will interfere with fishway entrances or falsely attract adults.

Recommended action

Continue with ongoing programs to improve fish passage.

Problem 3

Stream alteration and sedimentation as a result of logging, farming, road building and other practices degrade fish habitat and reduce fish production. The major problem is sedimentation caused by road construction and flow releases from reservoirs.

Actions taken

a. District Biologists review logging, road construction, dredging and filling in waterways and other land-use activities with private, state and federal landowners prior to construction to resolve conflicts and prevent destruction of aquatic habitat.

b. Ongoing habitat improvement projects such as stream clearance and bank protection improve degraded fish habitat.

c. The Department is cooperating in a study with the Department of Environmental Quality to assess the causes and impacts of nonpoint sources of pollution and to seek remedial action.

d. Major statutes and regulations available to protect stream habitat are described under Problem 2, Oregon Coastal Streams section, of this report.

Recommended actions

a. Continue with ongoing programs to protect and improve fish habitat. Increase efforts to follow up on recommendations made to protect habitat.

b. Increase efforts to minimize channel alterations associated with farming and land development practices.

c. Expand educational programs to increase environmental concern and responsibility by all citizens.

d. Investigate possibilities to increase penalities and convictions for violation of laws protecting fish habitat.

e. Assess long-term effects of gravel mining on streambed and aquatic habitat.

f. Develop a positive action program with U.S. Army Corps of Engineers to assure that discharge from reservoirs will produce a minimum of sediment in downstream waters.

Problem 4

Inadequate upstream fish passage at dams and other man-made obstacles on tributary streams results in injuries and mortalities.

Fish production is depressed when escapement is less than required to adequately seed the area. Problems occur at major water projects such as River Mill Dam (Clackamas River), at Foster Dam (South Santiam), and at numerous small dams and culverts. In many situations full compensation for losses has not been achieved.

Actions taken

a. Oregon law requires provision for fish passage at dams, culverts and other man-made stream structures. Most new facilities are designed for fish passage, and passage at older structures are constantly being improved.

b. Fish passage has been provided at most man-made barriers where requested by the Department.

c. Many barriers and other fish passage problems have been corrected by Department personnel or through negotiations with owners.

d. Fishways are constantly monitored by Department personnel and corrective action taken as needed.

e. Eugene Water and Electric Board will follow a prescribed plan when dewatering or watering either of their two power canals on the McKenzie River. This action will prevent the Walterville fish rack from washing away and allowing adults to travel into a blind tailrace or cul-de-sac.

Recommended action

Continue present efforts to correct ongoing fish passage problems.

Problem 5

Unscreened or improperly screened diversions continue to divert and kill downstream migrants.

These range in size from large facilities, such as the Leaburg and Walterville canals and diversions on the North Santiam, to several municipal and/or water supply intakes, to minor irrigation ditches.

Actions taken

a. Continuous efforts are under way with those responsible to correct or mitigate these problems including long-term negotiations with Eugene Water and Electric Board for resolution of problems at Leaburg and Walterville canals (McKenzie River).

b. Many diversions are routinely monitored and operations adjusted including shutdown of facilities to reduce losses to the lowest possible level.

c. The Department attempts to obtain proper screening or fully assess the levels of loss and gain compensation.

Recommended actions

a. Maintain and where possible intensify present programs to improve fish protection.

b. Seek adequate screening or other appropriate protection at all problem sites. Where this is impractical, assess losses and seek full compensation from those responsible.

Problem 6

Pollution from many sources results in fishkills and in stream degradation.

Nonpoint sources of pollution include: runoff from municipal areas often with heavy metal concentrations, pesticide residues, and drainage from farmlands. Industrial wastes because of their large volume continue to degrade the aquatic environment even though the level of treatment is increasing. An important problem is associated with increases in discharge levels of chlorine associated with expanding waste treatment facilities. The effects of chlorine on aquatic life and stream productivity are not well known.

Actions taken

a. Maintaining water quality is the responsibility of the Department of Environmental Quality. Water quality standards are established and programs established to meet them. Substantial improvements in water quality in the main Willamette River, lower Santiam and McKenzie rivers, and Coast Fork Willamette River have been made in recent years. Specific ongoing efforts include:

1. Tax incentive programs that encourage industries and municipalities to utilize best available technology.

2. Development of new innovative approaches such as spraying discharges onto forest or farmlands rather than returning effluent to stream.

