ISSUE NUMBER 1 - INCORPORATE HABITAT CONSIDERATIONS INTO THE FMP

This issue concerns the addition of information to the FMP regarding the significance of habitat and the impacts of habitat degradation on the groundfish resource and the fishery.

Background

In November 1983, a habitat conservation policy was implemented for NMFS. Among other things, this policy encouraged greater participation by the RFMCs in habitat conservation matters. In 1986, the MFCMA was amended to strengthen the involvement of the RFMC in habitat matters. The amendment requires (1) inclusion of a section in the FMP which provides readily available information regarding the significance of habitat to the fishery and assessment as to the effects which changes to that habitat may have upon the fishery and (2) federal agencies to provide a detailed written response to Council comments and recommendation concerning impacts of their activities on the habitat of a fishery resource under Council jurisdiction. The requirement for FMPs to include this habitat information became effective on January 1, 1987 and subsequent guidance from the Secretary of Commerce specifies that after that date failure to include specific habitat information in subsequent amendments submitted by the Council will be grounds for disapproval of the amendment. This section of Amendment 3 is included specifically to address the MFCMA amendment.

The following habitat discussion would be incorporated into the FMP.

Description of Habitat

Groundfish species off the Washington, Oregon, and California coast occur over all habitat types. They are found from intertidal areas to the depths of the continental slope, on sand or mud bottoms, in rocky reef areas, or in the water column. They seek and select an optimum combination of physical and biological conditions in the environment favorable to the species.

The offshore environment of Washington, Oregon, and California is characterized by relatively stable thermal, chemical, and physical conditions. The nearshore and inshore environments, where some groundfish species spend all or part of their life cycle, are regions of physical and chemical variability due to the influx of freshwater from rivers and run-off from land. These waters are particularly vulnerable to the effects of coastal development and habitat alteration.

Variation in environmental conditions can exert a profound effect on the behavior, distribution, and survival of fish, particularly during early life stages. Each species has its characteristic optimum range and tolerance limits for different environmental conditions.

Water temperature affects the metabolic activity of fish and can modify physical activity. Unusual temperature patterns can cause shifts in the timing and location of spawning, or disruptions in the development of eggs and larvae. The onshore-offshore movement of some groundfish stocks may be temperature dependent (Laevastu and Hayes, 1981). Temperature can also affect the distribution of adult populations.

Ocean currents may act as environmental boundaries to fish and the seasonal shifts in currents may play a role in the migrations of some groundfish stocks (Laevastu and Hayes, 1981). The influence of ocean currents on fish is greatest at the egg and larval stages. Currents transport pelagic eggs and fry from spawning areas to nursery grounds and from nursery grounds to feeding grounds. Current may also influence adult migrations and may affect the distribution of adults through the presence of food or temperature boundaries.

Several currents traverse the Northeast Pacific; of these the southerly flowing California current is significant due to the upwelling that occurs along its route off the Oregon and California coasts. Upwelling mixes deep, nutrient-rich waters with surface water, is associated with high productivity and probably has a great influence over many resident groundfish stocks. Occasional disruptions in upwelling occur, such as during El Nino events, when large scale shifts in currents and water temperature can severely affect fishery resources through the disruption of the food chain and displacement of food organisms.

Light is also an important factor in ocean habitats. Some groundfish species rely on sight for capturing prey. Light may also be used for signaling reproductive behavior, locating shelter, or for coloration. Light may be involved in triggering migrations, thus influencing the timing of reproduction.

The bulk of commercially important groundfish resources off the Washington, Oregon, and California coast occur on the continental shelf and slope. The continental shelf is the shallow apron of land 0 to 700 feet deep surrounding continental land masses. The shelf is continuous with the continental slope, the region where the continental land mass drops rapidly to the deep sea floor. Depth of the continental slope generally ranges from 700 to 10,000 feet. The continental shelf off Washington, Oregon, and California is narrow, ranging from less than one mile wide off Monterey, California to 43 miles wide off northern Washington.

The groundfish fishery is conducted along most of the coastline of Washington, Oregon, and California with concentrations of fishing effort found near major fishing ports and in certain productive banks and canyons. A majority of fishing vessels fish within a 60-mile radius of their home ports. Areas in the vicinity of the ports of Monterey, San Francisco, Eureka, Crescent City, Coos Bay, Newport, Astoria, Westport, and Neah Bay are especially important to groundfish fishermen. Grounds such as the Farallon Islands/Cordell Banks off California, Heceta Bank and Astoria Canyon off Oregon, and Grays Canyon and Cape Flattery Spit off of Washington are examples of productive groundfish areas which also concentrate groundfish fishing vessels.

