Agenda Item J.1.c
Attachment 1
March 2011

Discussion Document: Assessing Ecosystem Policy Principles and Bringing Ecosystem Science into the Pacific Fishery Management Council Process

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Prepared By:

PACIFIC FISHERY MANAGEMENT COUNCIL
ECOSYSTEM PLAN DEVELOPMENT TEAM
7700 NE AMBASSADOR PLACE, SUITE 101
PORTLAND, OREGON 97220-1384
503-820-2280

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1.0 Introduction

The Pacific Fishery Management Council (Council or Pacific Council) received its first report from its Ecosystem Plan Development Team (EPDT) at its September 2010 meeting. That report, the September 2010 Agenda Item H.1.b., Attachment 1, discussed ecosystem fishery management planning generally, draft goals and objectives for a potential ecosystem fishery management plan (EFMP,) issues to consider for developing the regulatory scope of management unit species for a potential EFMP, the geographic range and scale of an EFMP, and the state of ecosystem science. At that meeting, the Council decided to move forward with an ecosystem fishery management planning process, although the Council reserved the decision on whether to proceed with an EFMP with regulatory authority for some future time. To begin the planning process, the Council tasked its EPDT with reviewing the Council's four fishery management plans (FMPs) to identify existing ecosystem-based management principles, and to scope common management needs that may benefit from a coordinated overarching ecosystem-based fishery management planning framework. This document provides those reviews in Section 2, *Existing Ecosystem-Based Principles and Management Measures*, and Section 3, *Cross-FMP Review of Common Management Needs and Challenges*.

Based on the comments the Council received from its Scientific and Statistical Committee (SSC) and other advisory bodies, Section 4 of this document, *Cross-FMP and Ecosystem Science*, proposes an initial science product development process for the Council arena, discusses science questions for future considerations, and highlights some current science tools that could inform Council decision-making. And, based on Council discussions in September 2010, Section 5 of this document, *Understanding the Cumulative Effects of Fisheries Action*, discusses ways that the scientific information and products described in Section 4 could support analyses of the effects of Council actions taken under its four FMPs.

The EPDT has deliberately called this report a *Discussion Document* because we hope that it will generate discussion within and between the Council, its advisory bodies, and the public. While EPDT members have experience in a diverse array of Council-related science and management programs, our knowledge of Council activities and needs is far from comprehensive. If the issues below continue to be of interest to the Council and the public, we hope that many others join in the discussion to refine and develop an approach for ecosystem-based fishery management in the California Current.

2.0 Ecosystem-Based Principles and Management Measures

Fishery managers need the best possible understanding of the interactions among physical, ecological, socioeconomic, and management issues in the California Current Ecosystem (CCE) for a more integrated approach to decision making. Both long and short term changes in distribution and abundance of individual species, subsequent changes in fishing grounds, shifts in fishing effort among species and changes in market demand, can all have major ecosystem effects. Many FMP species have may have experienced historic stock declines or may have highly variable population levels, most likely due to the cumulative interactions among life history and habitat factors (Levin et al. 2006,) the impact of changing environmental conditions on productivity within the CCE (Brodeur et al. 2008,) and harvest rates. Variability in the biophysical components of the ecosystem must be considered in the context of variability and change in social components of the system (Lester et al. 2010, White and Costello 2011). An ecosystem fishery management planning process can help integrate knowledge and data in the CCE to: 1) promote sustainable human uses of the CCE, 2) allow for a coordinated evaluation of ecosystem health, 3) aid in identifying critical data gaps and common ground within and between current FMPs, and 4) allow for evaluation of ecosystem tradeoffs (e.g. predator/prey interactions). Ecological and economic considerations are of notable importance in providing comprehensive optimum yield estimates; the choice of yields depends on the relative net benefits provided society through ecosystem interactions (Hannesson et al. 2009; Hannesson and Herrick 2010).

In identifying existing ecosystem-based principles and management measures in place within current FMPs, the EPDT looked for management measures that were either taken to mitigate the impact of fishing on the environment or ecosystem, or measures that take into account the effects of the biophysical environment on managed species. For each measure listed under the species group FMPs, we indicate in brackets the FMP species groups or protected species that may benefit from the measure listed. The following lists, separated by FMP, may not be comprehensive and would benefit from review by species group management teams and advisory panels.

2.1 Coastal Pelagic Species FMP

1. Krill harvest prohibition: The coastal pelagic species (CPS) FMP prohibits harvest of all species of euphausiids (krill) that occur within the U.S. West Coast Exclusive Economic Zone (EEZ) to help maintain important predator-prey relationships and the long-term health and productivity of the West Coast ecosystem. These ecosystem conservation principal enhance fishery management by protecting, to the extent practicable, krill resources, which are an integral part the ecosystem. [highly migratory species (HMS), groundfish, salmon, CPS, marine mammals]
2. Conservative Management Strategy: The Council has demonstrated a consistently conservative approach to CPS harvest management and in response to Pacific sardine's ecological role as forage and its importance to west coast fisheries. The Council frequently reviews new science in support of stock assessments and management strategies. In the late-1990's, the Council chose the most conservative harvest control rule for Pacific sardine when presented a wide range of FMP harvest policies. The resulting and current control rule includes an environmental parameter linking temperature to estimated FMSY. [HMS, groundfish, salmon, CPS, marine mammals]
3. Environmental Indicators: The intent of the existing environmental parameter in the Pacific sardine harvest control rule is to explicitly adapt harvest levels in response to environmental variability. The existing environmental parameter is one of the Council's priority research needs and new science suggests a need to explore a broader range of ecological indicators of Pacific sardine productivity. [CPS]
4. Cutoff Parameters: CPS harvest control rules have long utilized "Cutoff" parameters to protect a core spawning population and avoid overfishing. The Cutoff is a biomass level below which directed harvest is not allowed. Cutoff values are set at or above the overfished threshold and have the effect of automatically reducing harvest rates as biomass levels approach an overfished status. This mechanism serves to preserve a spawning stock size. For Pacific sardine, the Cutoff value is 150,000 mt or three times the overfished threshold and is part of the Council's conservative management approach. [HMS, groundfish, salmon, CPS, marine mammals]
5. Monitored stock harvest strategy: The ABC control rule for monitored stocks consists of a 75 percent reduction from the species overfishing level. This precautionary approach is in response to relatively low harvest levels and/or greater scientific uncertainty about stock status or management. [HMS, groundfish, salmon, CPS, marine mammals]
6. Essential fish habitat (EFH): EFH for CPS finfish species is temperature-based: The east-west geographic boundary of EFH for CPS is defined to be all marine and estuarine waters from the shoreline along the coasts of California, Oregon, and Washington offshore to the limits of the EEZ and above the thermocline where sea surface temperatures range between 10°C to 26°C. The southern boundary is the United States-Mexico maritime boundary. The northern boundary is more dynamic, and is defined as the position of the 10°C isotherm, which varies seasonally and annually. [CPS]

2.2 Groundfish FMP

1. EFH Conservation Areas: extensive, coastwide, long-term closed areas to protect groundfish EFH from bottom contact gear, particularly in rocky reef areas; extensive, coastwide, long-term closed area to freeze the footprint of West Coast trawl gear use to inshore of 700 fm depth contour. [Groundfish, salmon (particularly Chinook), marine mammals, seabirds]
2. Rockfish Conservation Areas: coastwide, seasonally-variable closed areas to minimize bycatch in all groundfish fisheries of rebuilding groundfish species. For cowcod and yelloweye rockfish, species-specific closed areas off the southern (cowcod) and northern (yelloweye) U.S. West Coast. [Groundfish, salmon (particularly Chinook), marine mammals, seabirds]
3. Salmon Conservation Zones: mid-coast, estuary-plume-focused closed areas to minimize bycatch in whiting fisheries of endangered and threatened salmon stocks. [Salmon, CPS, green sturgeon, marine mammals, seabirds]
4. Commercial fishery vessel monitoring system (VMS) requirements to better enforce closed areas and other regulations. [Groundfish, salmon, marine mammals, seabirds]
5. Coastwide, mandatory observer program to gather total catch data from commercial fisheries. [All FMP species, all protected species taken as bycatch]
6. Weak stock management to curtail allowable harvest of more abundant species in order to reduce opportunities for incidental catch of less abundant, co-occurring species. Harvest levels for species managed via an overfished species rebuilding plan are usually set at a fraction of F_{MSY} harvest rate. [Groundfish, salmon]
7. For less abundant stocks and stocks with little scientific information, harvest policies become increasingly precautionary. [Groundfish]
8. Allowable harvest of shortbelly rockfish, an abundant species with high prey value to the CCE, is set extremely low to accommodate incidental catch while discouraging any fishery development, to ensure that it retains its role as prey for other (non-human) predator species. [Groundfish, HMS, salmon, marine mammals, seabirds]
9. Stock assessments include literature review and discussion of relevant ecological biological, social and economic factors and the interactions between them, to allow SSC and Council to weigh impacts of those factors under different potential harvest scenarios. [Groundfish]
10. Trawl gear regulations to constrain habitat damage through a small footrope requirement shoreward of the RCAs, and minimize catch of juveniles through a minimum mesh size requirement. Fixed gear regulations to prevent lost gear from ghost fishing through a gear attendance requirement and, for pots, a biodegradable escape panel requirement. [Groundfish, salmon (particularly Chinook), marine mammals, seabirds]
11. Regulations requiring fishery participants to sort their catch by species, ensuring better long-term data on the hugely varied groundfish species catch and landings. [Groundfish]
12. For whiting, participation in a U.S.-Canada bilateral treaty organization to jointly manage and conserve Pacific whiting to ensure that harvest of the cross-boundary resource remains within sustainable parameters. [Groundfish, marine mammals, seabirds]

2.3 Highly Migratory Species (HMS) FMP

1. FMP designates EFH for each species within the FMP, with sub-designations for the different life stages of those species. EFH designations for some HMS' life stages are temperature-based, recognizing those species' habits of associating with certain temperature ranges, regardless of where those temperatures may occur in any given season or year.
2. Sea turtle and marine mammal bycatch minimization and mitigation measures: swordfish longline fishery closure west of 150° W. long.; prohibition on light stick possession for longline vessels operating west of 150° W. long.; gear and operational modification requirements for HMS longline and drift gillnet vessels; seasonal area closures for longline and gillnet fisheries in times

and areas where there have been prior fishery interactions with sea turtles, with additional closures during El Niño events; equipment and handling requirements for bringing incidentally caught turtles onboard, and resuscitating and releasing when possible. [Sea turtles, marine mammals]

3. Seabird bycatch minimization and mitigation measures: gear configuration and setting requirements, offal discharge requirements, equipment and handling requirements for bringing incidentally caught short-tailed albatross onboard, and resuscitating and releasing when possible. [Seabirds]
4. Bycatch limitations for HMS taken with non-HMS gear. [HMS]
5. HMS permitting and record-keeping requirements for U.S. vessels operating in the EEZ and on the high seas and landing HMS in U.S. ports. [HMS]
6. Selected commercial fishery vessel monitoring system (VMS) requirements to better enforce closed areas and other regulations. [HMS]
7. Mandatory observer program to gather total catch data from commercial fisheries. [HMS, salmon, CPS, groundfish]
8. Nation-wide shark-finning prohibition. [Sharks]
9. Nation-wide dolphin-safe tuna import requirements. [Marine mammals]
10. Participation in international regional fishery management organizations to develop and implement multinational conservation measures, such as restricting fishing around fish aggregating devices (FADs) for tropical tunas, and area closures to minimize bycatch of mammals and turtles. [HMS, marine mammals, sea turtles]

2.4 Salmon FMP

1. FMP designates EFH from the ocean extent of the EEZ to the shore, and inland up to all freshwater bodies occupied or historically accessible to salmon in Washington, Oregon, Idaho, and California, with exceptions for dammed streams, recognizing the long-term potential for managed stocks to recover in historically-used areas. [Salmon, and in marine waters, groundfish and CPS where EFH for those species intersects with salmon EFH]
2. Yelloweye Rockfish Conservation Area off Washington state to minimize bycatch of an overfished rockfish species in the salmon troll fisheries. Regulations restricting groundfish and halibut retention, coupled with inseason management to adjust those as needed. [Groundfish, halibut]
3. Geographic control zones that may be opened or closed to fishing on an annual basis, depending on a particular year’s management objectives and run forecasts, used to constrain the catch of salmon from less abundant runs caught in common with salmon from more abundant runs. [Salmon]
4. Adaptive management process that allows swift inseason regulations changes to respond as catch information becomes available. That same process also includes an annual retrospective analysis of the effectiveness of modeling and management, ensuring an ongoing refinement of predictive and monitoring methodologies. [Salmon]
5. Oregon coastal natural (OCN) and Columbia River coho harvest matrices that use juvenile salmon ocean survival as a predictor of ocean conditions, ultimately providing allowable total fishery impacts rates based on the return of jacks (sub-adults) to spawning streams. Also for OCN coho, the Council’s SSC has recommended a new predictor methodology that blends multiple parameters, including sea surface temperature and copepod assemblage abundance. [Salmon]
6. Participation in international regional fishery management organizations to ensure cooperation on both North American and high-seas multinational conservation measures to prevent overharvest. [Salmon]

7. Prohibition on the use of nets to fish for salmon within the EEZ to allow for live release of undersized salmon and to prevent bycatch of non-target species. [Salmon, HMS, groundfish]

3.0 Cross-FMP Review of Common Management Needs and Challenges

The Council's four FMPs cover a broad array of species, with widely diverse life histories and trophic roles within the CCE. Management programs and fishing practices will necessarily differ for species that range from the short-lived and quickly-reproducing CPS, to the long-lived and slow-maturing groundfish species, to the fast-maturing and far-ranging salmon and HMS. The different FMP species fill different roles in the CCE, both in their interactions with each other and with non-FMP species. Figure 3.1, below, provides a simplified schematic of the interactions of our FMP species with each other and with non-Council species groups.

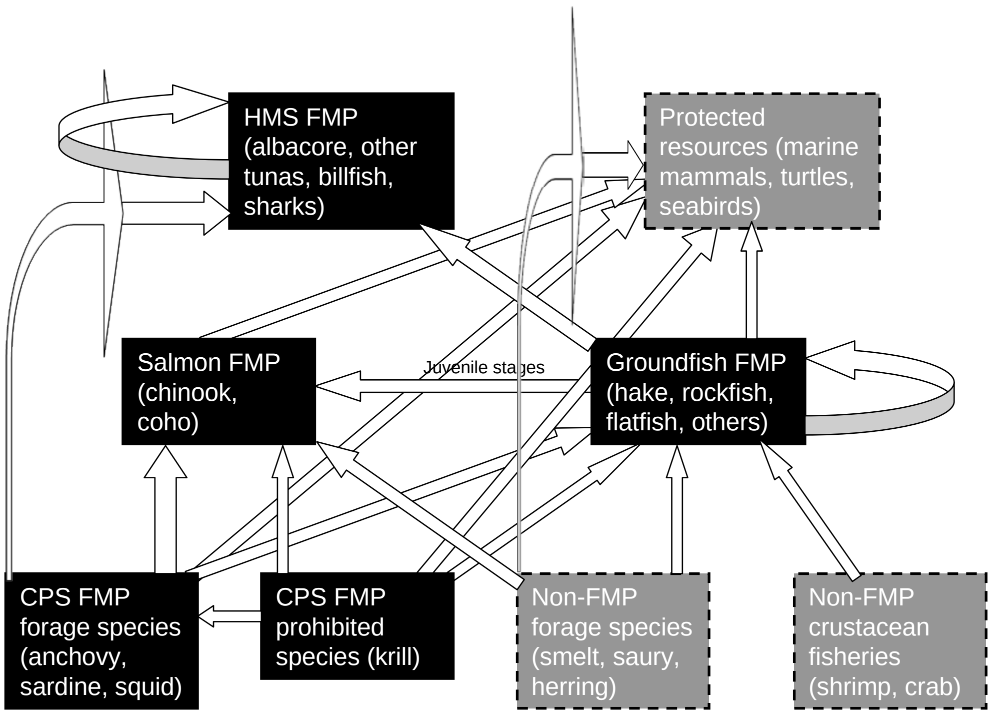

Figure 3.1: Simplified schematic of key trophic interactions between FMP species and others

Figure 3.1 provides a simplified schematic of generalized trophic interactions among the four FMP species groups and some of the major non-managed species groups in the CCE. This figure is not intended to represent the entire food web in any way, or to capture every potential interaction (trophic or otherwise) among the groups, rather the idea was simply to highlight where there are or may be major interactions among groups of FMP-managed and non-Council managed assemblages. For example, krill are an important part of the diets of many species in each of the FMPs, as well as many protected resource species. Similarly, salmon prey primarily on krill, coastal pelagic species (both FMP and non-FMP species, e.g., anchovy, sardine, herring and smelts), and groundfish (primarily young-of-year rockfish and other early life history stages). As such, there is presumably at least some level of connectivity between salmon productivity and the management of all of these other elements of the ecosystem, despite the fact that the functional relationships are poorly understood. Essentially, virtually all of the FMP assemblages have some level of direct trophic interactions with the other FMP assemblages, although the importance and strengths of such interactions vary. More accurate discussions of food webs interactions and food habits data can be found in the literature (Brand et al. 2007, Daly et al. 2009, Dufault et al. 2009, Field et al. 2006).

While Council process participants and the public are all aware that FMP species have varied life history characteristics and inter-species relationships, the traditional management process helps us to focus on immediate management challenges by separating managed species into the large FMP units. However, this tight species-group focus rarely provides an opportunity to step back and look at how the different FMPs approach similar fishery management challenges or the relationships between species. Below, we provide a series of tables with brief cross-FMP comparisons of how the Council addresses major fishery management issues in each of its four FMPs: harvest policies and overfished/overfishing, bycatch, essential fish habitat (EFH,) and community effects. We chose this particular set of issues as a starting point for discussion in order to highlight the Magnuson-Stevens Fishery Conservation and Management Act's (MSA's) national standard guidelines and EFH requirements.

3.1 FMP Harvest Level Policies and Overfished/Overfishing Issues (Appendix Tables A.1, A.2)

Setting harvest levels is at the heart of a fishery management council's responsibilities, as reflected in the MSA's National Standard 1: "Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry." The policies that the Council uses to set its harvest levels and to address overfishing and rebuilding overfished stocks must be based in sound scientific advice under National Standard 2, "Conservation and management measures shall be based on the best scientific information available." The Council's harvest policies for the species in its four FMPs are notably different from each other, reflecting diversity of life history characteristics between FMPs. Harvest policies for the FMPs hew to the MSA's National Standard 3 that "To the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination."

Beyond basic harvest policies, the MSA also requires ending overfishing where and when it occurs, and requires rebuilding overfished species in as short a time as possible, taking into account the status and biology of overfished stocks of fish, the needs of fishing communities, recommendations of international organizations in which the United States participates, and the interaction of the overfished stock within the marine ecosystem [§304(e)]. For the salmon FMP, the Council has the additional challenge of managing fisheries for a suite of evolutionarily significant units of salmon, some of which are listed as threatened or endangered under the Endangered Species Act (ESA). Among the many challenges of meeting the management requirements of both the MSA and the ESA, the Council has had to wrestle with the confusion of different terminology and standards in the two acts. Amendment 16 to the Salmon FMP is intended, in part, to resolve some of those differences in applying the two acts to the salmon management process.