3. Dechlorination at some waste treatment plants is under way.

4. Reduction of nonpoint sources of pollution through federally funded state program (208 Program). Studies are under way on the upper Tualatin, Molalla and Pudding Rivers.

b. Controlled streamflow augmentation from reservoirs is used to reduce pollution levels during low streamflows.

c. The Department monitors 150 to 200 waste discharge permits annually and works closely with the Department of Environmental Quality in reporting pollution sources and in responding to pollution-caused fishkills.

d. We review timber sale and road construction plans to resolve conflicts between timber management and aquatic resources.

<u>Recommended actions</u>

a. Continue to support efforts of the Department of Environmental Quality to reduce pollution.

b. Support land-use planning and zoning which control urban sprawl and stream degradation.

c. Support all efforts to recycle municipal and industrial wastewater to agricultural or other uses to prevent stream disposal.

d. Support continuing efforts to screen pesticides and control their application.

e. Support research to determine the effects heavy metals may have in eroding fish production potential in Willamette system.

f. Support efforts to improve monitoring of water quality in terms of chemical constituents, temperature and silt loads.

g. Support research to determine extent to which present levels of pollution and combinations of pollutants are affecting fish production.

h. Support better engineering techniques and tighter control of road construction projects.

i. Investigate with Corps of Engineers techniques to reduce sediment discharge below projects.

j. Support legislation to provide tax incentives to landowners to leave riparian cover along important salmon producing streams.

Problem 7

Widely fluctuating streamflows and especially the low flows of late summer and early fall limit fish production.

Many of the Basin's streams continue to experience low summer streamflows as a result of overappropriation for irrigation and other uses. Water quality is diminished and predation losses increase under low streamflows. Many streams lack legal guarantees of minimum streamflows. Enforcement of minimum flows where they have been set often is inadequate. Information is lacking to adequately measure changes in fish production under different streamflows but low, warm water can kill salmonids.

Actions taken

a. The Oregon Water Policy Board has established minimum streamflows on mnay of the Basin's streams. The Board is in the process of updating Basin programs to include additional minimum flows and other administrative changes to protect flows.

b. The Department has investigated streamflow requirements of salmonids on Elk Creek near Cannon Beach. Study results will provide a better scientific basis for recommending flow regimes to the Water Policy Review Board.

c. Water laws are administered by the Oregon Water Policy Board and provide an opportunity to challenge water right applications to gain greater protection for fish.

d. The Department reviews water right applications and reservoirs projects and seeks to improve streamflows from these activities.

Recommended actions

a. Agressively seek increased streamflow protection by the Water Policy Board by updating of stream Basin programs.

b. Support legislation to restructure water law policy to include better control over water withdrawals, water lease permits and other uses.

c. Encourage improved streamflow monitoring and enforcement of regulations.

d. Evaluate flow release schedules from existing reservoirs and seek changes to improve downstream flows and water quality.

e. Encourage development of off-channel storage and headwater impoundments to increase streamflows where present flows are inadequate, provided this is compatible with other management goals.

f. Determine practicality of obtaining control of additional water by purchase of water rights (indirectly) through purchase of private property or from federal storage projects.

g. Continue ongoing streamflow research.

h. Encourage citizen groups to support minimum flow recommendations before the Water Policy Review Board.

Problem 8

Populations of wild salmon are insufficient to meet present day user demands and in many instances are insufficient to provide adequate escapement to natural production areas.

Needs must be met at high cost through an extensive hatchery program designed to replace lost or inadequate natural production.

Actions taken

a. The Department adopted a Wild Fish Management Policy in 1978 designed to increase recognition and improve management of wild stocks.

b. An extensive hatchery program is used to supplement wild stocks.

Recommended actions

a. Develop programs for wild fish management and continue with ongoing fish culture efforts.

b. Determine the optimum spawning escapement for each species (number that can be naturally produced on a stream-by-stream basis.

Problem 9

Large populations of undesirable fish species in some Basin streams and reservoirs contribute to reduced abundance of salmon.

Action taken

Chemical rehabilitation is used to remove undesirable and competing fish populations.