The depths fishing are determined by the target species and the type of fishing gear used. Setnets are fished primarily off southern California and usually in waters less than 200 feet. Trawlers fish in depths between 40 and 1,400 feet, but about 90 percent of all trawling occurs in waters less than 1,000 feet. Longlines and pots are often fished deeper than the other gear types and are typically found in waters between 400 and 1,200 feet, with occasional forays to depths of 2,500 feet.

The general distribution of fishing effort as described above reflects present patterns, but should not be considered static. Areas presently fished infrequently or no at all could see an increase as market conditions and values of underutilized fish species change, as technological innovations occur, or as fishing regulations are modified.

Description of Species

This section summarizes information on generalized habitat requirements of commercially important groundfish species of the Washington, Oregon, and California coast. The species are categorized as roundfish, rockfish, or flatfish. Except as otherwise noted, references for the summaries are Miller and Lea, 1972 and Eschmeyer et al., 1983.

Roundfish

Lingcod (Ophiodon elongatus)

Lingcod occur from Baja California to Kodiak Island, Alaska. Adults live on rocky reefs from shallow inshore areas to 1,400 foot depths. Young lingcod live on the sand or mud bottom of bays and inshore areas. Spawning occurs from December to March, with females depositing their eggs in rock crevices in shallow water. Males guard the eggs from intruders. The species is generally sedentary, although limited movement occurs (Adams, 1987). Adults feed on herring, sand lance, flounders, Pacific whiting (hake), walleye pollock, crustaceans, and octopus. Juveniles feed on copepods and other small crustaceans. Lingcod seldom exceed four feet in length. Maximum weight ranges from 40 pounds off California to 100 pounds off British Columbia, Canada.

Pacific Cod (Gadus macrocephalus)

Pacific cod occur from central California to the Bering Sea, usually near the bottom in depths ranging from 40 to 1,200 feet, but usually do not occur in fishable quantities off Washington, Oregon, and California. Pacific cod congregate to spawn, and disperse to feed. They migrate to deeper waters in autumn, spawn in winter, then return to shallower areas in spring. Pacific cod eat worms, crabs, mollusks, shrimp, herring, sand lance, walleye pollock, and flatfishes. Pacific cod grow to three feet.

Pacific Whiting (Merluccius productus)

Pacific whiting also known as hake, occur in schools from the Gulf of California to Alaska. Often classified as a demersal species, the distribution and behavior of Pacific whiting suggest a largely pelagic existence. They have been taken in trawls from the surface to 2,900 feet, but they are most common at an average depth of 650 feet in the waters of the continental slope and shelf. Pacific whiting are pelagic spawners. Most spawning occurs off southern California and northern Mexico. Larvae eat copepods, while adults eat euphausiids, shrimp, eulachon, sole, tomcod, and other fishes. Feeding occurs coastwide on the shelf and upper continental slope. Mature whiting average 20 inches, 1.7 pounds, but they can reach three feet in length and nearly four pounds.

Sablefish (Anoplopoma fimbria)

Sablefish occur from Baja California to the Asiatic coast of the Bering Sea. Sablefish are demersal, living in shallow areas down to depths of at least 5,000 feet. Sablefish spawn from November to April, with peak spawning activity occurring in January and February. Juveniles have been observed in the shallow waters of Puget Sound and the Strait of Juan de Fuca. The diet of juvenile sablefish include copepods, amphipods, euphausiids, fish eggs, and fish larvae. Adults eat euphausiids, tunicates, and fish. Sablefish reach sizes of 40 inches, 30 pounds.

Jack Mackerel (Trachurus symmetricus)

Jack mackerel are semipelagic fish ranging from the tropical mid-Pacific off California to Alaska. Spawning occurs at night off southern California between February and May; the eggs are pelagic. Jack mackerel school to feed. Their diet is variable, often consisting primarily of macroplankton, but at times mainly lanternfish or squid. Jack mackerel reach lengths of 28 inches.

Rockfish

Rockfish are elongate and stout with a large head that usually bears prominent ridges and spines. Rockfish inhabit shores, bays, kelp beds, and offshore areas to 1,500 feet or deeper. Many live in rocky areas, others prefer soft bottoms found offshore. A wide variety of feeding habits exist among the rockfish species. Rockfish bear live young.

