3.0 WEST COAST MARINE ECOSYSTEMS AND ESSENTIAL FISH HABITAT

3.1 Affected Environment: West Coast Marine Ecosystems

Appendix A, Section 2.3.1 describes the West Coast fishery ecosystem. Marine ecosystems are influenced by the characteristics of the water column and underlying substrate. Key factors in the water column include water depth and temperature, vertical mixing, and currents. Temperature and depth place physiological limits on the distribution of species. Depth and water turbidity determine light penetration, which is required for primary production by phytoplankton. Vertical and horizontal mixing bring nutrients into the photic zone, the upper layers where light penetrates, further influencing the level of primary production. Large-scale surface and subsurface current systems affect water temperature, nutrients, and the transport of planktonic life forms, including larval fish. Nearshore and continental shelf zones are the most productive areas because the relatively shallow depths allow light penetration throughout the water column and complete mixing. Nonetheless, commercially important groundfish species are also found on the continental slope, the zone marking the transition from the shallower shelf to the deep abyssal plain. Physical characteristics of the bottom affect ecosystems. Large coastal features—islands and embayments, for example—affect water circulation. Bottom topography is important to the distribution of benthic species. As implied by their name, many rockfish species prefer hard substrate; flatfish, including commercially important species like Dover sole, require sand or mud substrate.

Climate change is also an important influence on the productivity of marine ecosystems, which in turn has an important effect on fishery production. Scientists have become more aware of cyclical climate changes in recent years. Many people are aware of the El Niño-Southern Oscillation phenomenon; strong events have had noticeable effects across the Pacific and continental U.S. El Niño (ENSO) events also affect West Coast marine ecosystems. During such an event, warm water moves up the West Coast, inhibiting the upwelling of cold nutrient-rich water. With less nutrients available in the photic zone, primary production suffers, which also affects species higher up on the food chain, including many commercially important groundfish species. Scientists have also identified a much longer climate cycle, which they have dubbed the Pacific Decadal Oscillation, or PDO. This is a shift between periods of relatively warm sea surface temperatures off the West Coast and cooler water. During the warm phase, as with El Niño, fisheries production suffers. Scientists now realize that a warm phase began around 1976 and 1977, just at the time domestic fisheries were expanding. As harvest rates increased dramatically, fish stocks were becoming less productive. By examining climate records scientists estimate these cycles last for about 20 years, and there is evidence West Coast waters recently entered a cooler phase, which should enhance productivity. This phenomenon is important when considering overfished species because stock productivity is a key factor in estimating how much fishing mortality a stock can sustain and still rebuild in the time period dictated by the rebuilding plan.

3.2 Affected Environment: Essential Fish Habitat

The MSA, as amended by the 1996 SFA, requires NMFS and federal fishery councils to describe essential fish habitat (EFH) for the species they manage. They must also enumerate potential threats to EFH from both fishing and non-fishing activities. These descriptions are compiled as part of each FMP. NMFS completed this task for the West Coast in 1998. However, a subsequent court challenge at the national level has required NMFS and the fishery councils to go back and do a better job of identifying, characterizing, and proposing protection measures for EFH. NMFS Northwest Region is currently preparing a programmatic EIS to address this challenge. The completion date for this project is early 2006. Chapter 4 in Appendix A gives an overview of how EFH for the West Coast has been identified and characterized to date. That section of the appendix also details what is known about the effects of fishing and non-fishing activities on EFH.

Because EFH must be identified for each life stage of each species in the fishery management unit, when taken together, groundfish EFH covers all marine and coastal waters in the West Coast EEZ. Currently, seven composite characterizations of different EFH types have been identified. These are broad classifications based on bottom type, topography, and water depth.

3.2.1 Bocaccio EFH

Bocaccio range from Krozoff and Kodiak Islands in the Gulf of Alaska to central Baja California, Mexico (Hart 1988). They are found in a wide variety of habitats, often on or near bottom features, but sometimes over muddy bottoms, both nearshore and offshore (Sakuma and Ralston 1995). Larvae and small juveniles are pelagic (Garrison and Miller 1982) and are commonly found in the upper 100 m of the water column, often far from shore (MBC 1987). Large juveniles and adults are semi-demersal and are most often found in shallow coastal waters over rocky bottoms associated with algae (Sakuma and Ralston 1995). Adults are commonly found in eelgrass beds or congregated around floating kelp beds (Love, *et al.* 1990; Sakuma and Ralston 1995). Young and adult bocaccio also occur around artificial structures, such as piers and oil platforms (MBC 1987). Although juveniles and adults are usually found around vertical relief, adult aggregations also occur over firm sand-mud bottoms (MBC 1987). Bocaccio move into shallow waters during their first year of life (Hart 1988), then move into deeper water with increased size and age (Garrison and Miller 1982).