Recommended actions

a. Maintain program of chemical rehabilitation.

b. Test use of temporary velocity barriers on streams to prevent upstream reintroduction of rough fish into treated areas (such as on the Molalla River). This would require some expenditure of funds and additional manpower or reassignment of duties.

c. Support research to develop selective piscicides.

d. Support clearance from the Environmental Protection Agency and the Food and Drug Administration to use new piscicides and retain use of traditional ones.

Problem 10

High ocean harvest rates for fall chinook and coho salmon of 80% or greater will probably prevent development of natural runs of these salmon above Willamette Falls. Harvest rates are believed to be excessive for established wild populations.

Actions taken

a. Ocean salmon management plans are developed through Pacific Fishery Management Council and ocean salmon fisheries have been restricted.

b. Tagging studies seek to determine ocean catch distribution and relative survival of adults from releases of cultured smolts.

Recommended actions

a. Continue ongoing efforts through Pacific Fishery Management Council and Department tagging programs to better determine catch distribution and harvest rates.

b. Determine adequate escapement needs for wild stocks and support efforts to provide needed escapement.

Problem 11

Decisions unfavorably affecting aquatic habitat and fish management are often made by legislative, regulatory, or land management bodies.

Actions of an agency not associated with fish production may inadvertently have adverse effects on natural salmon production. Often competing and conflicting land and water uses and the lobbying pressures of single purpose interests conflict with fisheries interests. Decision-makers representing other interests have frequently not been convinced of the importance of fishery resources and the need to protect their habitat.

Action taken

The Department provided information concerning the need for habitat protection and the value of fishery programs to a large cross section of governmental and private decision-making bodies.

Recommended actions

a. Continue to provide information as needed.

b. Gain more favorable response from key decision-makers and groups initiating programs affecting the salmon resource.

c. Increase public awareness of decisions made by the legislature, federal agencies, and other policy-making bodies that either favorably or unfavorably affect future fish resources.

APPENDIX II

CALIFORNIA COASTAL STREAMS KNOWN TO NEED HABITAT IMPROVEMENT WORK

STREAM CLEARANCE

Stream	County	Species	Miles Affected
Cottoneva	Mendocino	Coho	9
DeHaven	"	"	5
Dunn	"	"	2
Hardy	"	"	3
Howard	"	"	3
Juan	"	"	5
Pudding	"	"	7
Wages	"	"	7
Albion - Main	"	"	21
Donnelly Gulch	"	"	1
Hare	"	"	7
Hazel Gulch	"	"	2
Jug Handle	"	"	3
Marsh	"	"	3
Salmon	"	"	8
Gualala Tributaries	Sonoma	"	20
Russian Gulch	"	"	3
Salmon	"	"	5
Russian Tributaries	"	"	10
Garcia	"	"	10
Little	Humboldt	Coho and Chinook	3
TOTAL			137

BARRIER REMOVAL OR MODIFICATION

Eel			
Black Butte	Humboldt	Coho and Chinook	2
Rattlesnake	"	Coho and Chinook	5
Willow Creek-Trinity River	"	Coho and Chinook	8
Bluff Creek	"	Coho and Chinook	20
Redwood Creek	"	Coho and Chinook	4
TOTAL			39

APPENDIX III

Habitat, fish passage, and related problems affecting coastal fish stocks currently being addressed at the state and federal levels that do not require direct Council action.

Problem 1

Widely fluctuating streamflows and especially the low flows of late summer and early fall limit fish production.

Many of the Rogue and Umpqua tributaries are covered by water rights that take the entire flow. Major tributary streams with low flows include the Applegate and South Fork Umpqua rivers. The proposed Applegate Dam should improve flow conditions on that stream.

Water rights have been issued without regard to in-stream flows for fish. Water withdrawal for irrigation, principally in the Rogue and Umpqua drainages, has precluded use of many miles of rearing areas in the tributary streams.

The Savage Rapids Dam diverts water from the Rogue River, near Grants Pass. It has been a long-standing problem causing losses of both juvenile and adult salmon and steelhead.