Pacific Ocean Perch (Sebastes alutus)

Pacific ocean perch is a long-lived (90+ years) rockfish found from California to the Bering Sea and Japan. They occur in waters ranging in depths of 180 to 2,100 feet; adults usually are found below 400 feet. This species exhibits a seasonal inshore/offshore migration, spending summer months in the shallowest part of their range and winter months at the deepest, where larvae are released (Gunderson, 1971). Pacific ocean perch spawn in February and March; juveniles may remain pelagic until their second or third year. Pacific ocean perch feed mainly on planktonic crustaceans and small squid and reach lengths of 20 inches.

Yellowtail Rockfish (Sebastes flavidus)

Yellowtail rockfish are found in waters off San Diego, California to Kodiak Island, Alaska at depths ranging from near the surface to 900 feet. Yellowtail rockfish are semipelagic and live over rocky reefs. Spawning occurs from November to March. Major food sources are crustaceans and fish. They grow to 26 inches.

Shortbelly Rockfish (Sebastes jordani)

Shortbelly rockfish are the most distinctively pelagic of the rockfish group. A small fish (to 12 inches), they occur from Baja California to Vancouver Island. Adults are found at about 300 to 900 feet; juveniles occur in shallower water. Spawning occurs from January to April. Adults feed on plankton, mainly euphausiids.

Widow Rockfish (Sebastes entomelas)

Widow rockfish occur over rocky banks from Baja California to Kodiak Island, Alaska. The are frequently in midwater schools during hours of darkness. Adults are found at 80 to 1,200 foot depths; juveniles are found in shallower water. Young are produced mainly in January and February off California, and February and March off Oregon (Lenarz and Gunderson, 1987). The diet of widow rockfish varies seasonally but consists mainly of small pelagic crustaceans, salps, and fishes. At maturity, they reach lengths of 21 inches.

Canary Rockfish (Sebastes pinniger)

Canary rockfish grow to 30 inches and are found on rocky bottoms at about 300 to 900 feet from Baja California to Alaska. They are long-lived fish with a 70+ year life span. Their young are born in winter. Their diet consists of small fishes and euphausiids.

Chilipepper (Sebastes goodei)

Chilipepper range from southern Baja California to Vancouver Island. They frequent deep rocky reefs as well as sand and mud bottoms from 200 to 1,080 feet; young chilipepper are found in shallower water. The spawning period for chilipepper is November through March. Adults grow to 22 inches and they feed on euphausiids, small squids, and fishes.

Bocaccio (Sebastes paucispinis)

Bocaccio are found from central Baja California to Kodiak Island. They live over rocky reefs or open bottom at about 90 to 1,050 feet. Bocaccio are carnivorous, feeding mostly on other fish, including other rockfish. Females give birth in late fall and again in late winter. The young school and are found in shallower rocky areas. Adults grow to three feet in length.

Flatfish

With exceptions, flatfish generally spawn during late winter and early spring. Larvae are pelagic, but settle to the bottom after metamorphosis. Once on the bottom, flatfish eat small crustaceans, polychaete worms, and mollusks. As they grow, they eat larger forms of the same organisms.

Dover Sole (Microstomus pacificus)

Dover sole live on mud bottoms from northern Baja California to the Bering Sea at depths of 90 to 3,000 feet. Tagging studies show evidence of subpopulations, limited coastwide movement, and extensive seasonal inshore-offshore migrations associated with spawning (Frey, 1971). Spawning occurs from November through March in deep offshore areas. Eggs are pelagic; larvae have a prolonged pelagic existence before they metamorphose and settle to the bottom. Dover sole grow to 30 inches. They feed on sedentary, mud-inhabiting invertebrates, such as small bivalves, polychaete worms, and crustaceans.

English Sole (Parophrys vetulus)

English sole occur in ocean waters to depths of 1,800 feet, and in bays and estuaries, from Baja California to Alaska. Tagging studies indicate seasonal coastwide movement (Frey, 1971). Spawning occurs between November and March, peaking in January and February. Eggs and larvae are pelagic. After metamorphosis, they settle to the bottom. The diet of English sole consists of bottom organisms such as segmented worms, clams, and small starfish. Adults grow to an average of 22 inches in length.