Although bocaccio are found coastwide, only the stock in Southern California waters has been declared overfished.

3.2.2 Cowcod EFH

Cowcod are most abundant in waters off central and southern California. They range from 22m to 491 m in depth and are considered to be parademersal (transitional between a midwater pelagic and benthic species). Adults are commonly found at depths of 180 m to 235 m and juveniles are most often found in 30 m to 149 m of water (Love, *et al.* 1990).

MacGregor (1986) found that larval cowcod are almost exclusively found in Southern California and may occur many miles offshore. Juveniles occur over sandy bottom areas, and solitary ones have been observed resting within a few centimeters of soft-bottom areas where gravel or other low relief was found (Allen 1982). Young of the year have been observed on fine sand and clay sediment as well as oil platform shell mounds and other complex bottom features at depths ranging from 22 fm to 122 fm (40 m to 224 m). Adult cowcod are primarily found over high relief rocky areas (Allen 1982). They are generally solitary, but occasionally aggregate (Love, *et al.* 1990). Solitary subadult cowcod have been found in association with large white sea anemones on outfall pipes in Santa Monica Bay (Allen 1982). Although cowcod are generally not migratory, they may move, to some extent, to follow food (Love 1991).

3.2.3 Widow Rockfish EFH

Widow rockfish range from Albatross Bank off Kodiak Island to Todos Santos Bay, Baja California, Mexico (Eschmeyer, *et al.* 1983; Miller and Lea 1972a; NOAA 1990). They occur over hard bottoms along the continental shelf (NOAA 1990). This species prefers rocky banks, seamounts, ridges near canyons, headlands, and muddy bottoms near rocks. Large widow rockfish concentrations occur off headlands such as Cape Blanco, Cape Mendocino, Point Reyes, and Point Sur. Adults form dense, irregular, midwater and semi-demersal schools deeper than 100 m at night and disperse during the day (Eschmeyer, *et al.* 1983; NOAA 1990; Wilkins 1986). All life stages are pelagic, but older juveniles and adults are often associated with the bottom (NOAA 1990). All life stages are fairly common from Washington to California (NOAA

1990). Pelagic larvae and juveniles co-occur with yellowtail rockfish, chilipepper rockfish, shortbelly rockfish, and bocaccio larvae and juveniles off Central California (Reilly, *et al.* 1992).

3.2.4 Yelloweye Rockfish EFH

Yelloweye rockfish range from the Aleutian Islands, Alaska, to northern Baja California, Mexico and are common from Central California northward to the Gulf of Alaska (Eschmeyer, *et al.* 1983; Hart 1988; Love 1991; Miller and Lea 1972b; O'Connell and Funk 1986). They occur in water 25 m to 550 m deep with 95% of survey catches occurring from 50 m to 400 m (Allen and Smith 1988). These fish are bottom dwelling, generally solitary, rocky reef fish, found either on or just over reefs (Eschmeyer, *et al.* 1983; Love 1991; Miller and Lea 1972b; O'Connell and Funk 1986). Boulder areas in deep water (>180 m) are the most densely populated habitat type, and juveniles prefer shallow-zone, broken-rock habitat (O'Connell and Carlile 1993). They also reportedly occur around steep cliffs and offshore pinnacles (Rosenthal, *et al.* 1982). The presence of refuge spaces is an important factor affecting their occurrence (O'Connell and Carlile 1993).