In Appendix A, at Table A.1 we provide a snapshot of FMP harvest and overfished/overfishing policies. Table A.2 shows the Council's two-year schedule for setting harvest levels for its FMPs, two of which undergo an annual harvest specifications process (CPS and salmon,) and two of which undergo a biennial harvest specifications process (groundfish and HMS). The Council's HMS management work is significantly affected by the timing and management philosophies of the international regional fishery management organizations (RFMOs) that set stock-wide policies for many of the stocks within the HMS FMP.

The Council has a variety of policies and processes that account for both the trophic roles of its managed species and the relationships those species have with their environment. Despite such efforts, a more rigorous and quantitative analysis of these interactions and the possible trade-offs between managed species that might result from alternative harvest policies is lacking . A more organized ecosystem-based management effort could help the Council better address larger-scale harvest issues like: maintaining long-term age- and size-distribution in managed stock populations, assessing the evolutionary effects of fishing season timing and location; and climate shift effects on stock productivity and predator-prey relationships.

Cross-FMP Harvest Policy Issues

- In keeping with the MSA and the NS1 guidelines, Council harvest policies have been amended to better account for management and scientific uncertainty through the use of buffered harvest levels.
- Groundfish and CPS FMP amendments included Council direction to include ecological considerations in the setting of harvest specifications and in the development of management reference points. An ecosystem-based plan could provide valuable information within and between FMP and non-FMP species when developing harvest levels.
- The rebuilding of stocks declared overfished or listed under the ESA is a central responsibility and goal of Council fishery management. Improved understanding of ecological interactions between species of concern, healthy target stocks, and key predator and prey species could improve recovery efforts. The comprehensive prohibition on krill was, in part, based on an understanding that krill play a vital role in the ecology of many species of concern. Increased understanding of trophic interactions could help validate or improve forage species harvest policy while enhancing rebuilding efforts.
- Harvest policies commonly reduce allowable catch as stocks approach overfished thresholds. This is most notable in CPS harvest control rules where harvest is prohibited rather than restricted when MSST levels are approached for Pacific sardine or reached for Pacific mackerel. Reduction in allowable harvest is also built into groundfish harvest control rules and salmon harvest policies.

3.2 FMP Bycatch Issues (Appendix Table A.3)

Although the ESA and the Marine Mammal Protection Act (MMPA) have long supported bycatch minimization policies, Congress notably strengthened the MSA's approach to bycatch with the implementation of the 1996 Sustainable Fisheries Act. Among other things, the Act added National Standard 9, "Conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch." The revised MSA also included a new requirement that FMPs "establish a standardized reporting methodology to assess the amount and type of bycatch occurring in the fishery, and include conservation and management measures that, to the extent practicable and in the following priority – (A) minimize bycatch; and (B) minimize the mortality of bycatch which cannot be avoided" [§303(a)(11)]. In addition to requiring the minimization of bycatch in domestic fisheries, the MSA also supports the minimization of bycatch in international fisheries.

The 2007 amendments to the MSA supported the Act's bycatch provisions from 1996 by formalizing and more fully funding a bycatch reduction engineering program designed to encourage innovative research into gear modifications for bycatch reduction. The Council has historically had greater concern with bycatch in the groundfish and HMS fisheries than in the salmon and CPS fisheries, although salmon fishery management itself is largely a complex effort to conduct fisheries that minimize the bycatch of threatened or endangered runs of salmon. As discussed in Table A.3, the groundfish and HMS fisheries have been the primary West Coast beneficiaries of bycatch reduction engineering funding. In addition to the programs discussed below, NMFS has conducted cross-fishery research into the effects of fishing on incidental take of marine mammals and seabirds.

FMP-based bycatch minimization policies necessarily focus on the bycatch within particular fisheries. Responding to the MSA by reducing the volume and rate of bycatch in individual Council-managed fisheries has most likely resulted in an overall reduction in the total volume of incidentally-caught and discarded CCE marine life. However, moving beyond the fishery-by-fishery approach could allow the Council to better assess issues like: the cumulative effects of the bycatch of non-Council species taken in Council-managed fisheries; whether gear innovation programs or products in one fishery could benefit other fisheries; and whether the timing and interactions of multiple Council-managed fisheries increase or decrease the likelihood of bycatch in these fisheries.

Cross-FMP Bycatch Issues:

- National Standard 9 has made bycatch a key focus of conservation and management in all four FMPs.
- Bycatch of both fish and non-fish marine vertebrate species (i.e., seabirds, marine mammals, and sea turtles) is of at least some concern in all four FMPs. Bycatch has been highly significant to the HMS, Groundfish, and Salmon FMPs with the latter two driven largely by "weak stock" management of rebuilding rockfish stocks and ESA listed salmon.
- The Council has employed closed areas, gear restrictions, and species handling rules to address bycatch in all four FMPs with some measures (e.g., yelloweye rockfish conservation areas) crossing FMPs.
- The many fishery sectors managed under each FMP are monitored to varying degrees and with different tools such as logbooks and at-sea observers. Monitoring resources are targeted at the sectors for which bycatch is of highest concern, yet there are gaps in monitoring for some fisheries.

3.3 FMP Essential Fish Habitat Issues (Appendix Tables A.4, A.5)

The 1996 Sustainable Fisheries Act brought the concept of essential fish habitat (EFH) into the MSA, and subsequently into FMPs throughout the U.S. EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity" [§3(10)]. For several fishery management councils, the requirement to identify EFH led to a new and greater understanding of how managed species interact with their physical environment. Although this new understanding has not been universally identified as a move toward ecosystem-based fishery management, some councils used their work on EFH to launch or support further work on ecosystem-based management.

The Act requires NMFS and fishery management councils to identify EFH for their FMPs, identify adverse impacts to that habitat, and ensure the conservation of EFH. Through their FMPs, fishery management councils develop, and NMFS implements, management measures to minimize the effect of fishing activities on EFH.

For non-fishing activities, fishery management councils are permitted to comment on and make recommendations to the Secretary of Commerce or any Federal or State agency "concerning any activity authorized, funded, or undertaken or proposed to be authorized funded or undertaken, by any Federal or State agency that, in view of the Council, may affect the habitat, including essential fish habitat, of a fishery resource under its authority" [§305(b)(3)(A).] The Pacific Council has an additional duty to consider the effects of non-fishing activities on salmon EFH, since fishery management councils are required to comment on and make recommendations regarding activities that are likely to substantially affect the habitat of anadromous species [§Section 305(b)(3)(B)]. NMFS has consulted on the effects of numerous non-fishing activities on EFH, with the bulk of those consultations designed initially to look at the effects of those activities on salmon EFH while also considering those activities in light of salmon critical habitat requirements under the ESA, but to also take into account effects on groundfish and CPS EFH. Federal regulations at 50 CFR 600.815(10) require that NMFS and fishery management councils conduct a complete review of all EFH information in each FMP as recommended by the Secretary of Commerce, but at least every five years.

Cross-FMP Habitat Issues:

As shown in Appendix A, Table A.4, EFH has been described for all four FMPs, with the groundfish FMP having the most detail, including Habitat Areas of Particular Concern (HAPC) designations and closed areas to protect EFH. Geographic maps of EFH have been developed for all FMPs, except CPS. Three of the four FMPs have also either recently finished a 5-year review of EFH (CPS) or recently initiated a review (Groundfish and Salmon), which suggests that the Council might consider if there could be efficiencies in integrating some of the work between FMPs in future 5-year EFH review processes. An integrated Council approach to EFH would provide a better understanding of complex overarching issues such as: research needs, common threats to habitat quality, protected species interactions, or ocean acidification. A first step could be to map all EFH data and boundaries in a common tool, like the Groundfish EFH Mapping Tool (http://sharpfin.nmfs.noaa.gov/website/EFH_Mapper/map.aspx or http://pacoos.coas.oregonstate.edu/.) CPS EFH, which has not yet been mapped, is in part defined by a sea surface temperature range between 10 °C to 26 °C, making it annually and seasonally variable; satellite data are available for mapping sea surface temperature changes. General mapping of oceanic events and seasons, such as El Niño/Southern Oscillation (ENSO,) is also possible. A cross-FMP mapping effort could better reveal those habitats important to all four FMPs simultaneously. These common habitats could serve as focal points for Council policy efforts to assess and mitigate for fishing and non-fishing effects on EFH, and for research to better understand the complex interactions between FMP species and their shared habitat.

Unfortunately, limited information about habitat preferences and habitat-specific demographic rates (e.g. survival or growth rates) has resulted in very broad EFH designations. By better understanding what habitats fish use, the demographic rates associated with these habitats, and the factors that make some habitats more valuable than others, it will be possible to make more efficient use of limited resources (Levin and Stunz 2005). When all habitats are considered EFH, prioritization is difficult. New scientific approaches suggest focusing on protecting the habitat-dependent ecological processes that allow populations of fished stocks to persist or expand (Mangel et al. 2006). To this end, the nationally-coordinated NMFS Habitat Assessment Improvement Plan (HAIP) focuses on the marine fisheries aspects of habitat science. The HAIP is intended in part to reduce uncertainty of stock assessments, increase the potential number of advanced stock assessments and contribute to assessments of ecosystem services. The nexus of HAIP, stock assessments and integrated ecosystem assessments has the potential to vastly improve our ability to indentify truly essential EFH.

3.4 FMP Community Effects Issues (Appendix Table A.6. and subsequent figures)

In addition to bringing new management requirements for fish and their habitat, the 1996 Sustainable Fisheries Act recognized the connection of fishing communities to fisheries and fish stocks, particularly through National Standards 8 and 10. National Standard 8 requires that "conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities." National Standard

8 recognized that, while the many new requirements in the Act were expected to end overfishing and ultimately result in healthier and rebuilt stocks, humans are also part of the environment and fishing communities particularly represent the place of humans within the ocean ecosystem.

National Standard 10 requires that “conservation and management measures shall, to the extent practicable, promote the safety of human life at sea.” NMFS and fishery management councils have long worked with the U.S. Coast Guard, the states, and the public to address fishery safety issues, but fishing necessarily takes place in a harsh environment and remains a dangerous occupation. Table A.6 in Appendix A provides vessel incident data from the two U.S. Coast Guard West Coast offices, Districts 11 and 13, as well as information on how the Council addresses community effects in recommending fishery management actions. In providing the EPDT with U.S. Coast Guard safety data, Brian Corrigan of District 13 noted that the Dungeness crab fishery, which is not under Council purview, is usually considered the most dangerous fishery off the West Coast (Corrigan, pers. Comm. 2010).

One challenge of the Council’s current process is that the Council regularly finds itself of having to make a management decision under one FMP without necessarily having a clear picture of how that decision might affect fishing opportunities under other FMPs. Analyses for the MSA, the National Environmental Policy Act (NEPA,) the Regulatory Flexibility Act (RFA,) and other laws do address some of these cross-FMP issues on a case-by-case basis. However, expanding our thinking about the socio-economic effects of the Council’s decisions to an ecosystem context could provide the Council with more resources and information for assessing how their decisions on individual issues fit within the larger picture of all of the Council-generated management programs for fisheries within the CCE.

Cross-FMP Communities Effects Issues:

The importance of FMP fishery resources to fishing communities can be considered in terms of a community’s dependence on, or engagement in, the harvesting or processing of commercially or recreationally targeted fishery resources to meet social and economic needs, and includes fishing vessel owners, operators, and crew and United States fish processors and related entities that are based in such a community. One hundred and twenty three spatially defined communities in Washington, Oregon, California have been identified as being substantially dependent on or substantially engaged in the commercial harvest or processing of fishery resources (Norman et al. 2007). In addition to coastal tribal fisheries for FMP species, inland treaty tribes conduct commercial, and ceremonial and subsistence fisheries for salmon and steelhead. And, within Idaho, the sport fisheries for salmon and steelhead contribute to the economies of several river communities. From a holistic, ecosystem-based perspective it is important to understand how the structure and function of the CCE affects fishing activity (and vice versa), particularly spatial and temporal fishing patterns and the related impacts on fishing communities. This understanding will help the Council to assess how its specific management actions may affect the overall ecological-socioeconomic landscape.

Economists and other social scientists rely on economic impact, input-output models to gauge the impact of changes in fishing patterns on local and regional economic activity. These models can be coupled with models of the ecosystem to better understand the impact of changes in the ecosystem on fishing communities. The basic data for evaluating community dependence and interdependence on FMP fishery resources is the West Coast commercial fishing landings data found in the Pacific Fisheries Information Network (PacFIN) database. These data together with input from the Council’s FMP advisory bodies can be used to assess the socio-economic impacts across fishing communities of a change in the CCE expressed through a change in the abundance and distribution of commercially targeted species.

4.0 Cross-FMP and Ecosystem Science

At the Council's September 2010 meeting, the EPDT received advice and questions from the Council, SSC, and others on the science process and science products that the Council and its advisory bodies might consider for ecosystem-based fishery management planning. In this section: we propose an initial science product development process (4.1), discuss science questions for future consideration, both for FMP species and for more broad ecosystem-wide issues (4.2), and some of the science tools and models that could inform the Council decision-making (4.3).

4.1 Bringing Ecosystem Science into the Council Process

Based in part on advice received from the SSC in September 2010, the EPDT views the incorporation of ecosystem science into the Council process as a two-part process. The first part is to identify and act on opportunities to improve the quantity and quality of ecosystem information used in the science that supports Council decision-making, particularly stock assessments. The second part is to bring a new whole-picture assessment of the CCE into the Council process.

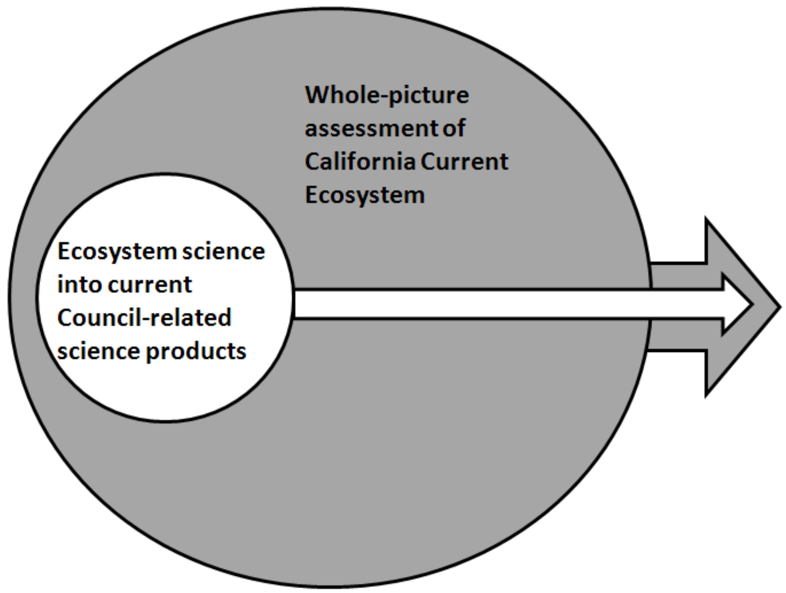

Figure 4.1: Two-part process to bring ecosystem science to the Council

4.1.1 Bringing More Ecosystem Information into Stock Assessments

While Council management decisions address a host of issues requiring wide-ranging science support and analysis, stock assessments and other harvest-level support science are the largest category of science products directly used in the Council process. Recognizing the status of stock assessments as both frequently conducted and heavily used Council-related science, the SSC recommended in September 2010:

> "*. . . that a subset of stock assessments be expanded to include ecosystem considerations. This would likely require the addition of an ecologist or ecosystem scientist to the Stock Assessment Teams (STATs) developing those assessments. The SSC's Ecosystem-Based Management subcommittee should develop guidelines for how ecosystem considerations can be included in stock assessments.*" (H.1.c., Supplemental SSC Report)

Based on this recommendation and on the management and activity cycles (Council Operating Procedure 9) for the Council's four FMPs, The first element of incorporating ecosystem science into the Council process could be addressed by a collaboration between NMFS's science centers and the SSC's Ecosystem-Based Management subcommittee to bring ecosystem considerations into some portion of near-future stock assessments.

There are three means by which ecosystem considerations could be incorporated into near-future stock assessments. First, assessments could include expanded ecosystem information in the overview text of the assessment document, as is currently included in PFMC stock assessments in a limited fashion and also in the North Pacific Fishery Management Council (NPFMC) stock assessments. Assessment documents typically summarize existing research on predator-prey interactions, as well as the impact of climate, habitat and/or predation on natural mortality, growth, fecundity, migrations, recruitment variability, and shifts in distribution that may impact availability to the fishery or survey. These topics could be expanded to more fully incorporate ecosystem considerations.

Second, stock assessment models and/or relevant model sensitivity runs that explicitly include ecosystem interactions, such as those described above, could be developed. The selection of specific stocks for which assessment models with ecosystem considerations are developed should be identified in collaboration with the SSC. There are at least three modeling approaches that might be considered for incorporating ecosystem interactions: 1) modifying relevant model parameters, 2) adding an environmental index of an ecosystem process (i.e. treating the ecosystem information as a data time series with a measure of variance), and 3) modifying the population dynamics equations using an index of an ecosystem process (treating the ecosystem information as known without error). Current stock assessment models have the technical capability to incorporate all of the above approaches given strong scientific evidence for including ecosystem considerations into stock assessment models. Research into improving stock assessments has been the focus of programs such as the NOAA Habitat Assessment Improvement Plan.

Finally, hypotheses on ecosystem considerations for or impacts on a specific stock could be investigated by using them to define alternative states of nature as the basis for the decision tables within current single species stock assessments, which are provided to managers as guidance for setting catches. Preferred methods for including ecosystem considerations into single species stock assessment should be addressed in the stock assessment terms of reference provided by the Council's SSC. Since the additional expertise necessary to include ecosystem considerations into stock assessment will likely extend beyond that of the current stock assessment teams single species stock assessments will require the commitment and active participation by agency ecologists and fisheries oceanographers. The following proposed schedule recognizes that stock assessment terms of reference and processes are generally prepared well in advance of the year in which they are ultimately used to support fishery management. HMS species are not included in this schedule because HMS stock assessments are conducted by international RFMOs.

Table 4.1: Bringing ecosystem considerations into stock assessment and harvest-setting processes	
CPS	November 2010 – Terms of reference were drafted for CPS stock assessment and methodology review panels that included revisions to begin to bring ecosystem considerations into the next full assessments (currently scheduled for 2014 per the CPS FMP) for Pacific mackerel and Pacific sardine, and for any other CPS species for which the SSC and Council deem such changes to be appropriate. June 2014 – Pacific mackerel full assessment with ecosystem considerations completed for first use in 2014-2015 fishery. November 2014 – Pacific sardine full assessment with ecosystem considerations completed for first use in 2015 fishery.
Groundfish	March 2012 – Proposed list of stock assessments, including recommendations on species assessments to be expanded to include ecosystem considerations, as part of *2013-2014 Terms of Reference for Groundfish Stock Assessment and Review Process*. June 2012 – Final list of stock assessments, including subset of species assessments to be expanded to include ecosystem considerations, as part of *2013-2014 Terms of Reference for Groundfish Stock Assessment and Review Process*. November 2013 – Groundfish stock assessments intended to inform 2015-2016 fishing years complete, including those that have been expanded with ecosystem considerations.
Salmon	April 2012 – As part of developing initial list of potential topics for salmon methodology review, Council and advisory bodies draft potential data and analysis requests for ecosystem information of potential benefit to salmon abundance and assessment models. September 2012 – Council and advisory bodies finalize data and analysis requests for ecosystem information of potential benefit to salmon abundance and assessment models for review by SSC Salmon Subcommittee and Salmon Technical Team. November 2012 – Council finalizes data an analysis requests for ecosystem information of potential benefit to salmon abundance and assessment models, using advice received through salmon-specific advisory bodies, the SSC, other advisory bodies, and the public. April 2013 – As part of developing initial list of potential topics for salmon methodology review, Council and advisory bodies review available ecosystem considerations data and analyses compiled in response to requests developed in 2012. September and November 2013 – Ecosystem considerations incorporated into salmon methodology for 2014 through regular methodology review process. March and April 2014 – 2014 salmon season management developed with methodologies that incorporate the ecosystem considerations developed over 2012-2013.