Petrale Sole (Eopsetta jordani)

Petrale sole are found from northern Baja California to the northern Gulf of Alaska on sandy bottoms at depths ranging from 60 to 1,500 feet. They are known to move great distances: tagged fish released at Eureka, California have been recovered off British Columbia (Frey, 1971). Petrale sole spawn from November through March at 900 to 1,200 foot depths. Shortly after spawning, petrale sole move inshore and northward for the spring and summer. During autumn and winter there is offshore and southerly movement associated with spawning (Frey, 1971). Their diet is composed largely of euphausiids, shrimp, anchovies, smelt, herring, juvenile whiting, small rockfish, and other flatfish. Adults reach sizes of 27 inches.

Rex Sole (Glyptocephalus zachirus)

Rex sole are found in shallow water to depths of 2,100 feet from southern California to the Bering Sea on sand or mud bottoms. Little is known of their movements and migrations. Spawning fish are most abundant from 180 to 300 feet at various times of the year; some are in spawning condition throughout the year. In the Eureka area, rex sole show heaviest spawning activity during summer months, while in the Gulf of Farallones spawning peaks in February and March. Rex sole are preyed upon by sharks, skates, rays, lingcod, and some rockfish. They eat annelid worms, shrimp, and amphipods. Maximum size of rex sole is about two feet.

Pacific Sanddab (Citharichthys sordidus)

Pacific sanddab live on sandy bottoms at depths of 30 to 1,800 feet from southern Baja California to the Bering Sea. Sanddab in the Puget Sound spawn in February, however, there are indications that females may spawn twice in a season (Hart, 1973). Sanddab grow to 16 inches.

Starry Flounder (Platichthys stellatus)

Starry flounder occur from Santa Barbara, California to the Bering Sea and Japan. They are a relatively sedentary species found mostly in nearshore areas, frequently in estuaries (Frey, 1971). They spawn in February and April in the Puget Sound region and in December and January off California (Hart, 1973). Eggs are pelagic. They feed on crabs, shrimps, worms, clams, small mollusks, small fishes, and brittle stars.

Sand Sole (Psettichthys melanostictus)

Sand sole is a large-mouthed flatfish up to two feet in length that occurs from southern California to the Bering Sea. They frequent sand bottoms in shallow, inshore areas but range to 600 foot depths. They spawn from January to April depending on their location. Eggs are pelagic. Sand sole eat fishes, crustaceans, worms, and mollusks.

Butter Sole (Isopsetta isolepis)

Butter sole are common from southern California to the Bering Sea. They occur in shallow water to depths of 480 feet. There are north-south migrations as well as seasonal inshore-offshore spawning movements (Hart, 1973). Butter sole spawn from February to late April. Eggs are demersal. While they can grow to 21 inches, they are usually under 12 inches in length.

Effects of Habitat Alteration

Industrial, urban, and agricultural activities are major contributors to marine habitat degradation. Developmental pressures in coastal areas have altered and decreased the amount of habitat available for fishery production, with chemical pollution degrading the quality of what remains. Impacts on fish include mortality, disease, increased susceptibility to predation, or reduced reproductive success, all potentially lowering the quantity and quality of commercial and recreational fishes or those species upon which they depend for food.

The dependence of Pacific groundfish species on nearshore or inshore areas, where the potential for impacts from habitat alteration may exist, is poorly understood. Areas close to shore have been suggested as essential habitat for juvenile boccacio; as well as blue, olive, yellowtail, widow, and shortbelly rockfishes (Miller and Geibel, 1973); for English sole and boccacio in their early years; and for lingcod spawning and nesting areas (Council, 1982). Starry flounder are common in estuarine areas (Conomos, 1977). Young Pacific ocean perch and sablefish are found in regions inshore of 150 feet and many species of rockfish; including blue, black, and olive rockfish; remain in this zone throughout their life (Council, 1982).

Although the effects of habitat alteration on fishery production are more pronounced inshore than offshore, concern about offshore species is warranted to the extent that offshore habitats are degraded by inshore activities or offshore uses, or offshore species are directly or indirectly dependent on inshore habitats for reproduction and/or food supply.

The waters off the coasts of California, Oregon, and Washington are used for commercial and recreational fishing, pleasure boating, commercial navigation, and waste disposal. At this time, it is unknown whether offshore habitats supporting Pacific groundfish species have been affected by these activities. Expanded use of the waters off the coasts of Washington, Oregon, and California may mean increased risks to Pacific groundfish from impacts associated with those activities, as discussed in the following sections.