3.3 Criteria Used to Evaluate Impacts

The proposed action does not have direct effects. (Direct impacts occur at the same time or place as the proposed action.) The strategic parameters identified in the rebuilding plan will be used, in concert with stock assessments and rebuilding analyses, to determine harvest levels (OYs) for overfished species in advance of each biennial management cycle. For a given species, rebuilding by an earlier year and/or with a higher rebuilding probability (P_{MAX}) requires a lower fishing mortality rate, which translates into lower OYs. The alternatives will have differential impacts depending on these different harvest levels. Higher OYs for a given overfished species could lead to increased fishing effort by different fishery sectors. This effect can be magnified because the relatively low OYs required to rebuild overfished species constrain fishing opportunity on co-occurring healthy stocks. (Section 1.2.2 in Appendix A details this issue.) Increased fishing effort could lead to an increase in fishing-related impacts, while a decrease in fishing effort would have the opposite effect. Thus, changes in fishing effort could be one way to evaluate the relative effects of the alternatives. However, there are limited data available on the distribution, intensity, and duration of fishing effort expended by various groundfish fishery sectors.[1/] Furthermore, different gear types have different kinds of impacts to habitat, although bottom trawl gear is likely to have the greatest impact because of its extensive contact with substrate. The effects of fishing gear on different types of habitat are not well understood either. For example, in high energy environments (e.g., strong wave action or currents) the relative effect of fishing gear may be modest compared to more stable, low energy environments. Currently, there is insufficient information to fully evaluate the effects of the proposed action on EFH.

Impacts of the proposed action at the ecosystem level are at least as difficult to predict. As already noted, rebuilding plans determine the harvest level (OY) for an overfished species as part of the biennial management process. This in turn determines the level of fishing and how many fish are removed from marine ecosystems. This may change the relative abundance of species at different trophic levels, affecting ecosystem structure and contributing to follow-on indirect and cumulative effects. However, the nature, intensity, and location of these effects are not well-understood, especially across the range of marine ecosystems potentially affected by changes in the abundance of harvested groundfish species.

1/ Fishing locations are reported in logbooks required for limited entry trawl vessels. Similar reporting is not required for other sectors catching groundfish. To date, a model has not been developed to predict the distribution and intensity of fishing effort for a given set of management measures. As part of the EFH EIS referenced below, NMFS is developing a model to predict impacts to EFH, which includes a component for predicting fishing effort distribution and intensity.

Given these limitations, rebuilding targets, which differ among the alternatives, are used as proxies for fishing effort as criteria to assess the relative effects of the alternatives on essential habitat and ecosystem function.

When an agency is evaluating reasonably foreseeable significant adverse effects, there is incomplete or unavailable information, and the costs of obtaining it are exorbitant or the means unknown, the agency must: (1) so state, (2) describe the importance of the unavailable information to the assessment, (3) summarize any existing scientific information, and (4) evaluate impacts based on generally accepted scientific principals (40 CFR Part 1502.22), which may accord with the best professional judgement of agency staff. NMFS acknowledges the information necessary to fully evaluate impacts to the fishery ecosystem and EFH, as described in the preceding paragraph, cannot be reasonably obtained at this time, and impacts are generally unknown. Necessary information may become available at a future date. NMFS is preparing an EIS to comprehensively evaluate groundfish habitat and the effects of groundfish fishing on that habitat, in response to litigation (*American Oceans Campaign v. Daley et al.*, Civil Action No 99-982(GK)). This EIS is gathering more information about the effects of fishing in order to evaluate alternatives to minimize fishing effects on EFH to the extent practicable, as required by the MSA. A predictive risk assessment model is being developed for this project, which will be used to develop alternatives for the designation and protection of EFH. In addition to any direct outcome of the EFH EIS, such as establishing additional protection measures for EFH, it may be possible to adapt the assessment model to predict the effects of other actions, such as setting harvest specifications. The DEIS for this proposed action is scheduled for release in February 2005, and the EFH EIS process will be completed (by signing of the ROD) in February 2006. The following evaluation is based on best professional judgement of NMFS staff.