4.1.2 Bringing Ecosystem Information and Science into the Larger Council Process

At its September 2010 meeting, the SSC also provided advice on approaches to bring ecosystem information more broadly into the Council decision-making process by increasing and improving the ecosystem science information used within the Council process:

"…The Council should request NMFS to initiate development of an annual report on conditions in the California Current ecosystem. The SSC can provide guidance on the content, review and dissemination of this report…" (H.1.c., Supplemental SSC Report)

At its November 2010 meeting, the Council received a presentation from Patricia Livingston of NMFS's Alaska Fisheries Science Center (AFSC) that, among other things, discussed the AFSC's Ecosystem Considerations chapter of its Stock Assessment and Fishery Evaluation (SAFE) Report. The AFSC first published its Ecosystem Considerations report in 1995 and the ongoing dialogue that report has created between NMFS and the NPFMC has led to many refinements to the report's format and to the information it presents – see box at right. The AFSC's report provides an example of the type of annual ecosystem report that could address the second element of incorporating ecosystem science into the Council decision-making process. However, NMFS and its partner science entities will necessarily have different types of data and analyses for the CCE than those available for ecosystems of interest to the NPFMC. For example, there is currently an annual briefing and report available on physical and biological oceanographic trends and conditions throughout the CCE developed by the California Cooperative Oceanic and Fisheries Investigations (CalCOFI) consortium (McClatchie et al. 2009, Bjorkstedt et all 2010). While the CalCOFI report is technical in nature, it could provide the foundation for a summary of physical and biological trends of key interest to fisheries managers. NMFS and the Pacific Council have an opportunity to benefit from the experience of our colleagues in the North Pacific and in other parts of the country by evaluating lessons others have learned on ecosystem reporting to better design an initial report on conditions in the CCE.

History and Goals of the AFSC Ecosystem Considerations Report *[Adapted from: http://access.afsc.noaa.gov/reem/ecoweb/EcosystemIndex.cfm, as viewed on 12/27/10]*

Since 1995, the NPFMC Groundfish Plan Teams have prepared a separate Ecosystem Considerations section to the annual SAFE report. The first report in 1995 compiled information on Bering Sea, Aleutian Island, and Gulf of Alaska ecosystems, and discussed ecosystem-based management.

In 1996-1999, AFSC added information to the report on these and other areas of interest: biological features of the N. Pacific; effects of bycatch and discard on ecosystem; seabird and marine mammal research; precautionary approach in scientific literature; EFH and effects of fishing gear on habitat; collection of local knowledge; marine protected areas research, and oceanographic changes during 1995-1999.

From 2000 to the present, the AFSC has been adding to and refining the report to meet goals set in 1999, emphasizing indicators of ecosystem status and trends, and ecosystem-based management performance measures. These changes are intended to:

1) Track ecosystem-based management efforts and their efficacy;
2) Track the changes in the ecosystem that are not easily incorporated into single-species assessments;
3) Bring results from ecosystem research efforts to the attention of fishery scientists and managers;
4) Provide a stronger link between ecosystem research and fishery management; and
5) Assess the past, present, and future role of climate and humans in influencing ecosystem status and trends.

The report's ecosystem-based management indices are intended to track management performance in meeting stated ecosystem-based management goals of the NPFMC:

1) Maintain biodiversity consistent with natural evolutionary and ecological processes, including dynamic change and variability;
2) Maintain and restore habitats essential for fish and their prey;
3) Maintain system sustainability and sustainable yields for human consumption and non-extractive uses;
4) Maintain the concept that humans are components of the ecosystem.

In early 2011, NMFS's Northwest and Southwest Fisheries Science Centers will cooperatively release their first iteration of a California Current Integrated Ecosystem Assessment (CCIEA) (Levin and Schwing, in press.) The CCIEA will provide the Council, its advisory bodies, and the public with an illustration of the types of information and analyses that may be possible with data available on the CCE and its component species and physiological features. An annual report on ecosystem conditions and considerations of particular interest to the Pacific Council would be shaped by the Council and its advisory bodies, and could feature different issues than those explored in this first California Current IEA.

Both the AFSC Ecosystem Considerations report and the CCIEA provide scientific analyses rooted in ecosystem-based management issues for the geographic areas they address. These reports, and similar reports worldwide, use an analysis framework that assesses: the state of the environment; the driving forces that affect the environment, both human-induced and natural; the pressures those driving forces place on the environment; the impacts that the driving forces and resulting pressures have on the state of the environment; and the policy responses that humans may or may not make to address any of the other factors. This analysis framework is known as Driver-Pressure-State-Impact-Response (DPSIR). In simple terms, DPSIR represents a process that essentially asks, "What's going on in the environment, how are we affecting it, and what are our goals for how we might alter our future effects on it?"

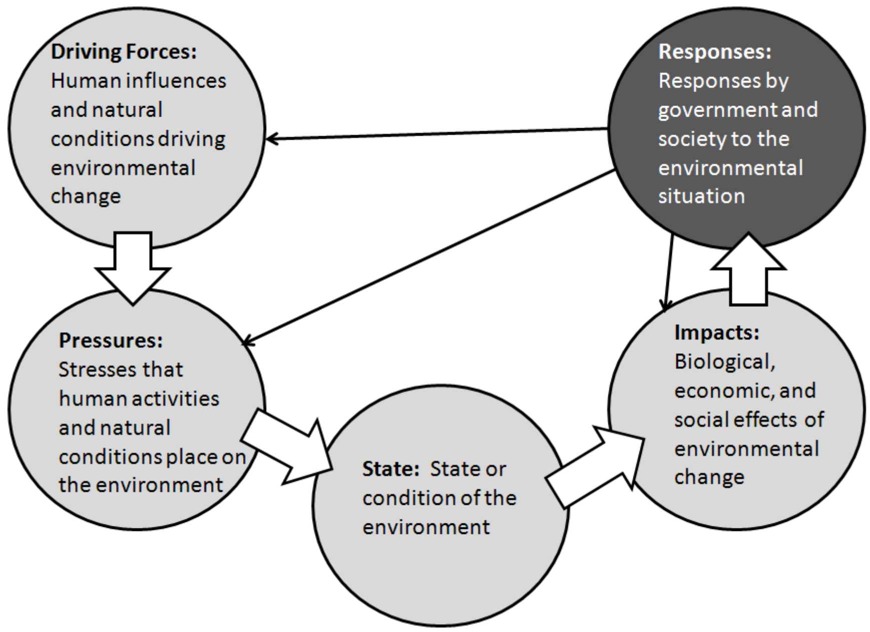

Figure 4.2: DPSIR Framework, illustration adapted from http://www.gulfofmaine.org/state-of-the-gulf/framework.html

As the DPSIR framework illustrates, a key task in assessing the state of the ecosystem is to ask management bodies to articulate their goals for the ecosystem and for their ecosystem-based management efforts. The Council has not yet articulated its ecosystem-based management goals, but this EPDT discussion document is an early step in the Council's ecosystem-based fishery management planning process. In our September 2010 report, we pointed out that the existing FMPs have suites of goals and objectives that have four common themes that are consistent with an ecosystem approach to fishery management: *avoid overfishing, maintain stability in landings, minimize impacts to habitat, and accommodate existing fisheries sectors*. The CPS FMP also explicitly recognizes the role of the target species in the food web, citing a need to *provide adequate forage for dependent species*.

The EPDT proposes an approach to develop an annual report format using existing capabilities at the NMFS Science Centers and leveraging the CCIEA. Currently, the CCIEA includes fisheries and "ecosystem health" among its primary foci. The initial iteration of the CCIEA examined trends in abundance, size structure and spatial distribution of target and non-target stocks (with a strong emphasis on groundfish). The ecosystem health component of the CCIEA examined attributes of ecosystem structure and function, including climate / ocean drivers, primary production, zooplankton and top predators.

For a more Council-focused CCIEA iteration, the EPDT would work with the Science Centers to select a pilot set of species, spread among the four FMPs and of potential interest to the Council. For each species, the next-round CCIEA would report the status of the following:

- Climate / ocean conditions affecting target species
- Juvenile and adult habitat (where data are available)
- Prey availability
- Predation risk
- Other ecological factors (e.g., disease, competitors, etc.)
- Other human activities that affect target species (e.g., water quality, activities affecting habitat, energy development, etc.

Thus, for each species, the report would provide a comprehensive picture of the ecosystem factors affecting stocks in a manner similar to the report in the North Pacific. By embedding this work within the IEA, the Council leverages other work performed within the IEA to get additional information such as:

- Influence of fisheries on protected species
- Effects of non-fishing activities on fish stocks and EFH
- Cumulative impact of fisheries

We envision this as an iterative process wherein the IEA team provides the Council with an initial ecosystem considerations report, for review and comment by the Council and its advisory bodies. Council feedback on the initial report would then lead to modifications to the topics or species considered, presentation, or other concerns, ultimately improving IEA products and reports over time.

Proposed Schedule:
March 2011 – IEA team begins assessment on [2 groundfish, some selected salmon ESUs, 1 CPS)
Sept 2011 – Draft product delivered.

In the North Pacific, NMFS and the NPFMC have had 15 years to develop and refine their Ecosystem Considerations report. NMFS could take a similar approach for the California Current – provide an initial report without first consulting with the Council on its items of interest for that report and rely on later iterations to bring in Council interests. However, ecosystem science and ideas about ecosystem-based management are much more advanced than they were when AFSC first led the way in designing an ecosystem considerations report. The EPDT believes that an initial investment of time to develop a format for and contents of a Council-focused California Current report through the Council process, accompanied by an iterative discussion of the Council's ecosystem-based management goals, will ultimately pay off with a more rapid coalescing of Council policies and science process.

4.2 Science Questions for Future Consideration

Ecosystem science can be useful both in its application to FMP species-group management, and to aid in long-term Council planning on ecosystem-wide concerns. In this section, we review the science questions common across all four FMPs, follow with FMP-specific research issues, and conclude with a discussion of some broad-scale and long-term issues that could affect fisheries management, such as climate shifts and ocean acidification. Francis et al. (2007) recommend making scientific progress towards ecosystem based fisheries management with these principles: 1. Keep a perspective that is holistic, risk-averse, and adaptive. 2. Question key assumptions, no matter how basic. 3. Maintain old-growth age structure in fish populations. 4. Characterize and maintain the natural spatial structure of fish stocks. 5. Characterize and maintain viable fish habitats. 6. Characterize and maintain ecosystem resilience. 7. Identify and maintain critical food web connections. 8. Account for ecosystem change through time. 9. Account for evolutionary change caused by fishing. 10. Implement an approach that is integrated, interdisciplinary, and inclusive (Francis et al. 2007). Given those recommendations, here are areas where ecosystem science might better inform Council decisions:

4.2.1 Cross-FMP – Needed Future Ecosystem Considerations

1. Evaluate the influence of climatic/oceanographic conditions on FMP species. Investigate the potential for incorporating environmental factors within the current stock assessment modeling framework (Stock Synthesis 3). Model effects of climate forcing on productivity and assess utility of simulated estimates of the unexploited biomass over time (a “dynamic B0”) rather than the static estimate of long-term, mean, unfished abundance (Sibert et al. 2006). This is now done for many assessments in order to represent relative depletion from both a static and dynamic perspective (Maunder and Aires-da-Silva 2010).
2. Assess high and low frequency changes in the availability of target stocks, and the vulnerability of bycatch species, in response to dynamic changes in climate and oceanographic conditions (such as seasonal changes in water masses, changes in temperature fronts or other boundary conditions, and changes in prey abundance). Link with socio-economic data and modeling to assess effects of changes in availability on West Coast fisheries. For example, during periods of low HMS availability, recreational fishermen who might prefer to harvest HMS species may increase harvest rates and activity for alternative species, such as rockfish and other groundfish.
3. Examine ecological interactions for influencing managed species, including predator-prey relationships, competition, and disease. Investigate the role of FMP species in the food web, including analysis of behavioral interactions (e.g. functional response) between predators and prey.
4. Develop quantitative information on the extent of the cumulative bycatch of all FMP fisheries.
5. Spatially-explicit management: What is the effect of marine spatial planning on FMP species and fisheries? To address this question, a review of marine spatial planning would include both fisheries and non-fisheries closures, traditional fishing grounds, the effects of potential future non-fishing ocean areas uses, and asking about the types of activities tend to generate EFH/ESA consultations.
6. Investigate how viability and resilience of coastal communities are affected by changes in ecosystem structure and function, including short- and long-term climate shifts.
7. Investigate how fishing activity affects ecosystem structure and function, particularly spatial and temporal fishing patterns and their relation to changing patterns in the ecosystem (cumulative impacts of all FMP fisheries).
8. Identify key indicators for recruitment, growth, spatial availability, and overall CCE productivity.
9. Review management reference points, including rebuilding reference points, in light of ecosystem interactions. For example, do reference points like Bzero account for ecosystem interactions of a given species, or do they just reference the life history information about that particular stock? (Brand et al, 2007)
10. Investigate how different habitat types contribute to species productivity rates (habitat-specific demographic rates). See Habitat Assessment Improvement Plan (NMFS 2010).
11. Better understand spatial structure (meta-population structure) of managed stocks and investigate what are the most appropriate spatial scales for management.
12. Assess the effects of different types of fishing gear on ecosystem structure and function, and investigate the effects of the ecosystem structure and function on gear performance.
13. Assess near-shore distribution of FMP species for habitat needs and fishery vulnerability during nursery and pre-reproductive life stages. Characterize the influence of nearshore marine, estuarine and freshwater water quality on survival, growth, and productivity.
14. Assess the evolutionary impacts of fishery management measures and fishing practices, and investigate whether those impacts affect yield or sustainability.
15. Develop an analytical framework to compile the information and evaluate the tradeoffs society is willing to make across the alternative ecological benefits fishery resources provide.

4.2.2 CPS FMP – Needed Future Ecosystem Considerations

1. Climate or ecosystem indicators are not included in the annual stock assessments for Pacific sardine and Pacific mackerel, the FMP's actively managed species. If significant climate-productivity relationships could be developed for Pacific sardine and Pacific mackerel, as well as for other CPS, assessments would benefit since CPS are known to be quite sensitive to long and short-term climate change in the CCLME.
2. Review and revise the climate-based factor in the harvest control rule for Pacific sardine. While not included directly in the assessment process, a climate-based factor is included in the process for determining the annual harvest level for Pacific sardine. For sardine, the FRACTION term in the harvest control rule formula is a function of a three-year average of sea surface temperatures (SST) taken at the Scripps Institute of Oceanography pier located in La Jolla, California. Including this term reflects the positive relationship between sardine reproductive success and water temperature; at higher SSTs a greater fraction of the available biomass can be harvested. Recent work by McClatchie et al. (2010) finds that the Scripps Institute of Oceanography SST is no longer valid in terms of predicting sardine reproductive success. The Council has long identified the review of harvest control rules as a high priority research need and has tasked the CPSMT and the SSC with reviewing these findings. It is anticipated that the Council, the SWFSC, and the States will work toward the development of improved environmental indicators.
3. A management concern of the Council under EBFM will be the evaluating trade-offs between increasing/decreasing the yield of CPS and the potential yield loss/gain of a predator that may be in another Council FMP or be of concern in terms of its ecological importance. In order to come up with a comprehensive optimum yield in this situation, ecological and economic considerations come to the fore, since its resolution depends crucially on the relative net benefits provided society through these interactions (Hannesson et al. 2009; Hannesson and Herrick 2010).
4. NMFS's Southwest Region initiated a pilot observer program for California-based coastal purse seine fishing vessels targeting CPS in 2004 to augment and confirm bycatch rates derived from CDFG dockside sampling. The pilot observer program's primary intent was to gather data on total catch and bycatch, and on interactions between their fishing gear and protected species such as salmon, marine mammals, sea turtles, and sea birds. This program needs to be reviewed to determine whether it should be revived and fully implemented to include standardization of data fields, development of a fishery-specific Observer Field Manual, construction of a relational database for the observer data, and creation of a statistically reliable sampling plan.

4.2.2 Groundfish FMP – Needed Future Ecosystem Considerations

1. Many species show low frequency variability in recruitment due to lower biomass and/or a low productivity environmental regime. For example, the biomass of widow rockfish has decreased steadily since the early 1980s, and recruitment during early 1990s is estimated to have been considerably smaller than before the mid 1970s (He et al. 2007). However, there is evidence that recruitment of many rockfish species since 1999 has been higher than the average of the 1990s (He et al. 2007). Additionally, several data sources in the cabezon assessment indicate that there was potentially good recruitment after 1999 and before 1977, whereas these same sources indicate that recruitment was poor prior to 1999 in the Southern California Stock (Cope and Punt, 2006). The cabezon recruitment patterns of the California sub-stocks suggest a possible link between environmental forcing and population dynamics (Cope and Key 2009). Specifically, strong ENSO conditions (especially in southern California) may be a pre-cursor to significant recruitment events and should be explored further to help increase the understanding of spatially-explicit recruitment responses and inform future recruitment events (Cope and Key 2009). For example, declines in kelp

habitat caused by increasing ocean temperatures in southern California since the 1990s led assessors to suspect that the decline of blue rockfish in this area was in part due to environmental factors affecting habitat, rather than entirely a function of fishing (Key et al. 2008). Finally, correlations between spring sea surface height (Schirripa 2005), zooplankton indices (Schirripa 2007) and sablefish age-0 survival suggest environmental forcing of recruitment. Hamel et al. (2009) recommend investigating effects of PDO, ENSO and other climatic variables on recruitment. A better understanding of the relationship between the population dynamics and climate for such species could reduce the uncertainty of future assessments (Cope and Punt, 2006; He et al. 2007).

2. Provide research on relative density of rockfish in trawlable and untrawlable areas and differences in age and length compositions between these areas (e.g. shortspine thornyhead (Hamel 2005); darkblocked rockfish (Hamel 2008)).
3. Investigate predation impacts likely to affect abundance of assessed species (e.g. lingcod on gopher rockfish (Key et al. 2005); sablefish and shortspine thornyhead on longspine thornyhead (Fay 2005, Field et al. 2006); Humboldt squid on Pacific hake (Field et al. 2007, Homes et al. 2008).
4. Investigate hake spatial distributions across all years and between bottom trawl and acoustic surveys to estimate changes in catchability/availability across years (Helser et al. 2006; Helser et al. 2008). Two primary issues are related to the changing spatial distribution of the survey as well as the environmental factors that may be responsible for changes in the spatial distribution of hake and their influences on survey catchability and selectivity (Agostini et al. 2006, Helser et al. 2006; Helser et al. 2008). Hamel et al (2009) also recommend investigating time-varying availability inshore for lingcod.
5. Review acoustic hake data to assess whether there are spatial trends in the acoustic survey indices that are not being captured by the model (Helser et al. 2006; Helser et al. 2008). Analysis should include investigation of stock migration (expansion/contraction) in relation to variation in environmental factors (Helser et al. 2006; Helser et al. 2008).
6. Investigate time-varying growth rates and maturity schedules as influenced by environmental factors because of apparent low frequency variability (e.g. Pacific hake (Hamel and Stewart 2009), bocaccio (MacCall 2008); chillipepper rockfish (Field 2007); english sole (Stewart 2008); lingcod (Hamel et al. 2009); splitnose rockfish (Gertseva et al. 2009), chilipepper (Harvey et al., in press).
7. Research consequences of poor environmental conditions on bioenergetic allocation patterns (bocaccio (Field et al. 2009)).