Oil and Gas Development

The DOI is considering oil and gas leasing in 1991 for the continental shelf and slope (to 200 nautical miles) from Cape Mendocino, California to the Washington-Canada border. Current estimates for oil and gas resources feasible for development off Oregon and Washington are projected at 56 million barrels. This amount is 20 to 33 percent of the amount off northern California, and 8 to 14 percent of that in the southern California planning area (MMS, 1987).

There are typically three phases to oil and gas development: geological surveys, drilling, and production. Each phase may pose some element of risk to marine organisms and some level of conflict with pre-existing fisheries. In general, the risks include biological impacts (i.e., mortality, impaired growth, reduced reproductive success) from spilled oil and discharged drilling fluids and cuttings, or physical disruption (i.e., scattering of species off normal grounds, altering migration routes, etc.) from soundwaves or construction and related exploratory and production activities. Other conflicts with fisheries include disruption of soft bottom areas, hard bottom areas, and kelp beds; impacts from the discharge of drilling muds and cuttings; loss of fishing area due to presence of drilling rigs; increased risk of collision due to increased vessel traffic; gear snags from lost drilling equipment; or fouling of fishing gear by spilled oil.

Two potentially competing objectives involved in the use of offshore resources are to meet national energy needs and to conserve living marine resources. While 39 percent of the estimated 3.2 million mts of petroleum entering the marine environment each year derives directly from oil and gas production and transportation, it is not known whether commercially important offshore fisheries have been disrupted by either chronic or catastrophic contamination of their habitat by oil (NAS, 1985).

In general, the greatest potential impact of offshore oil and gas development is to coastal areas. Specifically, risks are highest in shallow water areas; areas of poor circulation; areas where circulation patterns may entrain contaminants (e.g., Puget Sound); or pebble-cobble beaches, where oil penetrates deeply and rapidly and the pebble-cobble sediments are replaced very slowly by natural coastal processes (Owens, 1973).

The season, location, sea state, water temperature, volume and type of oil released, and whether oil dispersants are used are important factors influencing the impact of a spill on marine biota. If a spill were to coincide with fish spawning, hatching, or larval development, mortality might be higher than otherwise because the early life stages tend to be particularly susceptible to petroleum exposure. The rate of degradation of spilled oil slows as water temperature decreases. As such, spilled oil may persist for longer periods in colder waters.

Laboratory and field studies have shown a broad range of effects on behavioral, reproductive, and developmental processes at low concentrations (less than one part per million) including reduced feeding activity, delayed development, decreased hatching success, and increased incidence of skeletal abnormalities (NAS, 1985). Decreased growth in English sole has been observed in studies simulating field exposure conditions (McCain, et al., 1986).

Photosynthetic activity, and thereby phytoplankton growth, is depressed by a wide range of petroleum hydrocarbons (NAS, 1985). Zooplankton as well are vulnerable to dispersed and dissolved petroleum constituents (NAS, 1985). With perhaps the exception of chronically oiled or enclosed waters, recovery of oil-impacted phytoplankton and zooplankton communities is probably rapid due to recruitment from other areas and their wide distribution, large populations, and short generation times. Pacific groundfish larvae are directly or indirectly dependent upon phytoplankton and zooplankton productivity in the waters in which they rear.

Concerns about spills or chronic release of oil from offshore oil and gas development center on potential biological and ecological impacts. Various studies have shown that low concentrations of petroleum hydrocarbons can disrupt normal behavior of marine organisms, particularly fragile life stages such as larval or juvenile forms (NAS, 1985). Population changes that occur as a result of oil and gas development might result in additional effects by altering food web relationships and interspecific competition in the ecosystem. Identifying these effects is difficult because of problems associated with monitoring offshore pelagic and benthic communities and because the natural variability of offshore fish stocks may mask petroleum effects.

While studies support concern about spills and chronic discharges of oil into protected or enclosed coastal waters, there are virtually no data available on long-term effects of petroleum discharges offshore (Malins, 1981). Therefore, the effects of oil and gas development on the abundance and distribution of Pacific groundfish stocks is largely unknown.

Marine Mining

Demand is increasing for sand and gravel as a construction aggregate, and as onshore deposits are depleted, pressure increases to mine offshore. It is estimated that the continental shelf off Oregon and Washington alone contains eight billion cubic meters of sand and gravel (Moore and Luken, 1979).