3.4 Discussion of Direct and Indirect Impacts

Appendix A Chapter 4 describes adverse impacts of fishing gear to EFH, including ecosystem effects, in general terms. Ecosystem effects are, almost by definition, indirect. Overfishing has reduced some fish stocks to levels that are a small fraction of estimated unfished biomass and may affect trophic relationships: these species are less available both as prey and predators. Direct effects to habitat result from the deployment of fishing gear that damages benthic habitat. Habitat modification can also have indirect ecological effects because different species may be better adapted to the altered habitat, displacing other species. Bottom trawl footrope restrictions implemented by the Council make it difficult for fishers to access rock piles and other areas of complex topography (due to the risk of gear damage). This helps protect important, complex habitat and creates defacto refugia for species preferring that habitat type. Biodiversity impacts are directly and indirectly related to overfishing. Overfished species may become locally extinct in a part of their former range, and there is some risk of actual species extinction. It is unlikely such extinctions would be a direct result of overfishing, in the sense that all organisms were removed by fishing. However, the population could be reduced to such a low level that unfavorable environmental conditions or biological and behavioral constraints (inhibiting successful reproduction for example) could subsequently result in localized or species extinction. Given the current state of knowledge and available data, it is not possible to quantitatively evaluate the ecosystem, habitat, and biodiversity effects of the alternatives. Instead, the alternatives are evaluated qualitatively below.

The effects of fishery management practices on the physical environment typically include such things as fishing gear effects on the ocean floor, changes in water quality associated with vessel traffic, and fish processing discards as a result of fishing practices. There are no data to suggest that characteristics of the California Current System or topography of the coast change with fishery management or fishing practices. However, there is information to indicate fishery management and fishing practices may have an effect on EFH.

In general, potential bottom trawl fishing-related impacts to groundfish habitat take the form of lost or discarded fishing gear and direct disturbance of the seafloor from contact by trawl nets. While the effects of fishing on groundfish habitat have not been directly investigated, there is some research exploring how gear affects habitat. Auster and Langton (1999) reviewed a variety of studies reporting habitat effects due to fishing for a wide range of habitats and gear types. Commonalities of all studies included immediate effects on species composition and diversity and a reduction of habitat complexity.

Bottom trawling gear is known to modify seafloor habitats by altering benthic habitat complexity and by removing or damaging infauna and sessile organisms (Freese, *et al.* 1999; Friedlander, *et al.* 1999). In a study on the shelf and slope off California, high-resolution sidescan-sonar images of the Eureka area revealed deep gouges on the seafloor believed to be caused by trawl doors (Friedlander, *et al.* 1999). The effects of bottom trawling on a "hard bottom" (pebble, cobble, and boulder) seafloor was also investigated in the Gulf of Alaska, and results indicated a significant number of boulders were displaced and emergent epifauna were removed or damaged after a single pass with trawl gear. Casual observations during the Freese *et al.* (1999) study revealed that *Sebastes* species use cobble-boulder and epifaunal invertebrates for cover. When boulders are displaced they can still provide cover, but when piles of boulders are displaced it reduces the number and complexity of crevices (Freese, *et al.* 1999).

Limited qualitative observations of fish traps, longlines, and gillnets dragged across the seafloor during set and retrieval showed results similar to mobile gear, such that some types of organisms living on the seabed were dislodged. Quantitative studies of acute and chronic effects of fixed gear on habitat have not been conducted (Auster and Langton 1999).

In addition to fishing activities, humans have many direct and indirect effects on groundfish habitat. While non-fishing human impacts have not been directly assessed on groundfish habitat, a study of flatfish in Puget Sound, Washington indicated that anthropogenic stressors included chemical contaminant exposure and alteration of nearshore nursery habitats (Johnson, *et al.* 1998). The New England Fishery Management Council compiled a list of human-induced threats to fish habitat that may be used as a guide to factors affecting groundfish species off the West Coast. Oil, heavy metals, acid, chlorine, radioactive waste, herbicides and pesticides, sediments, greenhouse gases, and ozone loss are thought to be chemical factors that affect fish habitat. Biological threats can include the introduction of non-indigenous species, stimulation of nuisance and toxic algae, and the spread of disease. Human activities that may physically threaten fish habitat are dredging and disposal, mineral harvesting, vessel activity, shoreline alteration, and debris (Wilbur and Pentony 1999).

In the last few decades, marine debris has also been recognized as posing a risk to marine organisms via entanglement and ingestion. Seafloor debris was surveyed from Point Conception, California, to the United States/Mexico international border at depths of 10 m to 200 m, and anthropogenic debris occurred on approximately 14% of the mainland shelf. Of the debris sampled, discarded fishing gear had the largest spatial coverage, followed by plastic, metal, and other debris (e.g., shoe soles and automobile parts) (Moore and Allen 1999). Less is known about the quantity of marine debris off Washington and Oregon, but it may be at levels that could negatively affect marine organisms.