4.2.3 HMS FMP – Needed Future Ecosystem Considerations

1. Assess nearshore distribution of juvenile sharks for habitat needs and fishery vulnerability during nursery and pre-reproductive life stages (Hanan 1993, Cartamil 2010).
2. Research and modeling needed on the links between climate and the migration patterns of protected bycatch species to allow us to refine our closed area management programs, such as for leatherback and loggerhead sea turtles.
3. Evaluate utility of Pacific pelagic ecosystem models (e.g., Kitchell et al. 1999, Kitchell et al. 2002, Cox et al. 2002, Olson and Watters 2003, Watters et al. 2003, Hinke et al. 2004, Lehodey et al. 2008) for informing Council decisions. Polovina et al. (2009) recently found that with increasing fishing pressure, the catch rates of top predators such as marlin, spearfish, sharks, and large tunas (bigeye and yellowfin) declined, while the catch rates of mid-trophic level species such as mahimahi, pomfret and escolar increased – consistent with earlier models for this same area (Kitchell et al. 1999, Kitchell et al. 2002). Conversely, some later models did not predict as strong effects of fishing through the food web (e.g., Cox et al. 2002) or did not predict long term changes (e.g., Watters et al. 2003), the resulting release of predation mortality from mid-trophic level populations from declines in top trophic-level predators is consistent with the empirical results described in Sibert et al. (2006) and Polovina (2009).

4.2.4 Salmon FMP – Needed Future Ecosystem Considerations

1. Develop tools that describe the environmental state and potential habitat utilization for near-shore anadromous fish, including coastwide sampling of juvenile distributions, monitoring and characterization of the forage based for juvenile and adult salmon, and fine-scale mapping of stock-specific ocean catch distributions.
2. Characterize and map the ocean habitats for anadromous species using data from satellites and electronic tags.
3. Characterize trends in hatchery salmon production and assess the potential for density-dependent effects in freshwater streams, estuaries, and coastal ocean environments. Assess the potential for increasing hatchery production throughout the Pacific Rim to impact body size, age-at-maturity and productivity of salmon in offshore ocean environments.
4. Examine temporal trends in regional salmon harvest rates and measure their covariation with temporal and spatial patterns of environmental variability. Characterize temporal changes in size, age and migration timing of heavily exploited salmon stocks to evaluate correlations with harvest and environmental patterns.
5. Research is needed on the effects of ecological interactions such as disease, predation and competition on the population dynamics of adult and juvenile salmon. In particular, research is needed on the unique impact of cultured salmon, both hatchery smolts and marine net pen reared fish, on disease and competition.
6. Characterize the influence of nearshore marine, estuarine and freshwater water quality on survival, growth, and reproduction of salmon.

4.2.5 Oceanographic Conditions, Broad-Scale and Long-Term Ecosystem Considerations

The California Current is an "Eastern Boundary Current," an upwelling-dominated ecosystem characterized by fluctuations in physical conditions and productivity over multiple time scales (Parrish et al. 1981, Mann and Lazier 1996). Food webs in these types of ecosystems tend to be structured around coastal pelagic species that exhibit boom-bust cycles over decadal time scales (Bakun 1996, Checkley et al. 2009). By contrast, the top trophic levels of such ecosystems are often dominated by highly migratory species such as salmon, tuna, billfish and marine mammals, whose dynamics may be partially or wholly driven by processes in entirely different ecosystems, even different hemispheres.

The CCE essentially begins where the west wind drift (or the North Pacific Current) reaches the North American continent. The North Pacific Current typically encounters land along the northern end of Vancouver Island, although this location varies latitudinally from year to year. This current then splits into the southward-flowing California Current heading south and the northward-flowing Alaska Current. The "current" part of the California Current is a massive southward flow of water ranging from 50 to 500 kilometers offshore (Mann and Lazier, 1996). Beneath this surface current, lies the California Undercurrent in the summer, which surfaces and is known as the Davidson current in winter. This current moves water poleward from the south in a deep yet more narrow band of water typically close to (but offshore of) the continental shelf break (Hickey 1998, Checkley and Barth 2009). The southward California current is typically considered distinct from the wind-driven coastal upwelling jet that develops over the continental shelf during the spring and summer, which tends to be driven by localized forcing and to vary on smaller spatial and temporal scales than offshore processes (Hickey, 1998). Jets result from intensive wind-driven coastal upwelling, and lead to higher nutrient input and productivity; they in turn are influenced by the coastal topography (capes, canyons and offshore banks), particularly the large capes such as Cape Blanco, Cape Mendocino and Point Conception. The flow from the coastal upwelling jets can be diverted offshore, creating eddies, fronts and other mesoscale changes in physical and biological conditions, and even often linking up to the offshore California Current (Hickey, 1998). One example is south of Point Conception, where part of the California Current swirls eastward and then northward to form the Southern California Eddy.

Superimposed on the effects of these shifting water masses that drive much of the interannual variability of the California Current, are substantive changes in productivity that often take place at slower rates, during multi-year and decadal periods of altering ocean condition and productivity regimes. Climatologists and oceanographers have identified and quantified both the high and low frequency variability in numerous ways. The El Niño/Southern Oscillation (ENSO) is the dominant mode of interannual variability in the equatorial Pacific, with impacts throughout the rest of the Pacific basin (including the California Current) and the globe (Mann and Lazier 1996). During the negative (El Niño) phase of the ENSO cycle, jet stream winds are typically diverted northward, often resulting in increased exposure of the West Coast of the U.S. to subtropical weather systems (Cayan 1989). Concurrently in the coastal ocean, the effects of these events include reduced upwelling winds, a deepening of the thermocline, intrusion of offshore (subtropical) waters, dramatic declines in primary and secondary production, poor recruitment, growth and survival of many resident species (particularly salmon and groundfish), and northward extensions in the range of many tropical species.

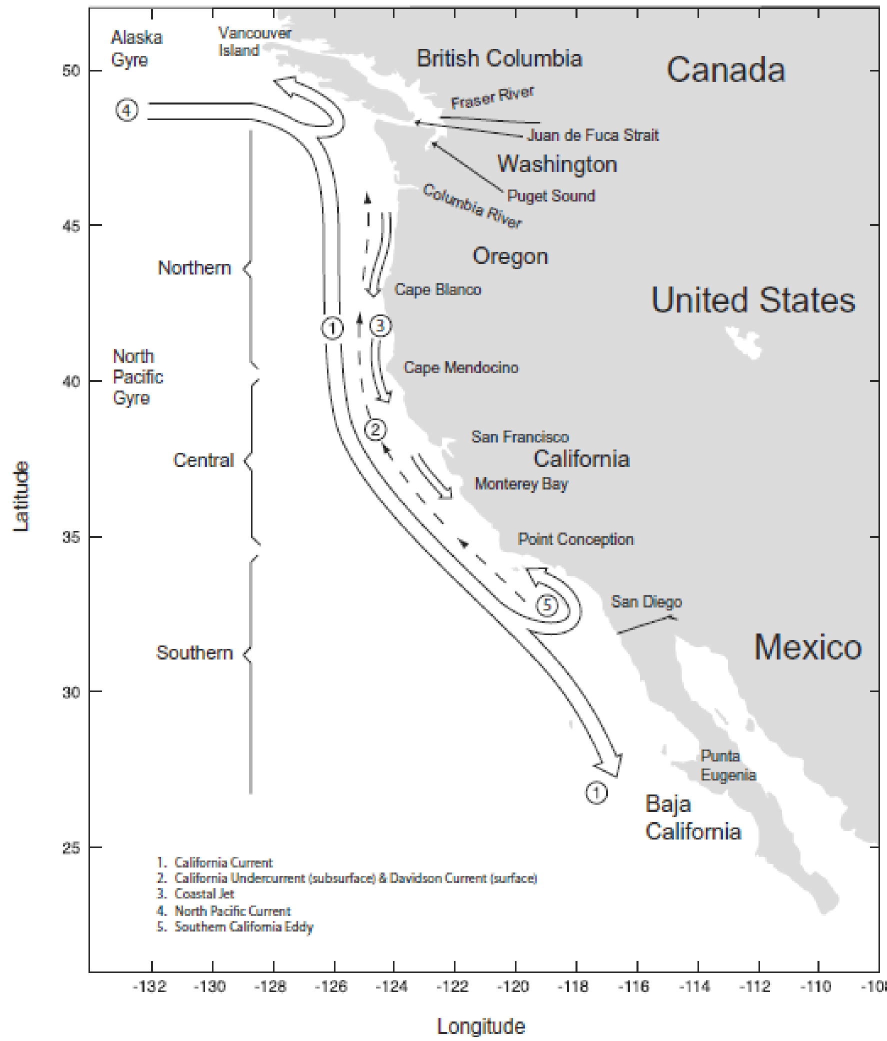

Figure 4.3: Dominant current systems off the U.S. West Coast

While the ENSO cycle is generally a high-frequency event (taking on the order of three to seven years to complete a cycle), lower frequency variability has been associated with what is now commonly referred to as the Pacific (inter)Decadal Oscillation, or PDO (Mantua et al. 1997). The PDO is the leading principal component of North Pacific sea surface temperatures (above 20° N. lat.), and superficially resembles ENSO over a decadal time scale. During positive regimes, coastal sea surface temperatures in both the Gulf of Alaska and the California Current tend to be higher, while those in the North Pacific Gyre tend to be lower; the converse is true in negative regimes. The effects of the PDO have been associated with low frequency variability in over 100 physical and biological time series throughout the Northeast Pacific, including time series of recruitment and abundance for commercially important coastal pelagics, groundfish and invertebrates (Mantua and Hare 2002).

Three major aspects of climate change that will have direct effects on the CCE are: ocean temperature, pH (acidity versus alkalinity) of ocean surface waters, and deep-water oxygen. Globally by 2050, ocean temperatures *on average* are expected to rise at least 1°C (by the most conservative estimates, ref: climate IPCC report), while at the same time, ocean pH in the upper 500m has steadily been decreasing (becoming more acidic, aka "ocean acidification") at a rate of approximately -0.0017 pH per year (Byrne et al., 2010). On a more regional basis within the CCE, deep-water oxygen levels have shown a steady and relatively rapid decrease since the mid 1980's (Bograd et al., 2008, McClatchie et al., 2010). There is linkage between these three factors: ocean temperature affects ocean pH, ocean temperature and deep water oxygen levels both can be controlled by large scale circulation patterns, primary production can affect both oxygen and pH, all three factors show long term trends and decadal scale variance similar to changes in the PDO (Mantua et al., 1997) and North Pacific Gyre Oscillation (DiLorenzo et al., 2008) climate signals.

Temperature

Increasing temperature will have both direct and indirect effects on all managed species within the CCE. For cold-blooded species, vital rates will change as a function of temperature, specifically growth and development rates, which could lead to changes in size-at-age relationships, and/or changes in egg production rates (Houde, 1989; Blaxter, 1992). Certain species with upper thermal limit tolerances, may become locally extirpated in some areas, or conversely expand into new territories that were once too cold. Other, more mobile species, may change their depth/and or spatial range in response to increasing temperature, typically through a northward shifting of population boundaries. Indirect effects on managed species include changes in both basic primary and secondary production rates, and/or community composition of the lower trophic levels which provide the food base for managed species. It is also likely that along with increased warming, there has been an increase in thermal stratification within the CCE (Palacios et al., 2004), which may lead to a decrease in overall primary production, through a reduction in the effectiveness of upwelling bringing nutrients to the surface layers. Thus we may expect system-wide changes in productivity, or changes in the centers of productivity over the next 50 years. Related to changes in temperature, there may also be associated changes in the timing of the onset of spring's seasonal upwelling, which could have widespread effects on total production, the match-mismatch of certain trophic interactions, and possible community shifts (Loggerwell et al., 2003; Holt and Mantua, 2009).

Temperature within the CCE is monitored reliably via several methods. Surface temperatures are sampled via satellite on relatively high temporal (daily) and spatial (several km) scales. In situ and some sub-surface temperatures are less frequently monitored by buoys and ship-based measurements. Gliders and shore-stations provide additional measurements at lower spatial coverage. CCE water temperature measurements have been taken for a longer span of time than any other measurements, providing excellent background data to evaluate current and historic trends (e.g. the CALCOFI program).

Ocean pH

Decreasing ocean pH ("ocean acidification") will have direct effects on certain species within the CCE. Primarily, decreasing pH makes it more difficult for shell-bearing species (such as corals, bivalves, gastropods, and crustaceans) to make their shells (Kleypas et al., 1999; Reibesell et al., 2000; Fabry et al., 2008). Decreased pH may possibly impact the larvae and young stages of fish, although studies documenting such effects on fish are sparse (see Fabry et al. 2008, and references therein). The most significant impact likely for the managed species within the CCE would be if decreasing pH caused changes in plankton productivity or community composition. Currently, the likeliness and extent of such effects are poorly known, but could be considerable. As changes in ocean pH roughly track changes in atmospheric pCO2 levels, it is expected that as pCO2 continues to rise, ocean pH will continue to steadily decrease, making changes in ocean plankton production and community structure more likely in the future. It is important to note that there is considerable daily, seasonal, and decadal scale variability in ocean pH, overlain on the overall long-term trend (reviewed in Fabry et al., 2008). Thus many oceanic species are already exposed to considerable variability in ocean pH compared to the rate of long-term change, and thus have some natural resilience to such changes.

Measurement of ocean pH requires in situ water sampling, and cannot currently be conducted via remote means. However, because of the relatively tight coupling of ocean pH with atmospheric forcing, biogeochemical models may be used in some cases to determine ocean pH at higher temporal and spatial frequency than in situ sampling would allow. In fact, historic ocean pH levels used for calculating long term trends have mostly been calculated used biogeochemical-atmospheric models (Fabry et al., 2008). There is much less data available, both temporally and spatially concerning ocean pH than nearly all other physical-chemical measurements, partly because up until recently, it was believed that the ocean was relatively "self-buffering" and would not undergo significant changes in pH. With the recent recognition that pH is indeed decreasing, and that this may be detrimental to many marine organisms, monitoring of pH has increased, particularly in coastal regions.

Oxygen

Within the CCE, there has been a notable decrease in deep-water oxygen levels since the mid 1980's (Bograd et al., 2008, Chan et al., 2008). Effects of low oxygen levels on marine organisms are fairly well known: death in most cases if the organisms cannot avoid the area, or reduced growth for those species with some tolerance. Overlaid on this steady decrease, occasional periods of heightened primary production without concomitant surface grazing, have sometimes led to large hypoxic or even anoxic zones in deeper waters, resulting in mass fish kills (e.g. recent events off Oregon coast; Chan et al., 2008). The decrease in deep water oxygen levels is most likely a result of changes in oxygen content of the source waters of deeper parts of the CCE, more of a basin-wide phenomenon effecting large regions of the CCE (Bograd et al., 2008). On top of the long term, system-wide change in deeper water oxygen, are regional-scale events that may further decrease oxygen levels. Particularly, strong surface primary production may sink out before being remineralized in surface layers, leading to a higher respiratory demand in deeper waters. Coupling such events with the already depleted deeper waters, may thus lead to fish kills, the likelihood of which will probably increase as the deep water oxygen continues to decrease under the current trend.

Oxygen levels have been measured for many decades throughout the CCE (e.g.CALCOFI), traditionally via in situ sampling, followed by ship-board analysis. Oxygen cannot be measured remotely via satellites or other means. However, recent technological advances have enabled the development of in situ oxygen sensors that can provide fairly rapid subsurface measurements of oxygen (Tengberg et al., 2006). Modeling in situ oxygen levels is problematic in most cases, since it requires complex atmospheric-physical-biological coupled models with accurate mixing schemes, although such models do exist and can be applied in some areas with decent success (Najjar and Keeling, 2000). Thus, modeling may provide a limited ability to fill in data gaps, and make limited predictions of water oxygen content.

Future research considerations that would improve the Council's ability to incorporate temperature, pH, and Oxygen research and information into ecosystem-based fishery management are:

1. Direct physiological effects of temperature, pH, and O changes on managed and non-FMP forage species, including, but not limited to: tolerance limits, growth rate, reproductive rate
2. Current spatial and depth boundaries of all FMP, and non-FMP forage species in regards to Temperature, pH, and O.
3. Spatially-specific trend analysis of temperature, pH, and O changes specific to the EFH of all FMP and non-FMP forage species
4. Spatially-specific forecasts of temperature, pH, and O changes specific to the EFH of all FMP and non-FMP forage species
5. Spatially-specific trend and forecast of temperature, pH, and O effects on food chain base (1° and 2° production) for all FMP and non-FMP forage species

5.0 Understanding the Cumulative Effects of Fisheries Actions

At its September 2010 meeting, the Council discussed the possibility of using information generated from the ecosystem fishery management planning process to support its work on its existing FMPs by broadening the scientific information available on the cumulative ecological effects of management actions taken for FMP species and their fisheries. The scientific questions, processes, and tools discussed in Section 4.0 are all intended to work towards this goal by ultimately improving the quality of ecological information available to inform Council decision-making. A suite of laws guide the issues NMFS and the Council must consider in making fisheries management decisions: MSA, NEPA, ESA, MMPA, the Regulatory Flexibility Act, Executive Order 12866, and others. Several of these mandates ask that we consider not just the particular action under consideration, but the larger management framework that governs that decision. NEPA particularly requires that we assess the cumulative effects of the proposed action, taken together with other "past, present, and reasonably foreseeable future actions" (40 CFR 1508.7.)

