

4 AFFECTED ENVIRONMENT

4.1 PHYSICAL ENVIRONMENT

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

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

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

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

4.2 OVERVIEW OF BIOTA

4.2.1 Status of Target Species

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

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

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

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

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

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

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

4.2.2 Status of Species Listed Under the Endangered Species Act

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

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

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

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

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

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

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

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

4.2.2.1 Reptiles

Sea Turtles

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

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

to tropical neritic waters, where individuals may dive as deep as 300 meters to feed on benthic crustaceans (Eckert, 1991).

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

4.2.2.2 Mammals

Steller Sea Lion

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

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

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

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

4.2.2.3 Fish

Salmon

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

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

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

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

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

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

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

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

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

- Sacramento River winter chinook - Achieve a 31% increase in the age-3 adult cohort replacement rate relative to the 1989-1993 mean rate of 1.35. Such an increase would result in a 1.77 adult cohort replacement rate.
- Snake River fall chinook - Failing agreement among the parties to the Pacific Salmon Treaty to meet conservation needs of chinook salmon, harvest impacts of ocean fisheries in the Council area and Alaska fisheries, or of all ocean fisheries, cannot exceed 50% or 70%, respectively, of the 1988-1993

average exploitation rate on age-3 and age-4 fish. If there is a NMFS approved Pacific Salmon Treaty agreement, but neither of the two criteria listed above are met, the Council must achieve a 50% reduction from the base period exploitation rate in Council-area fisheries.

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

Trout

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

Steelhead

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

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

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

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

4.2.3 Status of other Fish Species Taken Incidentally

Overall impact of the salmon fishery on other fish species is limited due the gear type (hook and line) used in the commercial and recreational salmon fisheries off the West Coast. The primary species taken incidentally in the salmon fisheries include: halibut, yellowtail rockfish, canary rockfish, lingcod, and sablefish. Halibut

stocks off the Washington, Oregon, and California are in good condition. The majority of groundfish species are presently are thought to be in fair to poor condition. Canary rockfish, lingcod, and sablefish stocks are declining and appear to be in poor condition; they are fully utilized by the groundfish fleet. Yellowtail rockfish also are fully utilized, but the stock appears to be stable. Various factors such as ocean conditions and over exploitation are thought to be the primary factors for those groundfish stocks in decline (PFMC 1998a).

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

4.2.4 Status of Higher Trophic Level Species

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

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

California Sea Lion

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

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

Guadalupe Fur Seal

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

Northern Fur Seal

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

Northern Elephant Seal

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

Pacific Harbor Seals

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

Dall's Porpoise

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

Harbor Porpoise

Harbor porpoise (*Phocoena phocoena*) in the eastern North Pacific Ocean range from Point Barrow, Alaska, down the West Coast of North America to Point Conception, California (Gaskin 1984). This species is divided

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

Bottlenose Dolphin

Bottlenose dolphins (*Tursiops truncatus*) are distributed world-wide in tropical and warm-temperate waters. This species primarily inhabits coastal habitats, but surveys also regularly find them in offshore waters (Forney et al. 1995). Based on potential fishery interaction this species is divided into three stocks: 1) California coastal stock, 2) California, Oregon and Washington offshore stock, and 3) Hawaiian stock. Since the 1982 through 1993 El Niño which increased water temperature off California, California coastal stock have been consistently sighted in central California as far north as San Francisco (Barlow et al. 1997). The California, Oregon and Washington offshore stock may range into Oregon and Washington during periods of warm-water intrusions. The total population of this species (coastal and offshore) occurring off the West Coast of the United States is estimated at 2,695 animals (Barlow et al. 1997). No reliable estimate can be made regarding trends in abundance for this species.

Northern Right Whale Dolphin

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

Pacific White-Sided Dolphin

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

Risso's Dolphin

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

Striped Dolphin

Striped dolphins (*Stenella coeruleoalba*) are distributed world-wide in tropical and warm-temperate waters. Recent ship board surveys observed this species within 100 nautical miles to 300 nautical miles from the coast (Barlow et al. 1997). For the Marine Mammal Protection Act (MMPA) stock assessment reports, striped

dolphins within Pacific U.S. EEZ are divided into two discrete non-contiguous areas 1) waters off California, Oregon, and Washington, and 2) waters around Hawaii. In recent analysis combining data from 1991 and 1993 ship board surveys within 300 nautical miles of the California coast, (Barlow and Gerrodette 1996) estimate the abundance of striped dolphins to be 24,910 animals. There is insufficient data available to evaluate potential trends in abundance for this species.

Short-Beaked Common Dolphin

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

Long-Beaked Common Dolphin

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

Baird's Beaked Whale

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

Blue Whale

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

Cuvier's Beaked Whale

The distribution of Cuvier's beaked whales (*Ziphius cavirostris*) is known primarily from strandings, which indicate it is the most widespread of the beaked whales and is distributed in all oceans and most seas except in high polar waters (Moore 1963). In the northeastern Pacific from Alaska to Mexico no obvious patterns of seasonality to strandings have been identified (Mitchell 1968). Populations found in the waters of California, Oregon and Washington are considered a single stock for management and stock assessment purposes. The population estimate for the California, Oregon and Washington stock is 9,163 animals and

is considered conservative because survey work did not cover the waters of Oregon and Washington (Barlow et al. 1997). Reliable estimates of trends in abundance for this stock is currently unavailable.

Fin Whale

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

Mesoplodont Beaked Whales

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

Gray Whale

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

Humpback Whale

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

Killer Whale

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

for California and inland waters of Washington do exist and combined produce an estimate of 843 animals (Barlow et al. 1997). Reliable data on trends in abundance for either of these two stocks is considered unavailable.

Minke Whale

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

Right Whale

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

Sei Whale

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

Short-Finned Pilot Whale

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

Sperm Whale

The sperm whale (*Physeter catodon*) is an open-water species and is found mainly in temperate to tropical waters in both hemispheres. They feed mainly on medium - to large-size squid, but may also feed on large dermsal and mesopelagic sharks, skates, and fishes (Gosho et al. 1984). Sperm whales are found year round in California waters (Dohl et al. 1983), but they reach peak abundance from April through June and from the end of August through mid-November (Rice 1974). They are seen in every season except winter (December through February) in Washington and Oregon (Green et al. 1992). The populations of this stock in California, Oregon, and Washington is estimated at 1,231 animals which is considered conservative as the

population assessment survey utilized did not include waters of Oregon and Washington (Barlow et al. 1997). Data regarding trends in population of this species in the eastern North Pacific is currently unavailable.

Pygmy Sperm Whale

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

Dwarf Sperm Whale

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

4.2.5 Status of Seabirds

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

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

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

4.2.6 Status of Lower Trophic Level Species

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

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

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

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

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

4.3 OVERVIEW OF SOCIOECONOMICS

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

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

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

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

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

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