3.5 Discussion of Cumulative Impacts

Cumulative effects result primarily in changes in the productivity of ecosystem components, which itself may be a result in fishery-induced changes in ecosystem structure. These factors include:

Climate variability. Climate cycles affect population productivity. Since predictions about future productivity are based on past relationships, between stock size and recruitment for example, if underlying conditions change, these predictions may be inaccurate. Thus, if climate is not or cannot be accounted for when modeling population dynamics, scientists may under- or over-predict population growth and sustainable fishery removals.

Ecosystem structure. Structural change becomes an effect itself (if resulting from fishery removals) that could interact cumulatively with the effects of the alternatives. Ultimately, it is the presence and differing abundances of species that constitutes ecosystem structure. The abundance of a given species is in turn the result of physiographic conditions (water temperature, relief, depth, etc.), processes external to an arbitrarily bounded system (e.g., fishing mortality), and interactions between system components (trophic relationships). Structure can change as a result of internal feedback. For example, scientists have posited "cultivation/depensation effects" that may lead to recruitment failure, even though one would expect compensation to declines in biomass (MacCall 2002a; Walters and Kitchell 2001). (Compensatory response assumes that growth and survival are density dependent.)

Non-fishing impacts to habitat. These change physiographic conditions, which may produce changes in ecosystem structure. (See Section 4.4 in Appendix A.) Activities such as dredging, oil and gas exploitation, wastewater discharge, aquaculture, and coastal development generally affect inshore habitats. With some notable exceptions (such as the live fish fishery in Southern California) most limited entry and directed open access fisheries do not occur in the inshore areas directly affected by these activities. However, according to EFH descriptions in the groundfish FMP, early life stages of some target species—such as Pacific cod, whiting, bocaccio, and English sole—use estuarine habitat, so these stocks could be affected if nearshore non-fishing activities reduce productivity by damaging habitat.

Past and future fishing activity and related management actions. Excluding whiting, the highest groundfish landings were in 1982, primarily because of very large catches of widow rockfish. Landings were lower, although fairly stable through the 1980s, but began to decline steeply beginning in the early 1990s. Non-whiting landings fell by 67% between 1992 and 2002. (See Appendix A Table 6-1a through 6-1c, which show historical landings by weight, and exvessel revenue in current and inflation-adjusted dollars.) Using landings as a proxy for changes in fishing effort, past effort was substantially higher than is likely to occur in the near future. This activity likely resulted in substantial impacts to EFH. The trawl vessel buyback program implemented in December 2003 retired about one third of the limited entry fleet. Although this may allow increases in landing limits and more fishing effort by the remaining vessels, the net effect is likely to be a reduction in total trawl effort. In the foreseeable future, the need to rebuild overfished groundfish stocks will likely constrain fishing effort to levels near or modestly above the level occurring at present. The distribution and intensity of fishing effort, and therefore impacts to EFH, could be affected by measures implemented pursuant to the EFH EIS mentioned above. Any such measures would likely come into effect in 2006.

3.5.1 Potential Unintended Consequences

Another way of looking at cumulative impacts is to identify the potential unintended consequences of the proposed action. The proposed action has an express purpose, as discussed in Chapter 1. However, when combined with other actions or external effects, the proposed action may have other effects. By definition, any description of unintended consequences must be speculative, because they cannot be fully anticipated. But this discussion helps inform the public as to the potential range of effects stemming from the proposed action.

Recovery of overfished stocks may allow fishing effort to increase, potentially increasing habitat and ecosystem impacts. Obviously, these impacts would have to affect organisms other than groundfish species managed under the FMP; if habitat impacts affected the productivity of groundfish stocks, this would hinder rebuilding of overfished species, or for non-overfished species, the harvest levels that could be sustained under the management framework. If this hindered stock rebuilding, under the management framework, harvests would continue to be constrained, which would likely require limits on fishing effort, thus limiting fishing-related habitat impacts. Furthermore, separate actions, such as the EFH EIS mentioned above, are likely to further mitigate habitat impacts. Alternatively, constraints necessary to rebuild stocks could lead to shifts in fishing pattern or the gear types used. For example, expanding closed areas, such as the RCA, could concentrate fishing effort in productive areas outside the RCA, intensifying fishing-related impacts there.