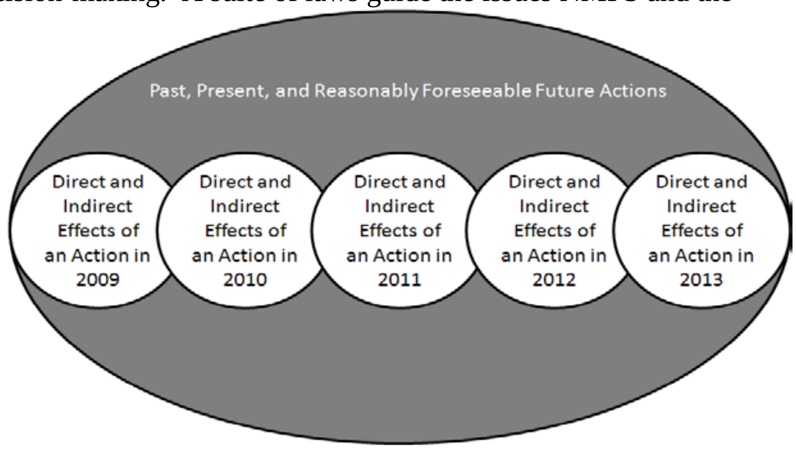

Figure 5.1: Cumulative Effects

Engaging in ecosystem-based management includes expanding our awareness of the range of human activities that affect the CCE. However, Council and NMFS authority is often constrained to considering fisheries actions, with some added authority and requirements to comment on how non-fisheries actions may affect CCE living marine resources and habitat. To assess whether ecosystem-based fishery management planning can aid in Council decision making, the field of effects of actions under Council consideration may be reduced to four broad categories:

1. *Removal of fish from a population*. Fishing activities result in some level of total (directed + incidental) fishing mortality. An action under Council consideration may specify the total permissible mortality level for certain species, for some defined time period – setting an annual catch limit, for example. The ultimate, or cumulative, effects of that action on the environment may be a series of actions, such as setting annual catch limits over successive years. The combined fishing mortality over time may have a broad range of effects, such as changes in age structure of target and non-target species populations, or availability of various species to other species as prey, predators, or competitors. Cumulative effects are likely to also be a product of various other non-fisheries actions, or even more ephemeral trends, such as climate forcing effects on primary productivity.
2. *Removal of other types of organisms from a population.* Our laws and regulations differentiate incidental mortality of protected, nonfish species (e.g., marine mammals) from fishing mortality. In terms of the overall effects, however, the same question applies – What are the ultimate effects of successive, human-caused mortality over time? We are asking ourselves, how multiple, individual regulatory actions affect population and trophic dynamics for these non-fish species.
3. *Destruction of biophysical habitat.* Fishing gear may have adverse effects on physical habitat, such as substrate, or on macrobenthos like corals and sponges. These effects represent the loss of physical habitat and its function in providing shelter and living space for other organisms. If habitat forming organisms may be killed as a result past, present, and

reasonably foreseeable future actions, then it may be appropriate to consider the types of population and trophic dynamic effects mentioned above for fish and non-fish species.

4. *Personal income and other socioeconomic effects.* Ex-vessel revenue is the proximate effect of selling fish (or, for recreational fisheries, revenue resulting from the sale of the fishing experience.) The movement of fish or the fishing experience as commodities within the economy, and resulting expenditures from revenues may be considered largely cumulative effects of an action or of the Council's activities as a whole. Other socioeconomic effects of past, present, and reasonably foreseeable future actions, such as the pleasure derived from private recreational fishing, diving, kayaking, or beachcombing, are less quantifiable but may also be considered in Council decision-making.

An ecosystem fishery management planning process may provide new information for or otherwise aid in Council decision-making in several ways. First, the scientific processes and research discussed in Section 4.0 would likely produce a detailed description of the affected environment at the ecosystem level. Second, these same scientific processes, research, and products could evaluate ecological linkages between the many Council-managed species at their varied trophic levels, and between the four categories of effects of fisheries actions discussed above. Finally, an evaluation of the effects of fishery management actions on the marine ecosystem could improve our understanding of both the role of fisheries within the ecosystem and the socio-economic role of the ecosystem for the U.S. and its citizens.

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Appendix A: FMP Summary Tables

Table A.1: FMP Harvest Level and Overfished/Overfishing Issues				
	CPS	Groundfish	HMS	Salmon
What harvest policies are used for FMP species?	Actively managed stocks are assessed annually. Environmental indicators are used in Pacific sardine control rules and are a high research priority. "Cutoff" values (biomass levels below which harvest is prohibited) are used to protect spawning stock and avoid overfishing. Scientific uncertainty in assessments is used in combination with a risk-policy choice to reduce ABC relative to OFLs. A 75% reduction from MSY is used to set monitored species harvest levels.	The Council's harvest policies are intended to prevent overfishing and maintain stock abundance near the level that produces maximum sustainable yield (B_{MSY}: $B_{25\%}$ for flatfish and $B_{40\%}$ for all other stocks). Overfished stocks are managed with rebuilding plans to bring stock abundance back to B_{MSY} in as short a time as possible, within constraints. Harvest levels for more abundant species caught in common with overfished species are managed to constrain bycatch of overfished stocks within the rebuilding harvest levels of those overfished stocks.	The Council's harvest policies are intended to implement harvest strategies that achieve optimum yield for long-term sustainable harvests and which provide a foundation to support US positions in cooperative international management of HMS fisheries. Prevent overfishing and rebuild overfished stocks, working with international organizations as necessary.	To achieve optimum yield (OY,) prevent overfishing, and assure rebuilding of salmon stocks whose abundance has been depressed to an overfished level, the salmon FMP establishes, to the extent practicable, conservation objectives to perpetuate the coastwide aggregate of salmon stocks covered by the plan. Each stock has a specific objective, generally designed to achieve MSY, maximum sustained production (MSP), or in some cases, an exploitation rate to serve as an MSY proxy.
What is the minimum stock size threshold (MSST) for designating a stock *overfished*?	P. sardine = 50,000 mt P. mackerel = 18,200 mt *Stock levels at which recovery is assumed to be quickly possible. Although northern	For all flatfish species, the FMP's default proxy MSST is $B_{12.5\%}$, or 12.5% of the stock's unfished biomass level. For all groundfish species other than flatfish, the FMP's default proxy	The HMS FMP defines a default MSST as no less than half of B_{MSY} (when natural mortality exceeds 0.5). If natural mortality is equal to or greater than 0.5 then the MSST would vary between	The FMP does not define MSST or overfishing; instead the Council sets annual fishery escapement levels as conservation objectives, intended to produce MSY over the long-term while

Table A.1: FMP Harvest Level and Overfished/Overfishing Issues				
	CPS	Groundfish	HMS	Salmon
	anchovy does not have a formal MSST, it does have a mechanism to close the fishery if the stock falls below 300K tons.	MSST is $B_{25\%}$	$0.5B_{MSY}$ and $0.75B_{MSY}$ based on the calculation $(1-M)B_{MSY}$. For vulnerable species the HMS FMP currently suggests a precautionary adjustment from the default value used to calculate the MSST; it would be set generally closer to B_{MSY} than under the default calculation.	preventing overfishing. If a stock falls below its conservation objective (MSY proxy) for three consecutive years, this triggers an "overfishing concern" and the stock is designated overfished. Amendment 16 to the Salmon FMP would set MSST at 1/2 MSY spawning escapement (S_{MSY}) and would designate a stock as overfished if the recent three year geometric mean spawners is below MSST.
What is the *overfishing limit (OFL)* in the FMP?	The OFL is the harvest rate expected to produce MSY and is based on a species specific estimate or proxy of MSY. Actively managed stocks: OFL = Biomass*Fmsy*Distribution. Monitored stocks: OFL=Stocks specific MSY proxy.	The OFL is the harvest rate expected to produce MSY, F_{MSY}. For category 1 stocks (with data-rich, quantitative assessments,) F_{MSY} proxies are $F_{30\%}$ for flatfish, $F_{40\%}$ for whiting, $F_{50\%}$ for rockfish, and $F_{45\%}$ for all other species. For category 2 (data-poor quantitative, or nonquantitative assessments) and category 3 (less- to nonquantitative assessments) stocks, OFL is set based on historical landings levels (typically	The OFL is the harvest rate expected to produce MSY, F_{MSY}. For vulnerable species, a precautionary reduction from the default OY calculation is considered on a case-by-case basis, based on information about the vulnerability of the stock. The FMP has a precautionary threshold of 0.75 F_{MSY}. Amendment 2 to the FMP (passed by Council) emphasizes the case-by-case approach, with 0.75 F_{MSY} as a starting point from	The Salmon FMP does not define overfishing. A *conservation alert* is triggered during the annual preseason process if a natural stock or stock complex is projected to fall short of its conservation objective. Conservation objectives are FMP measures intended to provide guidance during the annual preseason planning process. An *overfishing concern* is triggered if, in three consecutive years, the

Table A.1: FMP Harvest Level and Overfished/Overfishing Issues				
	CPS	Groundfish	HMS	Salmon
	The FMP framework includes ABC control rules that account for scientific uncertainty in assessed stock status and/or relatively scarce data and low landings.	reduced by approximately 50%.) For all three categories, ABC is reduced from OFL, with the percentage reduction from OFL based on the level of scientific uncertainty associated with each stock's OFL.	which to consider alternative values.	postseason estimates indicate that a natural stock has fallen short of its conservation objectives. Amendment 16 to the Salmon FMP proposed to establish an OFL equal to $F_{MSY.}$
Are any of the stocks within the FMP listed as *overfished*, or has *overfishing* occurred? Are any Council-managed stocks listed as threatened or endangered under the ESA?	Overfished species: none Undergoing overfishing: none	Overfished species: Bocaccio in the Monterey and Conception management areas; canary rockfish; cowcod south of Point Conception; darkblotched rockfish; Pacific ocean perch; widow rockfish; yelloweye rockfish, and; petrale sole. In addition to Council-managed species, three distinct groundfish population segments within Puget Sound (Washington) are listed as endangered (bocaccio) or threatened (canary and yelloweye rockfish). These stocks are not encountered in PFMC-managed fisheries.	Overfished species: none. Undergoing overfishing: yellowfin tuna, bigeye tuna, Pacific bluefin tuna	The Salmon FMP excepts three types of salmon stocks from overfishing criteria: hatchery stocks, stocks for which Council management actions have inconsequential impacts, and stocks listed under the ESA. Of the many evolutionarily significant units of West Coast salmon species, several populations are listed as either endangered or threatened under the ESA: Chinook, 2 endangered and 7 threatened; chum, 2 threatened; coho, 1 endangered and 3 threatened; sockeye, 1 endangered and 1 threatened; steelhead, 1 endangered and 10

Table A.1: FMP Harvest Level and Overfished/Overfishing Issues				
	CPS	Groundfish	HMS	Salmon
		Undergoing overfishing: none		threatened. Sacramento River fall Chinook triggered an overfishing concern in 2004 and are currently considered overfished.
Are additional economic, social, or ecological factors taken into account in setting annual harvests?	Pacific sardine landings tend to be the most constraining for the fishery. Socioeconomic impacts of sardine allocation were analyzed in support of the allocation formula adopted under FMP Amendment 11. This allocation scheme is applied to management annually. The CPSMT and the SSC are working to include additional ecological considerations in CPS management. For the 2011 management cycle the CPSMT reviewed PACOOS reports and trends in sea bird and	The Council's focus is on managing stocks for MSY based on the status and biology of each stock. Social, economic, and ecological factors are not typically taken into account in setting annual harvests for stocks above MSST, although overfished stocks are managed with rebuilding plans to bring stocks back to B_{MSY} in as short a time as possible, after taking those factors into account. The Council has reduced annual harvests based on other considerations for certain stocks (e.g., the 2011-12 ACLs for shortbelly rockfish were set based on the stock's ecological importance). In addition,	All HMS management unit species are managed under the auspices of regional fishery management organizations, to which the US is a party. The Council has not set annual harvests (quotas) for any HMS species. For common thresher shark and shortfin mako shark, the Council has set annual harvest guidelines. The guideline for mako shark is based on the stocks vulnerability and the possible importance of the West Coast EEZ as a nursery habitat.	The Council focuses on protecting weak or ESA-listed natural salmon stocks, while providing harvest opportunity on stronger natural and hatchery stocks. Achieving these objectives is complicated by natural variability in annual stock abundance, in ocean migratory routes and timing, and in the high degree of mixing of different salmon species and stocks in ocean fisheries. Socioeconomic objectives seek to: provide for Indian harvest opportunity as provided in treaties with the United States; maintain ocean salmon fishing seasons that continue established recreational and commercial

Table A.1: FMP Harvest Level and Overfished/Overfishing Issues				
	CPS	Groundfish	HMS	Salmon
	mammal populations when developing recommendations. This is an area of CPS management that would likely benefit greatly from an EFMP.	the Council does have social and economic objectives for utilization of the annual harvest (e.g., managing annual harvests to provide year-round fishing opportunity).		fisheries, while meeting fair and equitable salmon harvest allocation objectives among ocean and inside recreational and commercial fisheries.

Table A.2: PFMC Harvest Level and Management Measures Setting Process

	Odd-Numbered Years					Even Numbered Years				
	March	April	June	September	November	March	April	June	September	November
CPS			Stock assessment review for P. mack. and setting of annual specifications		Stock assessment review for P. sardine and setting of annual specifications			Stock assessment review for P. mack. and setting of annual specifications		Stock assessment review for P. sardine and setting of annual specifications
Groundfish	Final council action on whiting specifica-tions; inseason adjustments	Inseason adjustments	Stock assessment review for next odd-even biennium; inseason adjustments	Final stock assessment review for next odd-even biennium; inseason adjustments	Stock assessments and rebuilding analyses for next odd-even biennium; inseason adjustments	Final council action on whiting specifications; stock assessment planning for 2nd from next odd-even biennium; inseason adjustments	Interim discussion of biennial harvest specifications and mgmt. measures for next odd-even biennium; inseason adjustments	Final council action on biennial harvest specifications (and mgmt. measures) for next odd-even biennium; inseason adjustments	Inseason adjustments	Inseason adjustments
HMS								Preliminary consideration of potential biennial mgmt. measures	Council identification of preferred alternatives for biennial mgmt. measures	Final Council adoption of biennial mgmt. measures
		RFMO recommendations and potential RFMO stock assessment results					RFMO recommendations and potential RFMO stock assessment results			
Salmon	Review of prior year's fisheries and stock abundance forecasts for current fishing year	Final Council action on ocean salmon mgmt. measures for current fishing year. Preliminary list of new or revised methodologies proposed for use for next year.		Final list of topics chosen for salmon methodology review	Final Council approval of salmon methodology revisions for use in the next mgmt. cycle.	Review of prior year's fisheries and stock abundance forecasts for current fishing year	Final Council action on ocean salmon mgmt. measures for current fishing year. Preliminary list of new or revised methodologies proposed for use for next year.		Final list of topics chosen for salmon methodology review	Final Council approval of salmon methodology revisions for use in the next mgmt. cycle.

Table A.3: Bycatch Issues				
	CPS	Groundfish	HMS	Salmon
What standardized bycatch reporting methodologies are used in the FMP's fisheries?	Washington and Oregon state logbooks and California dockside monitoring. State and Federal observer programs are implemented dependent upon funding. Data from historic observations used in management.	Bycatch in commercial fisheries is monitored primarily by the West Coast Groundfish Observer Program. The rationalized trawl fisheries will be monitored with 100% observer coverage. Recreational bycatch is monitored with surveys in the three states (CA and OR also employ at sea observers in the for-hire/charter fleets).	Logbooks are required for all Council-authorized commercial HMS fisheries operating within and outside the West Coast EEZ and for West Coast recreational charter vessels. Observers are required on some HMS fisheries, primarily those with substantive potential for bycatch of ESA species or other species of concern (fish, birds, turtles, and mammals.) There is also dockside monitoring of commercial and recreational landings on the West Coast.	Bycatch estimation is based on observer data and release mortality studies. Bycatch does not include any fish that legally are retained in a fishery and kept for personal, tribal, or cultural use, or that enter commerce through sale, barter, or trade. In addition, under the provisions of the MSA, bycatch does not include targeted salmon released alive under a recreational catch-and-release fishery management program.
How often and in what format does the Council receive bycatch information for this FMP's fisheries?	Annually in CPS SAFE document	The NWFSC compiles information on landings and discards and reports total catch once per year (with roughly a one year lag). The Groundfish Management Team uses bycatch projection models that account for the time lags in discard data.	The SWFSC compiles bycatch information as it becomes available. Bycatch information is reported in the annual HMS SAFE documents. Specific, relevant bycatch information is also provided to the Council when it considers HMS fishery management actions (e.g., biennial management measures, EFPs or other fishery changes).	Annually in SAFE document, with focus on a review of the prior year's fisheries. In salmon preseason planning process, management options are assessed for the effects on the amount and type of salmon bycatch and bycatch mortality. Salmon bycatch and mortality estimates for salmon fisheries are reported throughout the preseason process.
Are any gear specifications or modifications required	When fishing for CPS, deploy a net if a southern sea otter is	Gear regulations to minimize bycatch include: selective flatfish trawl	Most HMS fisheries have some gear specifications to reduce or prevent bycatch (e.g., drift	Only hook-and-line gear is allowed in ocean salmon fisheries and many fisheries are

Table A.3: Bycatch Issues				
	CPS	Groundfish	HMS	Salmon
to reduce or prevent bycatch?	observed within the area that would be encircled by the purse seine net.	gear specifications; trawl gear footrope/bobbin size restrictions; pot gear must include "rotten cotton" escape panel; longline gear must be regularly tended.	gillnet fisheries, longline fisheries, purse seine fisheries).	limited to the harvest of fin-marked hatchery stocks (mark-selective fisheries). Gear modifications such as the mandatory use of barbless hooks/ Plugs, the prohibition of fish attractors or bait, and restrictions on the number of spreads per troll line are used to minimize bycatch and/or release mortality.
Are any area closures required to reduce or prevent bycatch?	Washington state waters closed to sardine fishing for salmon and forage reasons (not Council required).	There are coastwide Rockfish Conservation Areas (RCAs,) for which the precise depth closures may vary by season and latitude, since these closures are intended to minimize incidental catch of overfished rockfish in depth zones where they commonly co-occur with more abundant groundfish stocks while maintaining some fishing opportunities for healthier stocks. There are also several RCAs with static boundaries off California and Washington, with a focus	Bycatch has been identified as a concern in the HMS drift gillnet, longline, and large-vessel purse seine fisheries. Within the EEZ, leatherback turtle conservation area is seasonally closed to drift gillnet fishing to prevent bycatch of these turtles. There is also a summer closure area for drift gillnet fishing during El Niño years to prevent bycatch of loggerhead turtles, (The HMS FMP also accounts for state area closures for the drift gillnet fishery to reduce bycatch of thresher sharks and other species.) RFMOs may also adopt conservation measures with area closures for HMS fisheries. EEZ is closed to HMS harvest of great white, basking and	Conservation areas closed to salmon fishing are established around certain river mouths and ocean areas are closed seasonally or annually to avoid concentrations of salmon stocks of concern. Additionally, salmon fisheries are restricted by mandatory and voluntary conservation areas to aid in the rebuilding of yelloweye rockfish populations.

Table A.3: Bycatch Issues				
	CPS	Groundfish	HMS	Salmon
		on protecting overfished cowcod and yelloweye, respectively; and Salmon Conservation Zones intended to minimize salmon bycatch in the whiting fishery.	megamouth sharks for conservation purposes, and to Pacific halibut and Pacific salmon.	
Have any of the fisheries participated in the MSA bycatch reduction engineering program?	No.	*FY08:* conservation engineering funding for researching groundfish gear alterations to reduce bycatch (selective flatfish trawl) *FY09:* seabird bycatch avoidance research for groundfish fisheries; monitoring seabird distribution and abundance in the California Current; continuing of FY08 gear technology research *FY10*: Continued gear technology funding, with additional new focus on open escape window bycatch reduction device (BRD) for Chinook salmon and rockfish bycatch in whiting mid-water trawl fishery; for bycatch *of* groundfish, rather than in	*FY08:* collaborative research to reduce post-release mortality for common thresher sharks taken in the recreational fishery off California *FY09:* continuation of FY08 thresher shark research *FY10*: continuation of thresher shark research; incidental take a post-release mortality of blue shark research in drift gillnet and longline swordfish fisheries	No.