The MMS of the DOI is examining the possibility of leasing areas of the Oregon-Washington continental shelf for mining placer deposits of hard minerals such as chromite, garnet, ilmenite, magnetite, zircon, gold, and platinum. The extent and abundance of these deposits is unknown, and while market conditions do not favor extraction at present, exploration and development is expected in the near future because of demand and strategic importance of many of these minerals (ODFW, 1987).

Potential impacts from marine mining are a function of the timing of dredging operations in relation to seasonal fish migration, and include coastal erosion, interruption of the longshore transport of sand, potential conflicts with fisheries, and the loss of important benthic habitat. There may also be beneficial effects, such as resuspension of nutrients trapped in sediments. The release of these nutrients increases food availability.

The potential impacts of mining operation to groundfish species would have to be assessed on a site-specific basis. In general, risks to groundfish species would be greater in later rather than earlier life stages, since many of these species have pelagic egg and larval stages. While some studies suggest limited harmful effects on fish (Gustafson, 1972; Moore and Luken, 1979), the effects of increased turbidity from mining on primary productivity and egg and larval survival, as well as other long-range impacts of marine mining operations on Pacific groundfish stocks are unknown.

Dredge and Fill

The removal and relocation of river, harbor, and coastal sediments is often conducted for maintenance of navigation channels and port facilities. Associated impacts have the potential to affect Pacific groundfish species to the extent that populations occur at or near sites of dredging, filling, or dredged material disposal operations.

Dredging results in increased turbidity, with the effects being dependent on the type of substrate dredged, on currents, tides, preventive measures, and the type of dredge employed by the contractor. Habitat alteration occurs from dredging through disruption of benthic communities, loss of shallow water habitat, or resuspension of polluted sediments. These effects can be temporary or long term.

Dredged material is either disposed of at designated sites or used as fill. There is little evidence that the disposal of dredged material poses significant risk to Pacific groundfish communities, except perhaps in localized inshore areas. NMFS conducted a study of four interim dredge disposal sites off Oregon and found no indication of habitat degradation as measured in terms of benthic invertebrate species and densities (NMFS, 1987).

Filling occurs as part of dredging operations, as well as for urban and agricultural purposes. Significant losses of wetlands have reduced important nursery, rearing, and spawning habitats for fish. The relationship between wetland loss and the distribution and abundance of offshore groundfish stocks is poorly understood. More knowledge of the life histories of groundfish species as well as that of their food organisms is required to judge impacts.

Marine Debris

The problem of debris in the marine environment is receiving increased attention. Highly persistent plastics cause mortality of fish, marine mammals, and seabirds through ingestion or entanglement. Discarded fishery gear (ghost nets) continue to catch commercially valuable species, Pacific groundfish included, for years after their loss.

Quantitative data regarding effects on fishery stocks due to plastic debris or ghost nets are limited. There is concern, however, that ghost fishing may pose a significant problem to fisheries (Center for Environmental Education, 1987). A NMFS study observed a synthetic gillnet to remain adequately strong to hold living animals for six years (High, 1985). Although commercially and ecologically important, impacts on fish are the least researched and documented areas in the study of the effects of marine debris (Wallace, 1985). Therefore, no conclusions on impacts of marine debris on Pacific groundfish species can be drawn at this time.

Waste Discharge

The discharge of organic and industrial wastes can cause severe damage in the marine environment. Heavy metals, petroleum hydrocarbons, chlorinated hydrocarbons, and other wastes can be toxic or cause sublethal effects in fish and their food organisms. The effects of waste discharge are the most severe in areas where the contaminants are entrained or collect in bottom sediments.

A variety of pollutant-associated pathological conditions, including liver lesions and cancers, have been identified in Puget Sound and San Francisco Bay. In Puget Sound, a correlation has been established between certain liver diseases in English sole, concentrations of aromatic hydrocarbons in sediment, and metabolites of aromatic compounds in bile (McCain et al., 1986). Very high levels of organochlorine compounds, including DDT and PCBs, have been found in fish off Los Angeles and near the Farallon Islands in California (Brown, 1987; Melzian et al., 1987). These studies measured contaminant levels only and did not assess the effects of the contaminants.