Actions taken

a. The Water Policy Review Board has established minimum streamflows on many Oregon streams. The Board is in the process of updating Basin programs to include additional minimum flows and developing other administrative changes to protect in-stream flows.

b. The Department has investigated streamflow requirements of salmonids on Elk Creek near Cannon Beach. Other studies are under way in the Rogue Basin. Study results will provide a better scientific basis for recommending flow regimes to the Water Policy Review Board.

c. Approximately 300 storage sites have been identified on coastal streams.

Recommended actions

a. Continue ongoing streamflow research.

b. Support legislation to restructure water law policy to include better control over water withdrawals, water lease permits, and other water uses.

c. Aggressively seek increased streamflow protection by the Water Policy Review Board through updating of stream Basin programs.

d. Encourage improved streamflow monitoring and enforcement of regulations.

e. Encourage development of offchannel storage and headwater impoundments to increase streamflows where found compatible with other fish management objectives. Flow augmentation in late summer could increase salmonid production substantially in a number of coastal streams. Bear Creek below Medford (Rogue Basin) and on Cow Creek, South Umpqua below Cow Creek, Elk Creek, Olalla Creek, and the main stem Umpqua River are in special need of flow augmentation.

f. Cooperate with the Corps of Engineers and other agencies responsible for planning impoundments to assure streamflow augmentation is considered.

g. Support development of coordinated program among agencies responsible for water management to promote water conservation.

h. Encourage citizen groups to support minimum flow recommendations before the Water Policy Review Board.

Problem 2

Physical alteration of waterways and estuaries by channel changes, dredging, filling, gravel removal, and other activities greatly reduces their ability to produce salmon.

Sedimentation is a major problem associated with these activities and results in smothering of eggs in the gravel and reduced food production.

State and federal legislation has resulted in better control of activities; however, these gains have often been offset by the rapid increase in permit applications and land-use activities generally.

Logging and road building have affected almost all coastal streams by increasing turbidity and summer temperatures. Steep terrain and fragile erosive soils in many coastal basins have been subject to practices that result in landslides, excessive turbidity, and stream blockage.

Dredging, filling, diking, pollution, siltation, and other activities have caused major losses in most of Oregon's estuaries. For example, Coos Bay has lost 3,600 acres of the estuary to diking and filling. Each year numerous applications are received for additional diking and filling. Despite efforts from natural resource groups and agencies, land-use planning designations for major estuaries such as Coos and Tillamook bays have predominantly favored economic development at the expense of natural resources.

Protecting the integrity and quality of estuaries is essential to maintaining and improving salmon stocks, especially fall chinook which depend largely on estuaries for rearing.

Currently the Department field staff is spread too thin to give more than cursory inspection to many of the proposed habitat changes.

<u>Actions taken</u>

a. Some of the major statutes and regulations available to protect stream habitat include:

<u>Federal</u>
U.S. Army Corps of Engineers - requires permits for filling, removal of material, and other activities in navigable waters.

Fish and Wildlife Coordination Act - establishes procedures whereby states can develop, through Fish and Wildlife Service compensation and/or mitigation, plans for losses to aquatic habitat associated with federal projects.

National Environmental Policy Act - requires a formal environmental assessment of all federal projects having a significant effect on the environment.

Federal Water Pollution Control Act - one provision of the Act requires states to set and enforce acceptable standards of water quality.

<u>State of Oregon</u>
Fill and Removal Law - requires a permit from Division of State Lands for filling and material removal in state's waterways in excess of 49 cubic yards.

Forest Practices Act - prescribes timber management and harvest practices on forest lands and provides for review and control of these activities by Department of Forestry.

Water Quality Laws - sets standards and procedures by which Department of Environmental Quality sets water quality standards for the state's stream basins and issues permits allowing discharge of wastes in the state's waters.

Streamflow Requirements - requires that minimum streamflows be established by the Water Policy Review Board.

Fish Passage Requirements - makes fish passage at man-made barriers a function of the Department of Fish and Wildlife.

Land-Use Goals and Guidelines - requires that land-use development be governed by goals and guidelines of the Land Conservation and Development Commission.

b. District Biologists review logging, road construction, dredging and filling in waterways, and other land-use activities with private, state, and federal landowners prior to construction to resolve conflicts and prevent destruction of aquatic habitat.

c. Ongoing habitat improvement projects such as stream clearance and bank protection improve degraded fish habitat.

d. The Department is cooperating with the Department of Environmental Quality to assess the causes and impacts of nonpoint sources of pollution and to seek remedial actions.