Table A.3: Bycatch Issues				
	CPS	Groundfish	HMS	Salmon
		the groundfish fisheries, FY10 also saw funding for BRD research in the Pacific shrimp trawl fishery to reduce juvenile rockfish bycatch		
Which **fish** species are of greatest concern as bycatch within the FMP's fisheries?	ESA-listed salmon	ESA-listed salmon; rockfish species managed under overfished species rebuilding plans	In addition to the prohibited shark and salmon species listed above, the fish species of greatest concern as bycatch are those proposed to be listed as EC species. Also, non-targeted HMS species taken incidentally in HMS fisheries, such as tuna species with overfishing occurring being taken in other tuna fisheries (e.g., purse seine).	Minimizing the bycatch of threatened and endangered salmonid ESUs is the primary concern in salmon fisheries, and bycatch of fish other than salmon is generally very limited. Regulations allow for retention of most groundfish species and limited numbers of Pacific halibut that are caught incidentally.
What are the known gaps in monitoring for bycatch of **fish** species within the FMP's fisheries?	Detailed information on the number, species and size of salmon bycatch. Oregon and Washington have state logbook programs but salmon must be immediately released if captured.	WCGOP coverage varies between sectors with the focus on the limited entry trawl and fixed gear fisheries. Some fisheries that catch rockfish are not observed at all (e.g., salmon troll and directed halibut fishery).	Drift gillnet fisheries and longline fisheries have mandated observer programs. These fisheries have declined in recent years in the EEZ and bycatch data are considered adequate at this time.	Observer data is either dated or nonexistent for some fisheries. The observed and forecast mortality associated with mark-selective fishing is an ongoing research priority. Genetic Stock Identification is a developing tool to better understand the mixing and migration of various natural salmon stocks.

Table A.3: Bycatch Issues				
	CPS	Groundfish	HMS	Salmon
Which **non-fish (mammals, turtles, birds)** species are of greatest concern as bycatch within the FMP's fisheries?	None. A Biological Opinion was prepared on the interaction of the sardine fishery with southern sea otters, but interaction rate is extremely small.	Bycatch of marine mammals, seabirds, and turtles is rare, occurring in fewer than 2% of observed trips in 2002-2008. Bycatch estimates for California sea lions were highest of the marine mammals taken in the groundfish fisheries, with these animals primarily taken in trawl nets. Bycatch estimates for black-footed albatross were highest of the seabirds taken in the groundfish fisheries, with these birds primarily caught by longline gear in the limited entry primary sablefish fishery.	Bycatch of several mammals, birds, and turtles are major concerns for HMS drift gillnet, longline and purse seine fisheries, both within and outside the EEZ. Biological opinions have been prepared to address some of these concerns. Many fishing gear requirements and fishing activity restrictions are implemented to prevent and reduce bycatches of these species.	The bycatch of non-fish species in salmon fisheries is negligible.
What are known gaps in monitoring for bycatch of **non-fish (mammals, turtles, birds)** species within the FMP's fisheries?	Currently no observer program for CPS vessels.	Bycatch is monitored using the same methods as for fish species, so although take of non-fish species is recorded, sampling design is focused on capturing the bycatch of fish in a statistically significant manner.	Bycatch is monitored using the same methods as for fish species, primarily observers and logbooks.	None.

Table A.4: EFH Issues				
EFH Issues	CPS	Groundfish	HMS	Salmon
Brief description of FMP's EFH	The east-west geographic boundary of CPS finfish and market squid EFH is defined to be all marine and estuarine waters from the shoreline along the coasts of California, Oregon, and Washington to the limits of the exclusive economic zone (EEZ) and above the thermocline where sea surface temperatures range between 10°C to 26°C. The southern boundary is the US-Mexico maritime boundary, while the northern boundary varies both seasonally and annually with temperature.	All waters and substrate within areas with a depth less than or equal to 3,500 meters shoreward to the mean higher high water level or the upriver extent of saltwater intrusion, including seamounts in depths greater than 3,500 meters. (50 CFR 660.395)	In general, management unit species are found within temperate waters. The FMP does not provide a multi-species EFH designation. Instead, the FMP at 7.2 describes species- and life-state-specific EFH for: common thresher shark, pelagic thresher shark, bigeye thresher shark, shortfin mako shark, blue shark, albacore tuna, bigeye tuna, northern bluefin tuna, skipjack tuna, yellowfin tuna, striped marlin, swordfish, and dorado.	Water bodies occupied or historically accessible in WA, OR, ID, and CA in 4th field hydrologic units identified at 50 CFR 660, except for where certain identified dams represent the upstream extent of Pacific salmon access. EFH also includes marine and estuarine areas shoreward of the boundaries of the EEZ and shoreward of state marine boundaries off the coasts of California, Oregon, Washington, and Alaska. (50 CFR 660.412)
Brief description of FMP's Habitat Areas of Particular Concern	None.	Groundfish HAPCs include both mapped areas and described habitat types. In addition to the mapped area HAPCs, provided in the FMP at Section 7.3, groundfish HAPCs include the following habitat types: estuaries, canopy kelp, seagrass, and rocky reefs.	None.	None, although a list of potential HAPCs is under consideration as part of the Salmon FMP's 5-year review.
Does the FMP have any closed areas to protect EFH? Do	No.	Yes: large (>700 fm/>1280 m) coastwide closure, plus 51 enclosed areas. Yes:	No.	No.

Table A.4: EFH Issues				
EFH Issues	CPS	Groundfish	HMS	Salmon
those closed areas apply to fisheries not managed under the FMP?		prohibitions vary between areas, but apply to bottom trawl (including non-groundfish trawl) and bottom contact gear (including for spp. other than groundfish).		
Where is the FMP in its EFH 5-year review process?	Finished in 2010/	Review initiated in 2010. Council to affirm process schedule in 03/11 or 04/11	Not yet initiated	Review initiated over 2009-2010. Final Council action anticipated in April 2011
Is the EFH currently mapped? If not mapped, why not? How can the EFH be best described/communicated?	No, although there are maps of general locations of temperature boundary line.	Yes, see: http://www.nwr.noaa.gov/Groundfish-Halibut/Groundfish-Fishery-Management/Groundfish-EFH/Index.cfm	Yes, but it is mapped for individual species, not aggregated for all FMP species. See: http://www.pcouncil.org/wp-content/uploads/HMS_AppF.pdf	Yes, see: http://www.nwr.noaa.gov/Salmon-Habitat/Salmon-EFH/Index.cfm
What consultations has NMFS done on the effects of non-fishing activity on the FMP's EFH?	Since the 1996 Sustainable Fisheries Act introduced the concept of EFH, NMFS's Northwest Region has completed >300 consultations on the effects of various non-fishing activities on CPS EFH, many of which were consultations combined with groundfish and salmon EFH consultations. Projects ranged from tidal and erosion area construction, military training, dredging, cable laying, and other activities.	Since the 1996 Sustainable Fisheries Act introduced the concept of EFH, NMFS's Northwest Region has completed >300 consultations on the effects of various non-fishing activities on groundfish EFH, many of which were consultations combined with CPS and salmon EFH consultations. Projects ranged from tidal and erosion area construction,	None.	Since the 1996 Sustainable Fisheries Act introduced the concept of EFH, NMFS's Northwest Region has completed >1800 consultations on the effects of various non-fishing activities on salmon EFH, ranging from construction projects in or near waterways, wastewater treatment, dredging, and other projects. Most of these

Table A.4: EFH Issues				
EFH Issues	CPS	Groundfish	HMS	Salmon
		military training, dredging, cable laying, and other activities.		consultations (>1700) were combined EFH and Endangered Species Act consultations on the habitat effects of the proposed action.

Table A.5: Critical habitat designations and proposed designations for ESA listed species on the West Coast	
Marine mammals Killer whale (*Orcinus orca*) – Southern Resident (Northwest U.S) Stellar sea lion (*Eumetopias jubatus*)	 Portions of Puget Sound (WA) Oregon and California rookeries
Marine and anadromous fish Chinook salmon (*Oncorhynchus tshawytscha) – 9 listed ESUs* Coho salmon (*Oncorhynchus kisutch) – 4 listed ESUs* *Chum salmon (Oncorhynchus keta*) – 2 listed ESUs Sockeye salmon (*Oncorhynchus nerka*) – 2 listed ESUs Steelhead trout *(Oncorhynchus mykiss) – 11 listed DPSs* *Green sturgeon (Acipenser medirostris) – southern DPS*	 CA, OR, WA streams and rivers CA, OR, WA streams and rivers OR and WA streams and rivers WA and ID streams and rivers CA, OR, WA, ID streams and rivers WA, OR, CA nearshore areas
Marine and anadromous fish *Pacific eulachon/smelt[1] (Thaelichthys pacificus) – southern DPS*	*Proposed freshwater creeks and associated estuaries of WA, OR, CA*
Sea turtles Leatherback sea turtle[2] (*Dermochelys coriacea*)	 *Proposed marine waters off WA, OR, CA*
Marine invertebrates and plants Black abalone[3] *(Haliotis cracherodii)*	 *Proposed nearshore waters off CA*

DPS – distinct population segment
ESU – evolutionary significant unit

[1] Critical habitat for Pacific eulachon was proposed on January 5, 2011. The proposed designation includes areas within the states of California, Oregon, and Washington. The proposed areas are a combination of freshwater creeks and rivers and their associated estuaries which comprise approximately 470 km (292 mi) of habitat. (76 FR 515).

[2] Critical habitat for Leatherback sea turtles was proposed on January 5, 2010. The proposed designation includes two adjacent marine areas totaling approximately 119,400 km² stretching along the California coast from Point Arena to Point Vincente; and one 63,455 square km²) marine area stretching from Cape Flattery, Washington to the Umpqua River (Winchester Bay), Oregon east of a line approximating the 2,000 meter depth contour. Proposed critical habitat extends from the surface down to a depth of 80 m (75 FR 319).

[2] Critical habitat for black abalone was proposed on September 28, 2010. The proposed designation includes approximately 390 square kilometers of critical habitat for the endangered black abalone, pursuant to section 4 of the Endangered Species Act (ESA). Specific areas proposed for designation include rocky habitats from the mean higher high water (MHHW) line to a depth of 6 meters (m) within the following areas on the California coast: Del Mar Landing Ecological Reserve to Point Bonita; from the southern point at the mouth of San Francisco Bay to Natural Bridges State Beach; from Pacific Grove to Cayucos; from Montan˜ a de Oro State Park to just south of Government Point; Palos Verdes Peninsula from the Palos Verdes/Torrance border to Los Angeles Harbor; the Farallon Islands; An˜ o Nuevo Island; San Miguel Island; Santa Rosa Island; Santa Cruz Island; Anacapa Island; San Nicolas Island; Santa Barbara Island; Catalina Island; and San Clemente Island. (75 FR 59900)

Sturgeon
http://www.nmfs.noaa.gov/pr/pdfs/criticalhabitat/greensturgeon.pdf

proposed leatherback
http://www.nmfs.noaa.gov/pr/pdfs/criticalhabitat/leatherback_proposed.pdf

stellar sea lion
http://www.nmfs.noaa.gov/pr/pdfs/criticalhabitat/stellersealion_ca_or.pdf

killer whale
http://www.nmfs.noaa.gov/pr/pdfs/criticalhabitat/killerwhale_sr.pdf

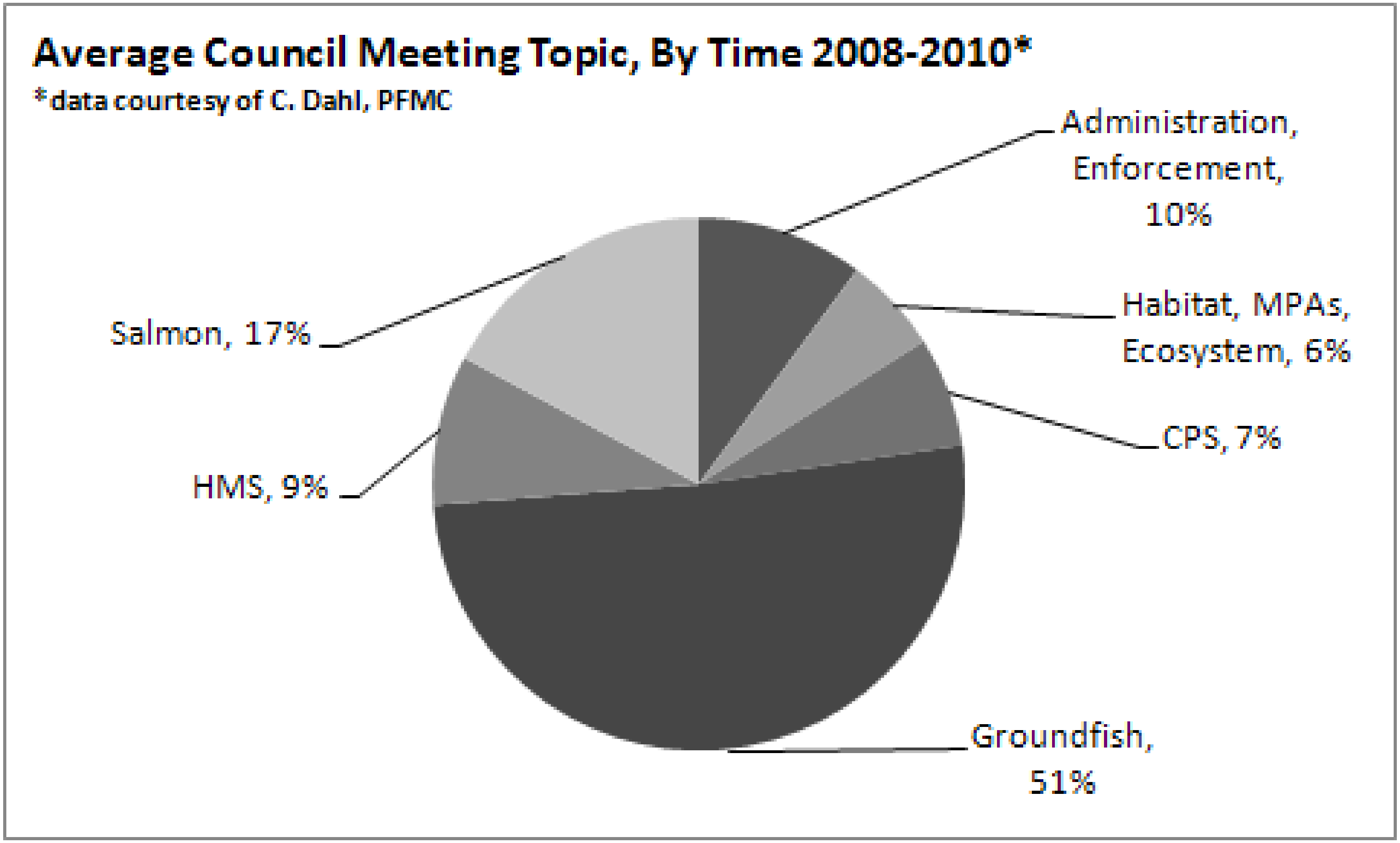
NW salmon
http://www.nwr.noaa.gov/Salmon-Habitat/Critical-Habitat/upload/NWR-CH-map.pdf

Cali. Salmon
http://www.nwr.noaa.gov/Salmon-Habitat/Critical-Habitat/upload/SWR-CH-map.pdf

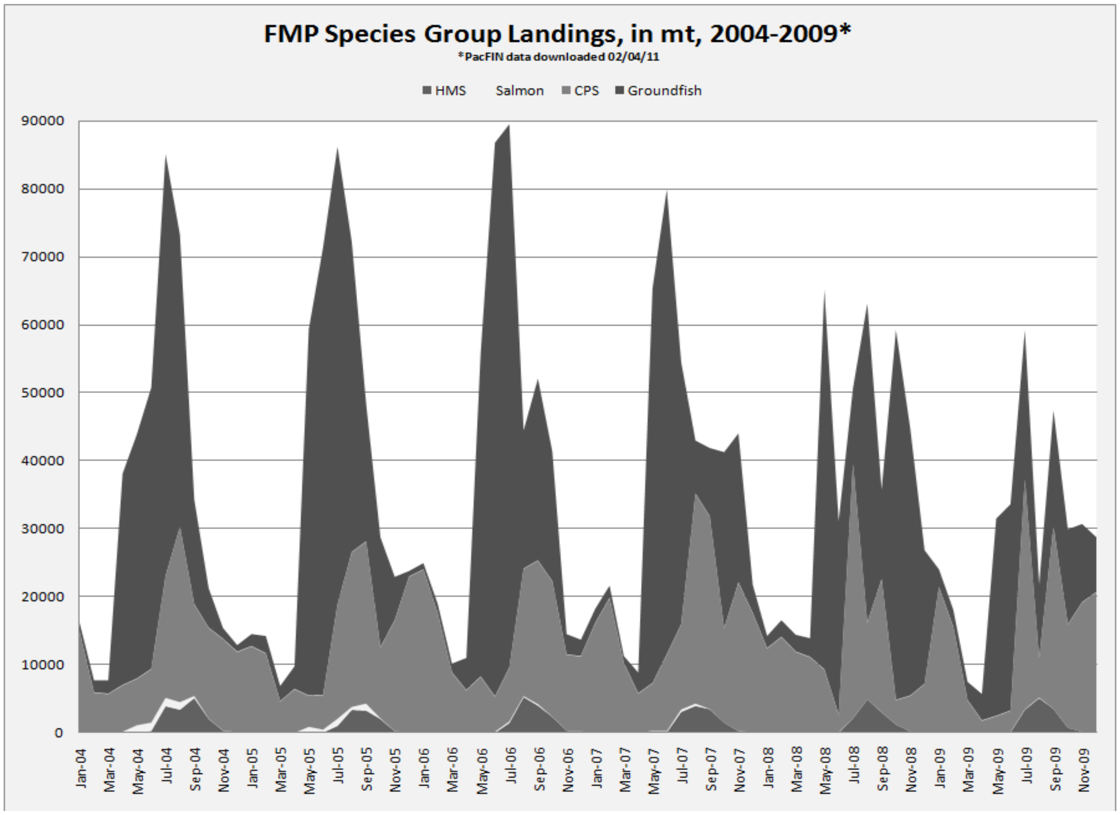
eluachon
http://www.nwr.noaa.gov/Other-Marine-Species/upload/eulachon-CH-maps.pdf