At present, it is unknown whether offshore Pacific groundfish habitats have been adversely affected by waste discharges, or to what extent contaminants are entering the groundfish food chain, since very little monitoring of offshore sites and species within the management area has been conducted. In general, contaminant concentrations drop to low levels moving away from depositional urban areas. However, certain contaminants have been found in organisms inhabiting pristine areas at concentrations rivaling those found in species inhabiting contaminated habitats. PCBs, for example, were found in Pacific cod liver in concentrations comparable to levels observed in inshore English sole (Malins, 1982). The PCB concentrations in Pacific cod edible tissue, however, were well below federal standards. Levels of PCBs and DDT in sablefish and Dover sole taken at depths of 1,500 and 3,000 feet near the Farallon Islands, 30 miles off the coast of central California, were reported to be as high or higher than levels recently reported in the same species taken from highly contaminated areas off southern California (Melzian et al., 1987). These species were collected in the vicinity of former low-level and chemical munition disposal sites located near the Farallon Islands. Although the definitive sources of the contaminants are not known, the disposal sites may be a potential source of one or both of these contaminants.

Discussion

The level of commercial and recreational harvest in a fishery is in part a function of productivity in the fish stock, which is in turn directly related to the availability and quality of appropriate habitat for both the target species and its food sources. Disturbances that reduce either the availability or quality of habitat will depress production in the fishery, potentially leading to reduced commercial and recreational harvest.

There is no evidence that offshore Pacific groundfish habitat is at this time significantly affected by either onshore or offshore activities, largely because studies to identify levels and effects of contaminants in offshore Pacific groundfish species have not been conducted. Neither is it known whether nearshore groundfish subpopulations are adversely affected by existing sources of habitat alteration, and, if so, if overall stock abundance is affected. If offshore uses expand, pressure on groundfish stocks from habitat alteration would likewise increase. Oil and gas development, marine mining, or expanded use of offshore areas for waste disposal constitute the primary risks to offshore habitat.

Maintaining the current productive capacity of Pacific groundfish habitat will require careful case-by-case, site-specific, and cumulative impact analysis of proposed activities. Until the life histories of Pacific groundfish species are better understood in terms of offshore-inshore distribution of larvae and juveniles and their importance as recruits to the commercial fisheries, the potential impact of habitat alteration from onshore and offshore activities should not be underestimated.

Therefore, it is the policy of the Council that there be no net loss of the productive capacity of any marine or estuarine habitat which sustains Pacific groundfish species. It is the policy of the Council that habitats critical to the reproduction, rearing, and survival of Pacific groundfish species be protected from significant adverse effects of habitat alteration.

Guided by these policies, the Council will pursue its goal of maintaining productive capacity of Pacific groundfish habitats by participating with other agencies in decisions which directly or indirectly affect those habitats, and by working to resolve conflicts regarding uses of the coastal and offshore areas of California, Oregon, and Washington.

Further, in order to better judge potential impacts of expanded use of coastal and offshore areas on Pacific groundfish, the Council will encourage the pursuit of the following areas of research.

- Life histories of Pacific groundfish species, including spawning, rearing, food sources, migrations, etc.
- Inshore/offshore distribution of Pacific groundfish species.
- Importance of nearshore subpopulations to overall stock abundance.
- Short- and long-term impacts of discharged and spilled oil on Pacific groundfish and their food sources.
- Extent and effect of organochlorine contamination in commercial groundfish species.
- Impact of marine debris on Pacific groundfish.

The Council will convey the importance of these research and information needs to NMFS, the DOI, the U.S. Environmental Protection Agency, or other federal agencies; Sea Grant institutions; state resource agencies; and other appropriate entities.

Impacts

The proposed action describes the diverse habitats and life histories of various groundfish species in the Washington, Oregon, and California coastal waters. It describes habitat factors of importance to groundfish production and identifies the general effects and associated risks of various activities and habitat alterations. The proposed action also establishes Council policies regarding habitat protection and alteration in line with the NMFS habitat conservation policy and MFCMA. The proposed action also provides the necessary authorization to implement regulations to protect marine fish habitat such as regulations to prohibit discard of debris from fishing vessels at sea. However, no regulations to implement these provisions are proposed at this time.

Specific biological or socio-economic impacts cannot be quantified for this issue. However, the general impact of supplying this habitat information in a readily available and documented format should be positive from both a biological and socio-economic standpoint. It should reduce the duplication of effort and expense by management agencies in assembling and disseminating this information. Federal law requires that habitat provisions be included in all FMPs at the earliest possible time. Failure to incorporate habitat information would result in disapproval of the entire amendment.

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