Recommended actions

a. Continue with ongoing programs to protect and improve fish habitat. Increase efforts to follow up on recommendations made to protect habitat.

b. Increase efforts to minimize channel alterations associated with farming and land development practices.

c. Expand educational programs to increase environmental concern and responsibility by all citizens.

d. Investigate possibilities to increase penalties and convictions for violation of laws protecting fish habitat.

e. Assess long-term effects of gravel mining on streambed and aquatic habitat.

Problem 3

Pollution from many sources results in fishkills and in stream degradation.

Nonpoint sources of pollution include: runoff from municipal areas often with heavy metal concentrations, pesticide residues, and drainage from farmlands. Industrial wastes because of their large volume continue to degrade the aquatic environment even though the level of treatment is increasing. An important problem is associated with increases in discharge levels of chlorine on aquatic life and stream productivity are not well known.

Actions taken

a. Maintaining water quality is the responsibility of the Department of Environmental Quality. Water quality standards are established and programs established to meet them. Substantial improvements in water quality have been made in recent years. Specific ongoing efforts include:

   (1) Tax incentive programs that encourage industries and municipalities to utilize best available technology.

   (2) Development of new approaches of using waste effluents such as spraying them onto forest land or farmland rather than returning them to the stream.

   (3) Dechlorination of some waste treatment plant effluents.

   (4) Identification and reduction of nonpoint sources of pollution through a federally funded state effort (208 Program).

b. Controlled streamflow augmentation from reservoirs is used to dilute pollutant concentrations during low streamflows.

c. ODFW monitors 150 to 200 waste discharge permits annually and works closely with the Department of Environmental Quality in reporting pollution sources and in responding to pollution-caused fishkills.

d. ODFW reviews timber sale and road construction plans to resolve conflicts between timber management and aquatic resources.

e. The Department is cooperating in a study with the Department of Environmental Quality to assess the causes and impacts of nonpoint sources of pollution and to seek remedial action.

Recommended actions

a. Continue to support efforts of the Department of Environmental Quality to reduce pollution.

b. Support land-use planning and zoning which control urban sprawl and stream degradation.

c. Support all efforts to recycle municipal and industrial wastewater to agricultural or other uses to prevent stream disposal.

d. Support continuing efforts to screen pesticides and control their application.

e. Support research to determine the effects heavy metals may have in eroding fish production potential in Willamette system.

f. Support efforts to improve monitoring of water quality in terms of chemical constituents, temperature, and silt loads.

g. Support research to determine extent to which present levels of pollution and combinations of pollutants are affecting fish production.

h. Support better engineering techniques and tighter control of road construction projects.

i. Support legislation to provide tax incentives to landowners to leave riparian cover along important salmon producing streams.

Problem 4

Unscreened or improperly screened diversions continue to divert and kill downstream migrants.

Actions taken

a. Continued efforts are taken to correct or mitigate diversion-related fish losses. Screens at Savage Rapids Dam (Rogue River) have not operated satisfactorily and are scheduled for replacement.

b. Many diversions are routinely monitored and operations adjusted to minimize losses.

c. The Department attempts to obtain proper screening or fully assess the levels of loss and obtain adequate compensation.

Recommended actions

a. Maintain and where possible intensify present programs to improve fish protection.

b. Seek adequate screening or other appropriate protection at all problem sites. Where this is impractical, assess losses and seek full compensation from those responsible.

Problem 5

Decisions unfavorably affecting aquatic habitat and fish management are often made by legislative, regulatory, or land management bodies.

Actions of an agency not associated with fish production may inadvertently have adverse effects on natural salmon production. Often competing and conflicting land and water uses and the lobbying pressure of single purpose interests conflict with fisheries interests. Decision-makers representing other interests have frequently not been convinced of the importance of fishery resources and the need to protect their habitat.

Action taken

The Department provides information concerning the need for habitat protection and the value of fishery programs to a large cross section of governmental and private decision-making bodies.

Recommended actions

a. Continue to provide information as needed.

b. Gain more favorable response from key decision-makers and groups initiating programs affecting the salmon resource.

c. Increase public awareness of decisions made by the legislature, federal agencies, and other policy-making bodies that either favorably or unfavorably affect future fish resources.