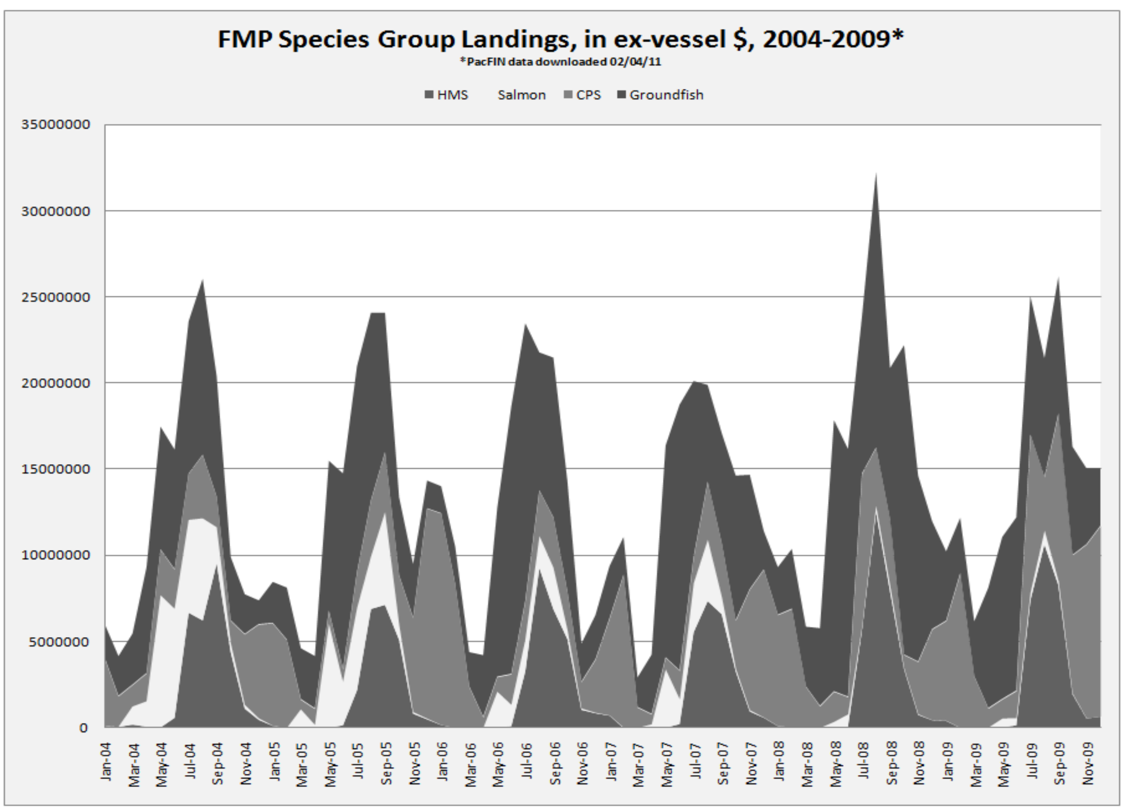
Table A.6: Community Effects Issues				
	CPS	Groundfish	HMS	Salmon
Recorded safety issues, vessel incidents, mortalities for fisheries under this FMP?	USCG District 11 2006-2010 data: 10 squid fishery vessel incidents, from which one life was lost and seven vessels were lost. USCG District 13 2000-2008 data: 4 sardine fishery vessel incidents, from which two lives were lost and four vessels were lost.	USCG District 11 2006-2010 data: 9 vessel groundfish fishery vessel incidents, from which two lives were lost and seven vessels were lost. USCG District 13 2000-2008 data: 10 groundfish fishery vessel incidents, from which six lives were lost and five vessels were lost.	USCG District 11 2006-2010 data: 1 tuna fishery vessel incident, no lives nor vessels lost. USCG District 13 2000-2008 data: 8 tuna fishery vessel incidents, from which two lives were lost and seven vessels were lost.	USCG District 11 2006-2010 data: 7 salmon fishery vessel incidents (3 of which were combination crab/salmon trips,) from which three lives were lost and five vessels were lost. USCG District 13 2000-2008 data: 17 salmon fishery vessel incidents, from which eleven lives were lost and sixteen vessels were lost.
Has fishing community dependence on FMP resource and resilience to changes in resource availability been assessed?	Socioeconomic and community impacts from Pacific sardine harvest policy were assessed for Amendment 11 which established a long-term allocation scheme.	The Council assesses impacts to fishing communities during the biennial management measures process.	The Council assesses impacts to fishing communities during the biennial management measures process and when considering other management measures (such as possibly establishing a high seas shallow-set longline fishery), and at times, when providing recommendations to RFMOs.	Socioeconomic impacts are assessed by port area, both historically (see Amendment 14-App. B) and for the proposals under the preseason management cycle.
How does Council receive policy process input from	The Council receives community input primarily from the Coastal Pelagic Species Advisory	The Council process receives input from public comment and the	The Council process receives input from public comment and the	The Council process receives input from public comment and the Salmon

Table A.6: Community Effects Issues				
	CPS	Groundfish	HMS	Salmon
FMP's fishing communities?	Subpanel and the public.	Groundfish Advisory Panel each Council meeting.	HMS Advisory Panel each Council meeting. NMFS reports on RFMO processes and activities, which may involve community input via US advisory groups and delegations to RFMOs.	Advisory Panel each Council meeting and at annual public hearings.
How is economic and social information monitored and considered in the decision-making process?	The annual CPS SAFE contains information on fishery economics and socioeconomic impacts of harvest policies are considered through the Council and NEPA processes.	Economic and social information is monitored mainly by tracking landed catch and effort by port/area and is taken into account most prominently in the rebuilding plans as part of the assessment of the "needs of the fishing community." Regular monitoring of other socioeconomic information is limited. Information considered by the Council is compiled from existing sources (e.g., the U.S. Census) and a few voluntary surveys administered by NMFS. NMFS is implementing a mandatory economic data collection program for the trawl rationalization program.	Economic and social information is monitored mainly by tracking landed catch and effort by port/area and is reported in annual SAFE documents and considered during the biennial management cycle and when other management actions (e.g., EFPs) are being considered. It is also considered in the Council's formation of recommendations to RFMOs.	Economic and social information is monitored mainly by tracking landed catch and effort by port/area and is reported and considered during the preseason management cycle. Data for previous years as well as projections for each to the alternative management options are available to the public and the Council through a series of preseason documents.

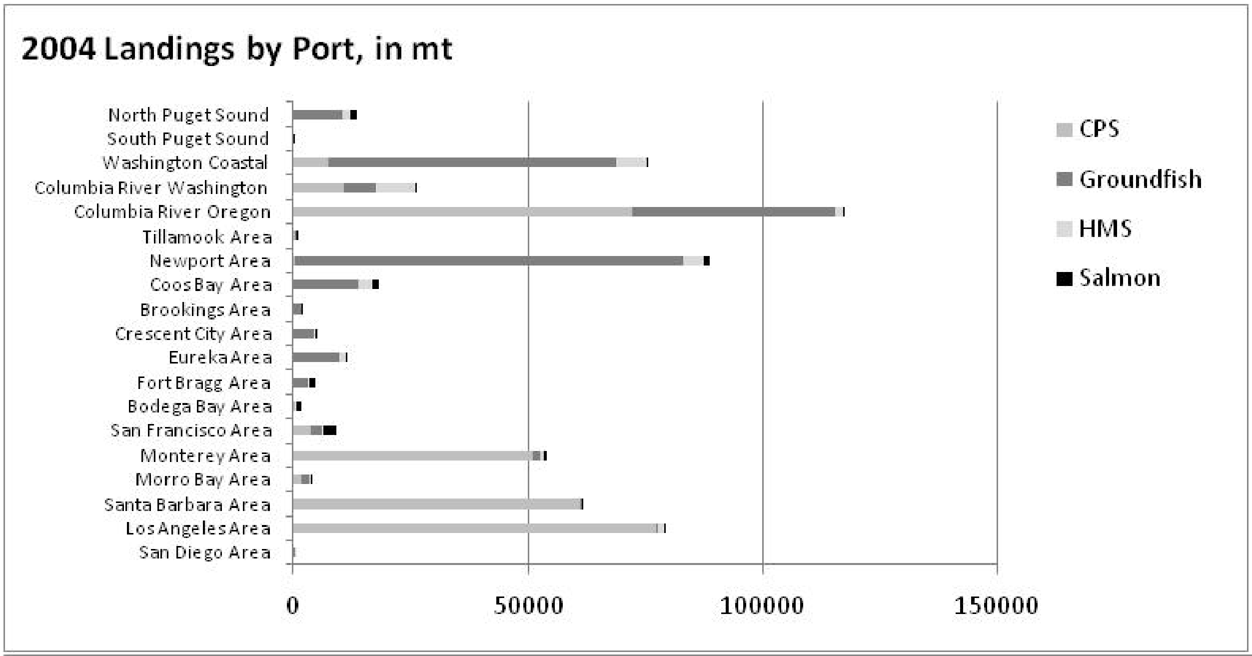


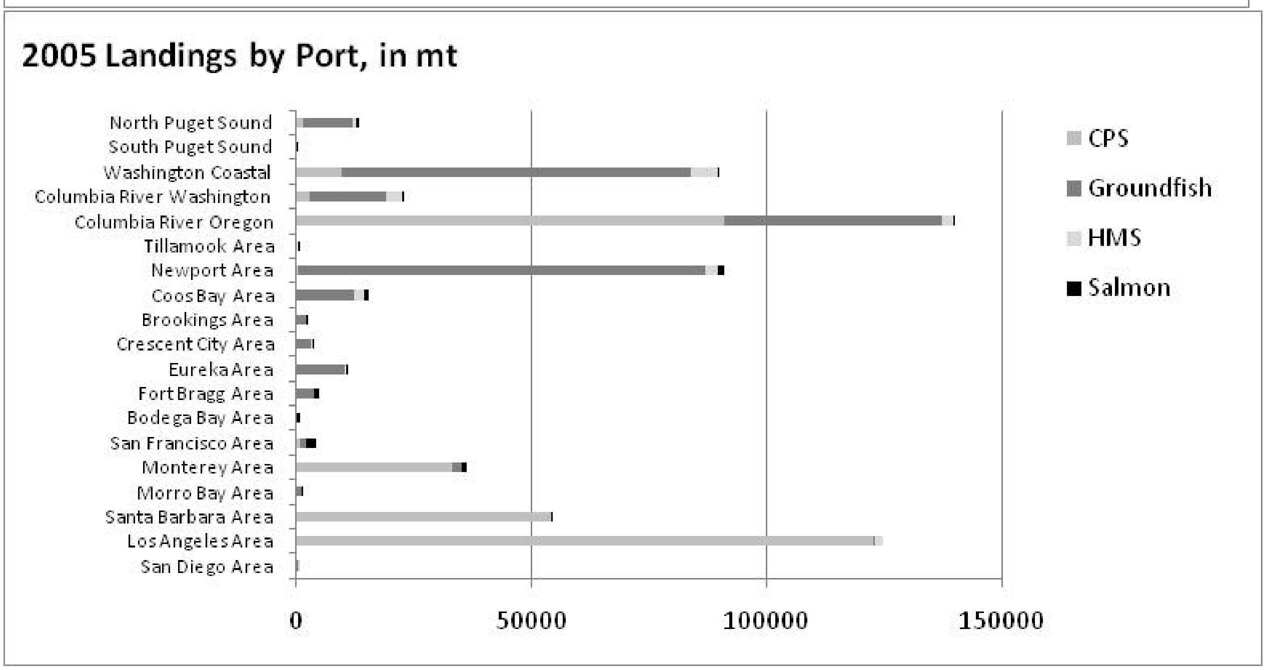
Average Council Meeting Topic, By Time 2008-2010*
*data courtesy of C. Dahl, PFMC
Administration, Enforcement, 10%
Habitat, MPAs, Ecosystem, 6%
CPS, 7%
Groundfish, 51%
HMS, 9%
Salmon, 17%

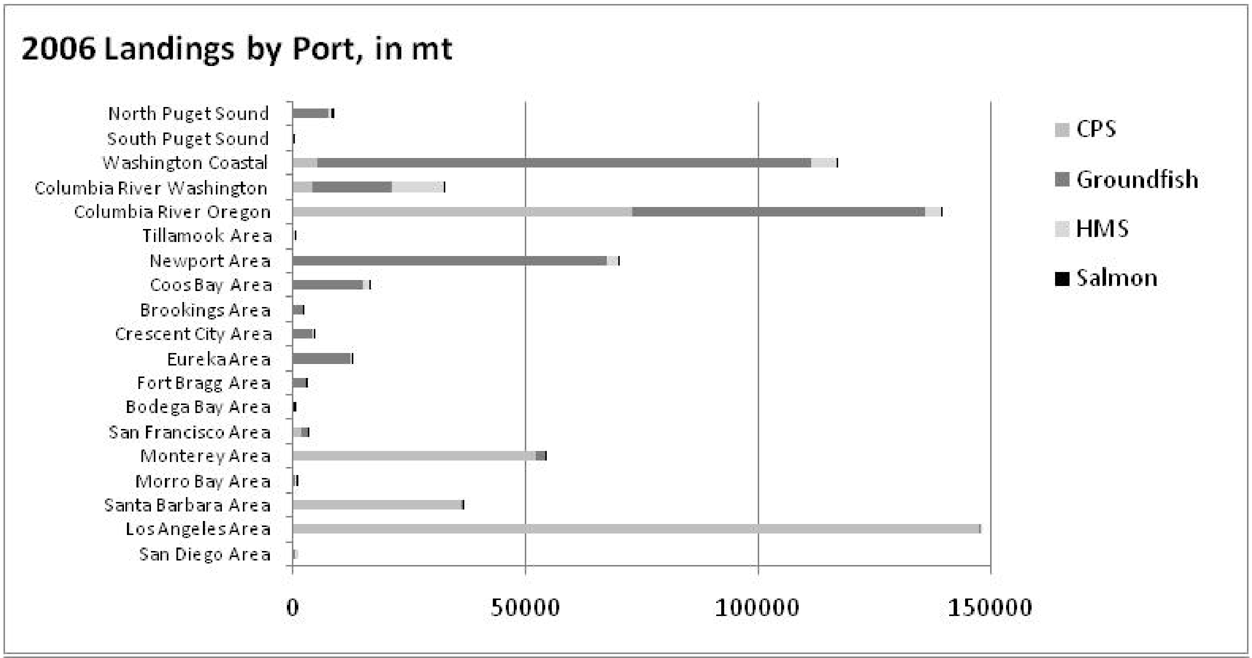

FMP Species Group Landings, in mt, 2004-2009*
*PacFIN data downloaded 02/04/11
HMS
Salmon
CPS
Groundfish

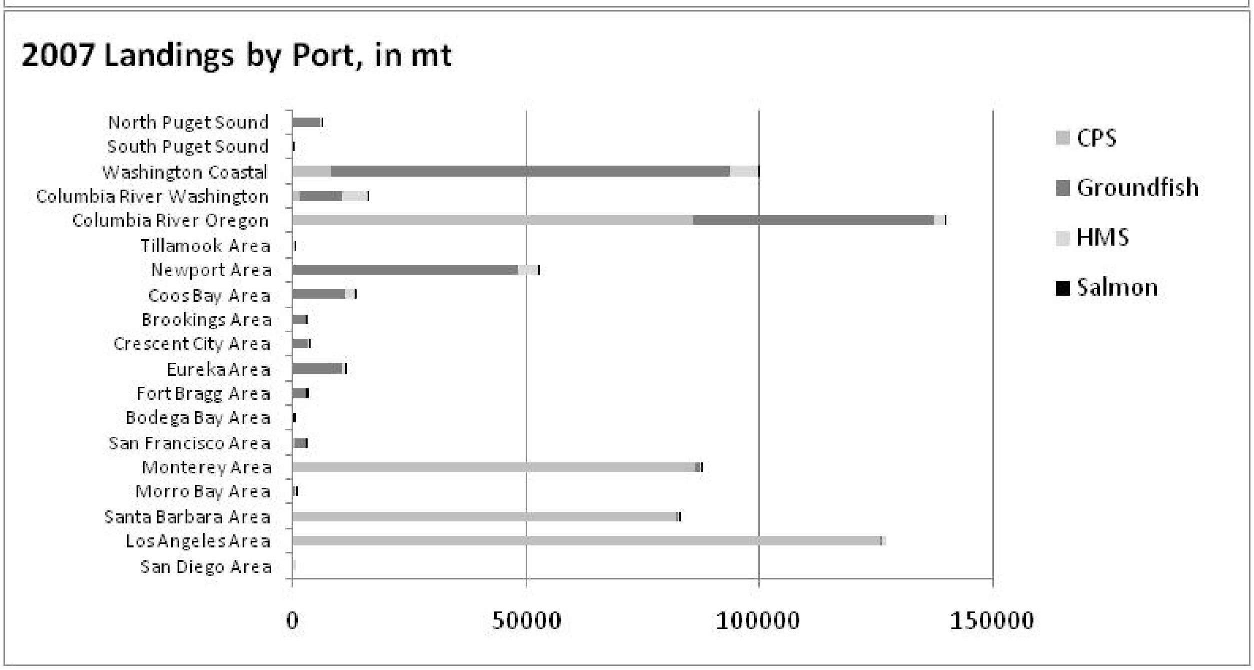

FMP Species Group Landings, in ex-vessel $, 2004-2009*
*PacFIN data downloaded 02/04/11
HMS
Salmon
CPS
Groundfish

The following charts illustrate 2004-2009 FMP species group landings in metric tons and in ex-vessel revenue, separated by Pacific Fisheries Information Network (PacFIN) Port Group Areas. A list of individual ports aggregated into each Port Group Area may be found online at: http://pacfin.psmfc.org/pacfin_pub/codes.php






2006 Landings by Port, in mt
North Puget Sound
South Puget Sound
Washington Coastal
Columbia River Washington
Columbia River Oregon
Tillamook Area
Newport Area
Coos Bay Area
Brookings Area
Crescent City Area
Eureka Area
Fort Bragg Area
Bodega Bay Area
San Francisco Area
Monterey Area
Morro Bay Area
Santa Barbara Area
Los Angeles Area
San Diego Area
0
50000
100000
150000
CPS
Groundfish
HMS
Salmon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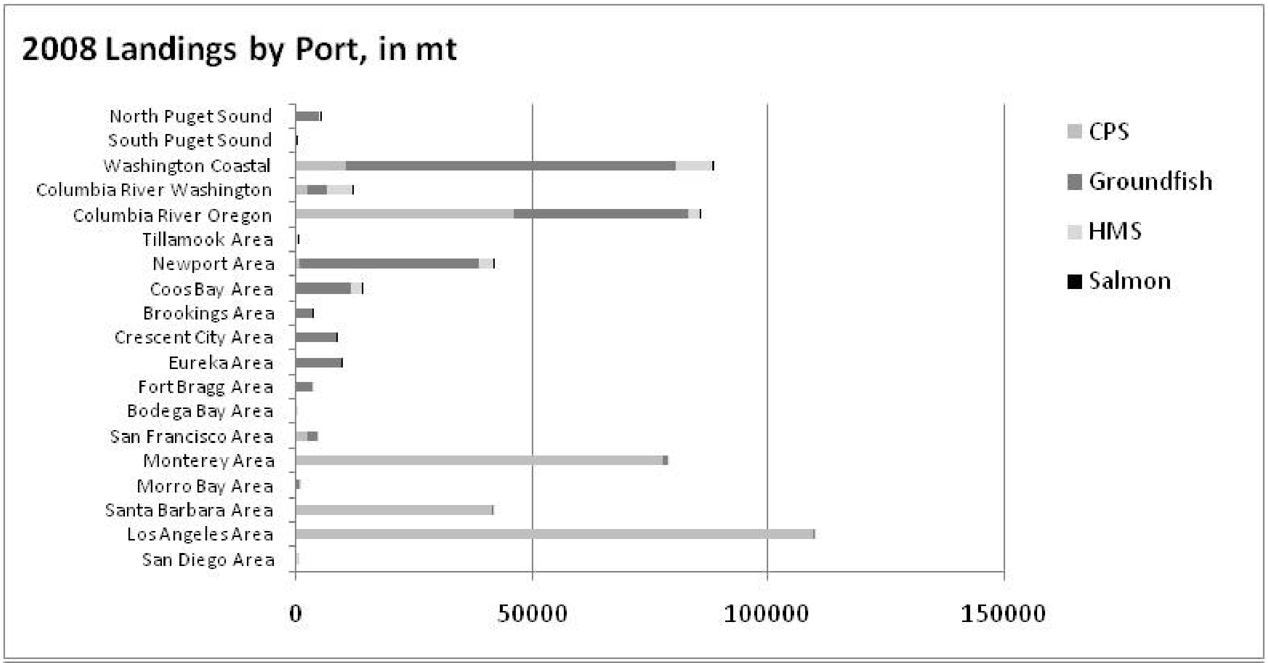
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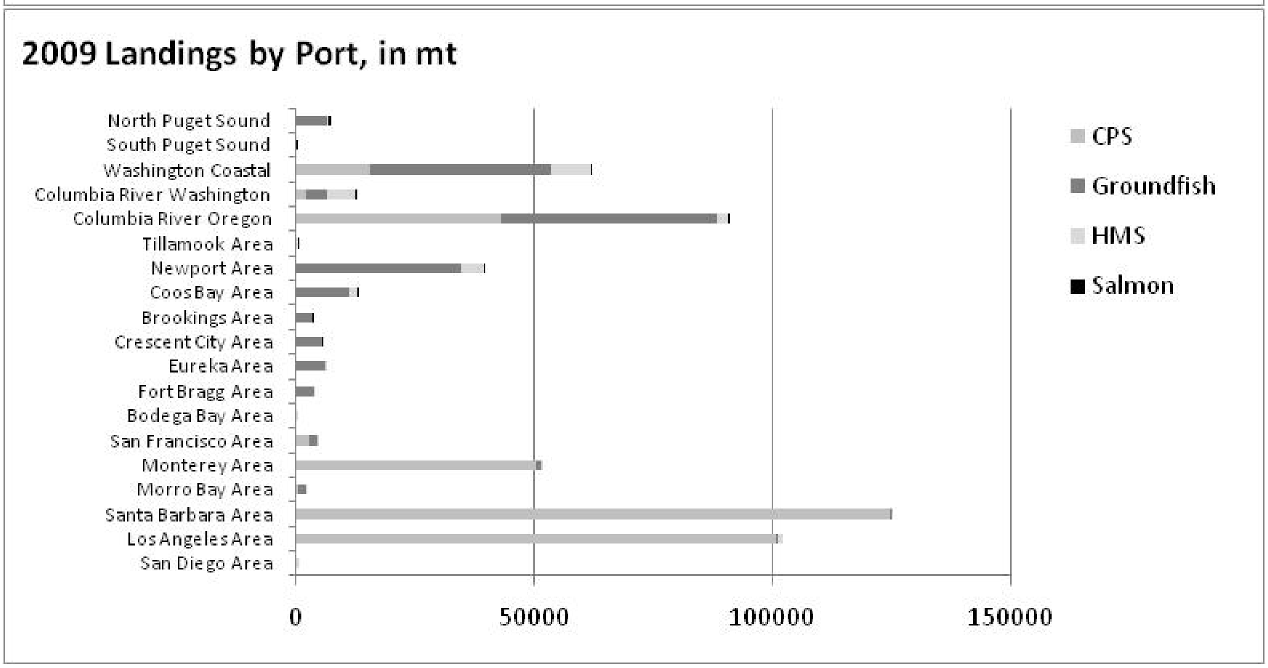
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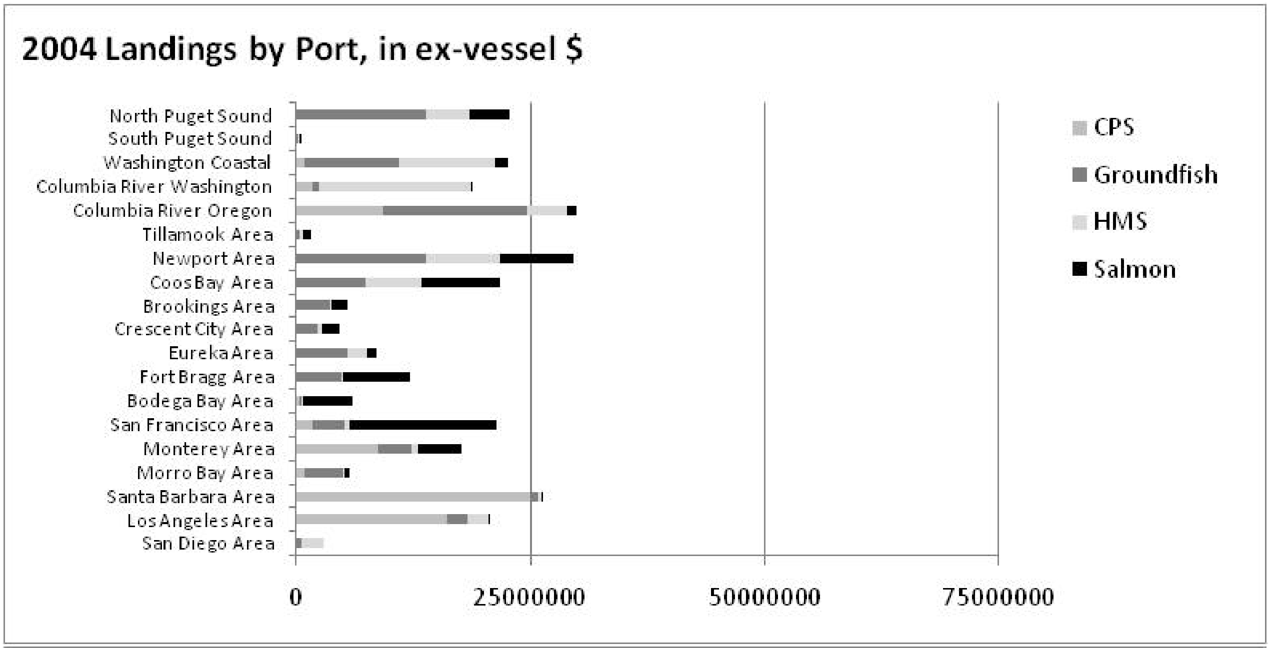
2004 Landings by Port, in ex-vessel $
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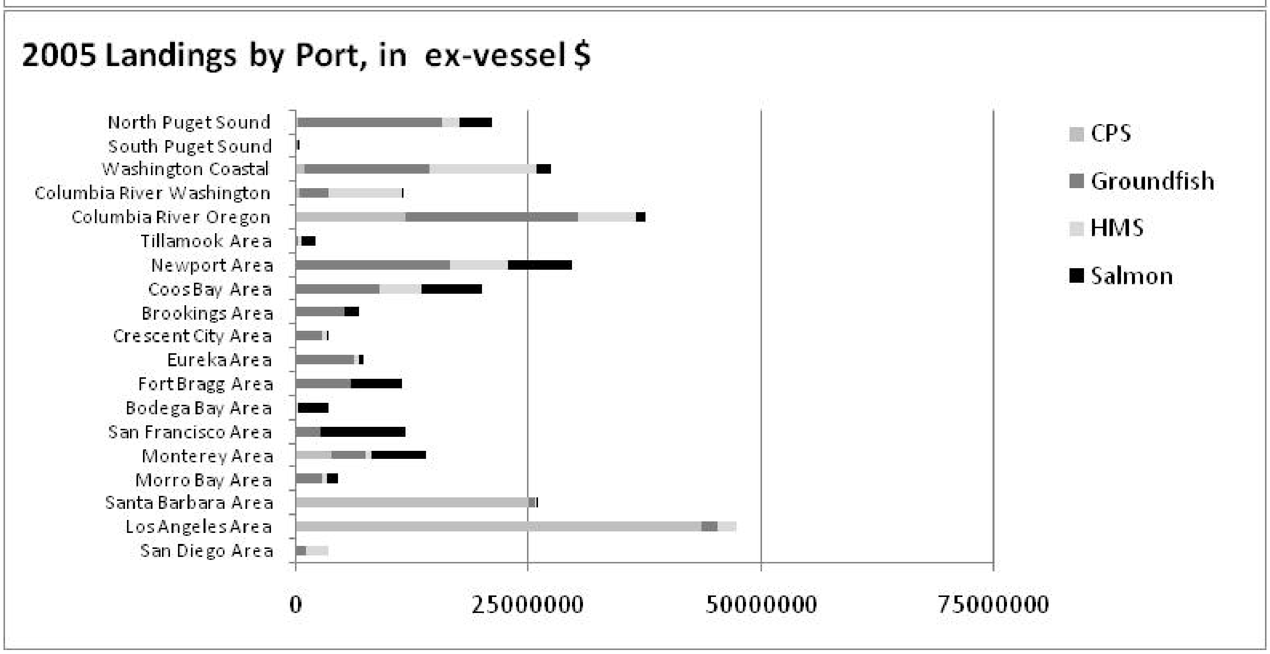
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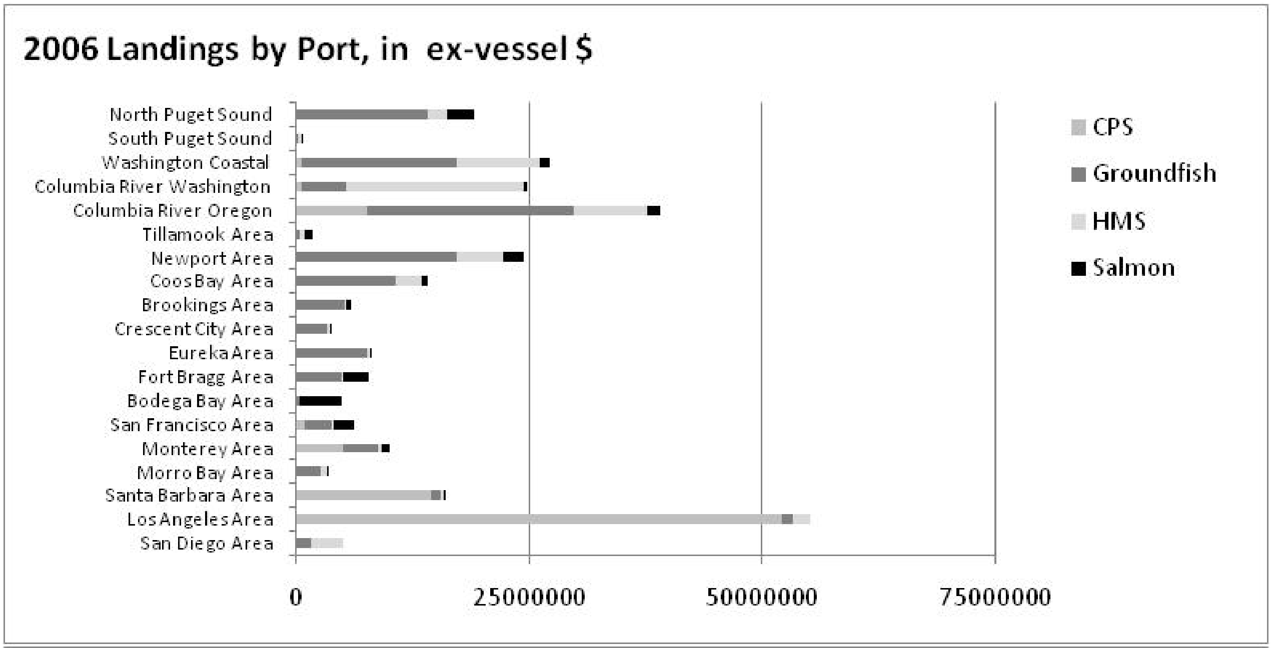
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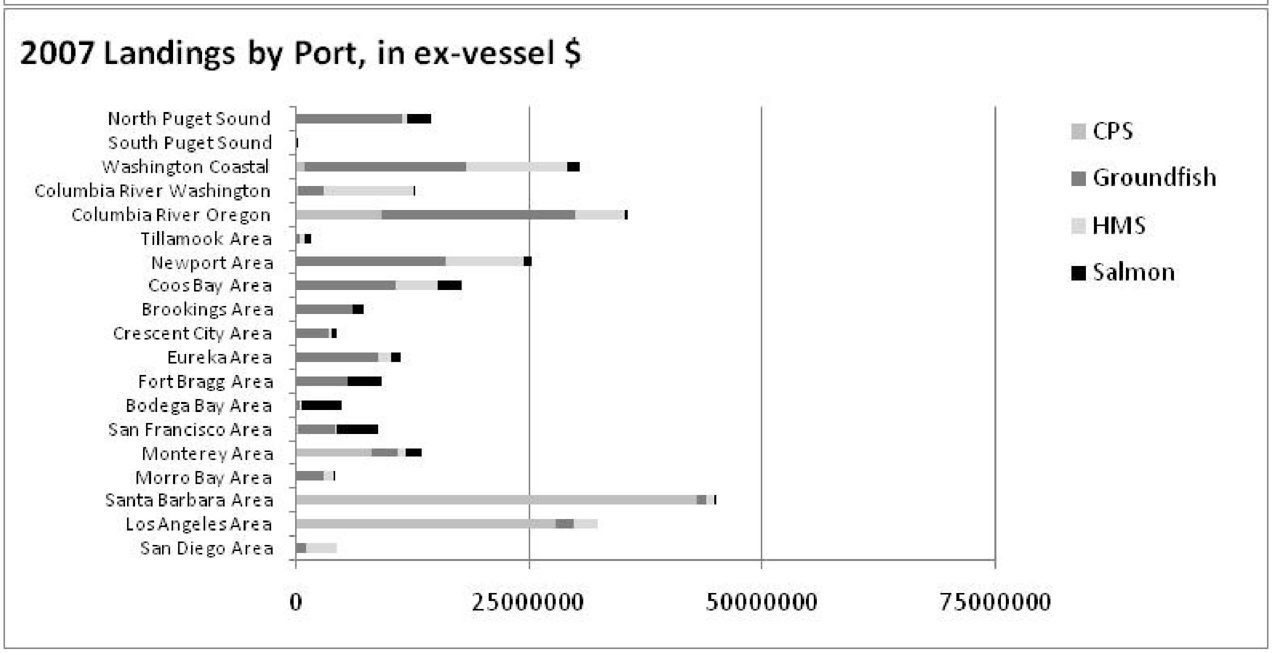
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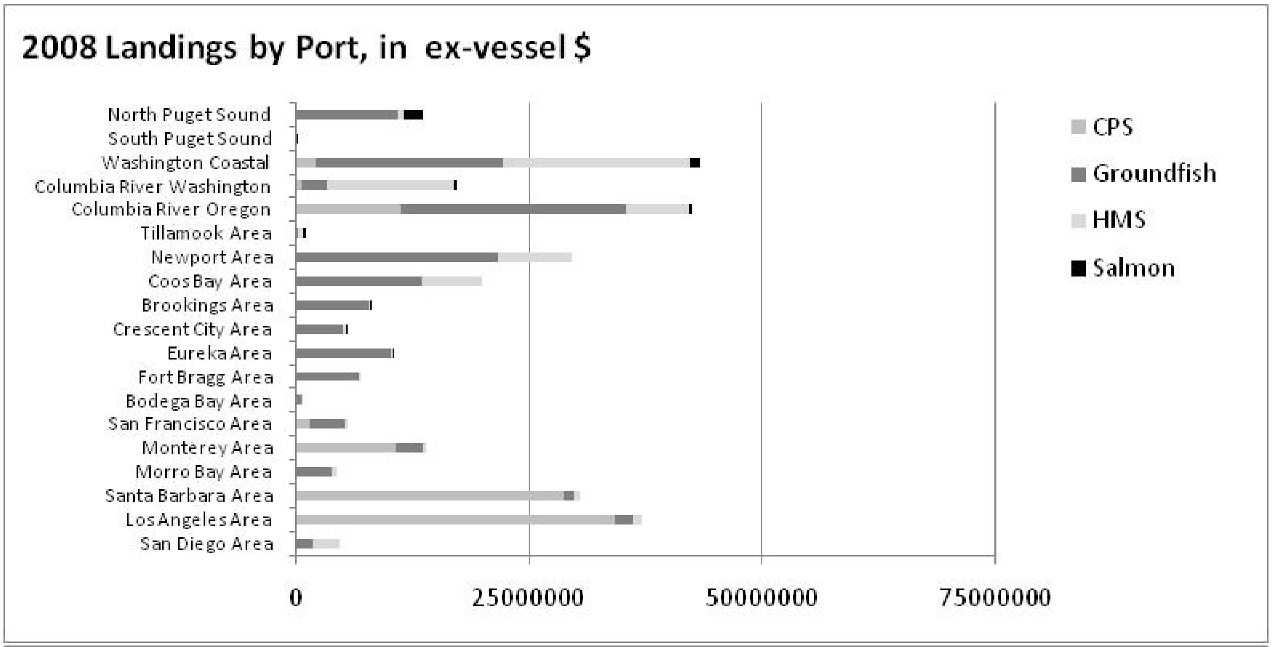
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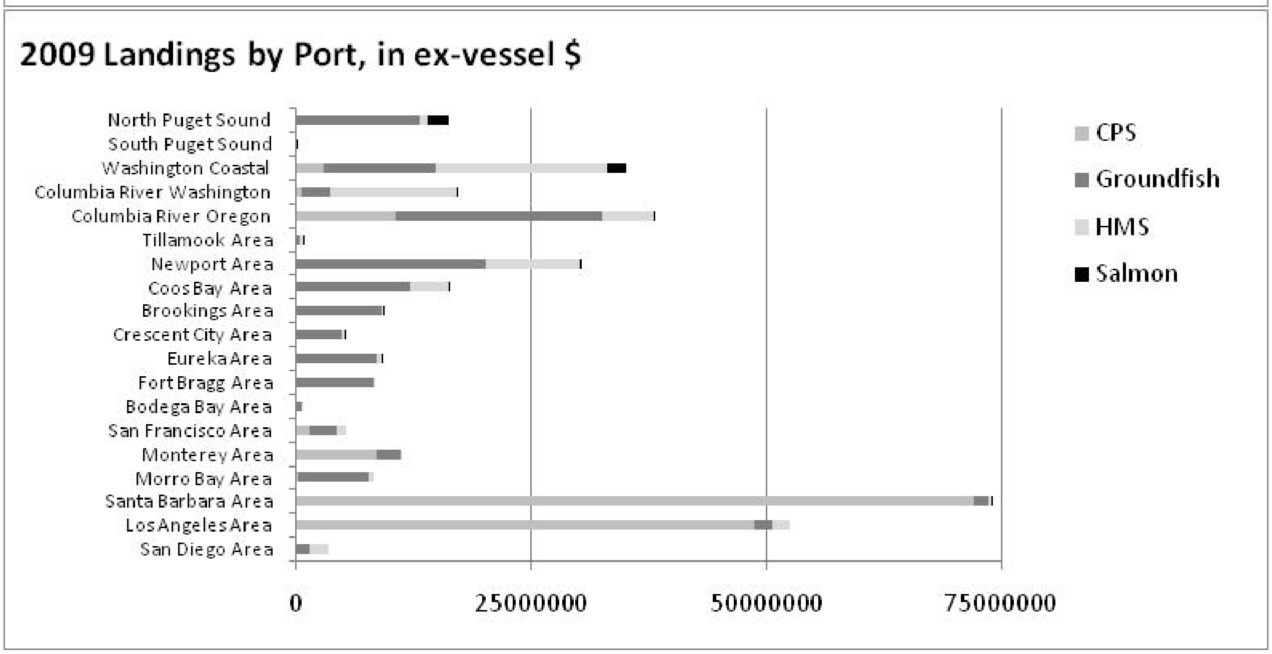
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02/10/11