Problem 6

Undesirable species of fish reduce salmon populations through competition and predation.

There are several underutilized fish species that tend to populate streams marginal for salmonids because of temperature or other factors. Chemical rehabilitation can bring them back into production. A specific chemical, squoxin, can be used to remove squawfish without harm to other species. It has been field-tested and awaits registration by the Environmental Protection Agency (EPA). A new toxicant, specific for suckers, is in the final stages of development. Either or both chemicals could be used in the Rogue, Siuslaw, and Umpqua/Smith river systems to reduce species competing with salmon.

Action taken

Chemical rehabilitation is used to remove undesirable and competing fish populations.

Recommended actions

a. Maintain program of chemical rehabilitation.

b. Support research to develop selective piscicides.

c. Support clearance from the Environmental Protection Agency and the Food and Drug Administration to use new piscicides and retain use of traditional ones.

Problem 7

Habitat improvement techniques are not fully implemented to create additional salmon habitat.

Actions taken

a. Federal land management agencies, notably the Bureau of Land Management, have undertaken several habitat improvement projects on mid- and south coast streams. For example, the Smith, Coos, Coquille, and Siuslaw river systems contain extensive areas of bedrock which produce few fish because of shallow, warm water in the summer months. Rearing pools have been blasted in Vincent Creek, a tributary of Smith River, and in several small tributaries of the Siuslaw River. Results indicate that fish use these pools. The program could be extended to other streams.

b. Habitat structures, such as gabions and log or concrete sills, have been installed in a few small streams; and they show some promise. Such installations cannot withstand high velocities and moving debris found in large main stem streams.

Recommended actions

a. Evaluate stream habitat improvement practices in terms of costs and level of increased production.

b. Encourage more aggressive programs to improve spawning and rearing habitat where benefits can clearly be anticipated.

c. Identify areas where additional spawning and rearing habitat are needed and could be developed.

Problem 8

Fish passage is blocked by natural falls, debris jams, and man-made obstacles.

Poor upstream passage for adult salmon over dams and other barriers results in migration delays, mortalities, and reductions in escapements necessary for run maintenance.

Fish congregated below barriers are more vulnerable to illegal angling activities and predators. Delay in passage appears to reduce the ability of adults to reach upriver destinations and results in lost production.

Actions taken

a. Fish passage has been provided at most natural barriers. Where it has not been practical to provide passage, fish have often been trucked above the barriers to utilize available production potential.

b. Actions are under way at several falls to correct or improve fish passage.

c. Debris jams are removed by the Department or federal landowners when they are a barrier to fish passage.

d. Oregon law requires provision for fish passage at dams, culverts, and other man-made stream structures. Most new facilities are designed for fish passage, and passage problems at older structures are constantly being improved.

e. Efforts are under way to improve inadequate fishways at Fielder Dam (Evans Creek, Rogue River) and McKee Dam on the Applegate River and in other areas.

Recommended action

Maintain at least present program level to correct fish passage problems.

Problem 9

Harvest rates for naturally produced coho salmon are believed to be excessively high and therefore responsible for lack of adequate escapement needed to build natural coho runs.

Actions taken

a. Ocean salmon management plans are developed through Pacific Fishery Management Council and ocean salmon fisheries have been restricted.

b. Tagging studies seek to determine ocean catch distribution and relative survival of adults from releases of cultured smolts.

Recommended actions

a. Continue ongoing efforts through Pacific Fishery Management Council and Department tagging programs to better determine catch distribution and harvest rates.

b. Determine adequate escapement needs for wild stocks and support efforts to provide needed escapement.

Problem 10

Populations of wild salmon are insufficient to meet present day user demands and in many instances are insufficient to provide adequate escapement to natural production areas.

Needs must be met at high cost through an extensive hatchery program designed to replace lost or inadequate natural production.

Actions taken

a. The Department adopted a Wild Fish Management Policy in 1978 designed to increase recognition and improve management of wild stocks.

b. An extensive hatchery program is used to supplement wild stocks.

Recommended actions

a. Develop programs for wild fish management and continue with ongoing fish culture efforts.

b. Determine the optimum spawning escapement for each species (number that can be naturally produced on a stream-by-stream basis).