3.6 Summary of Impacts

3.6.1 No Action Alternative

Only bocaccio is projected to rebuild under the No Action Alternative. Widow rockfish and yelloweye rockfish are not projected to rebuild; there is insufficient information to determine the long-term prospects for cowcod, although the short-term OYs are consistent with rebuilding. Therefore, this alternative is only legally viable for bocaccio and possibly cowcod. Overfished bocaccio and cowcod stocks occur mainly south of Point Conception; changes in fishing effort related to stock rebuilding would, therefore, primarily affect habitat in those areas. Both are found in a variety of habitats in continental shelf areas, although rocky areas are preferred adult habitat, especially for cowcod (see discussion above). The largest component of fishing mortality for both species is from recreational fisheries. Limited entry trawl, fixed gear, and directed open access (which is primarily fixed gear) account for most of the remaining fishing mortality for both species. In the open access sector, the exempted trawl fishery for California halibut accounts for a lot of the bocaccio bycatch. Under No Action the OYs for both species would be reduced to zero or near zero in the short term (see Tables 2-1 and 2-2). Management strategies for cowcod would likely not change, since current OYs (and under the action alternatives) are already very low. The primary strategy is avoidance: using the CCA and RCA to exclude fishers from areas where this species most frequently occurs. Managing for the near-zero short-term OYs for bocaccio would likely require expanding the RCA in Southern California to push more commercial fishing effort into deeper, continental slope waters, and further curtailing or eliminating sport fishing opportunity. The short-term effect on habitat, in terms of fishing impacts, would be modest. Recreational fishing has negligible habitat impacts, so further curtailing it would have little effect. Habitat-related impacts from trawl fishing on the continental shelf could be reduced, although impacts in deep water could increase if effort shifted into this zone.

Bocaccio OYs are projected to increase fairly rapidly under No Action. The projected 2006 OY of 28.2 mt would exceed the very restrictive 2003 OY of 20 mt. By 2010 the OY would exceed the projected total fishing mortality for 2004. This suggests management restrictions could be relaxed to allow more fishing opportunity in areas where bocaccio occurs. Other overfished species, such as canary rockfish and cowcod, would then act as constraints on the amount and distribution of fishing effort, since these stocks have low projected OYs over the long term.[2/] Thus, over the long term the distribution and intensity of fishing effort related to bocaccio rebuilding may not differ substantially from current conditions.

It is not possible to predict cumulative impacts to EFH and West Coast fishery ecosystems under No Action. Leaving aside for a moment the legality of this alternative, in that widow and yelloweye rockfish would not

2/ The target year for canary rockfish is 2074, and projected OYs during rebuilding are below 200 mt. They are distributed coastwide and are caught in many of the same fisheries that catch bocaccio in the Monterey and Conception management areas. Section 2.4.1.2 in Appendix A describes canary rockfish distribution, life history, and stock status.

rebuild, this alternative would result in higher OYs over the long term, which could lead to an increase in fishing effort. However, if one assumes the rebuilding targets adopted under Amendment 16-2 for the four other overfished species remain in place, resulting OYs for those species would place an additional limit on fishing activity.

3.6.2 The Action Alternatives

The projected OYs for cowcod and yelloweye rockfish vary by a small amount under the action alternatives. Thus, there would be little practical difference in the kinds of management measures and resulting distribution and intensity of fishing effort resulting from the need to rebuild these two species. In addition, in the short term at least, these OYs are close enough to those now in place under interim rebuilding measures that the impacts are unlikely to differ from current levels.

Although there are three different stock assessment model results presented for bocaccio and widow rockfish under the alternatives, discussion here is confined to an evaluation using the base models. This evaluation is qualitative and primarily focuses on the relative impacts of the alternatives. The other models bracket uncertainty around the base models. Comparing alternatives using any one of the models would result in a similar arrangement of relative impacts.

Referring to Table 2-2, which shows short-term OYs for bocaccio under the alternatives, successively lower OYs would be implemented moving through the alternatives from Alternative 1 to Alternative 4. Alternatives 1 through 3 have short-term OYs substantially above the projected catch of bocaccio in 2004, which is 145.1 mt (see Table 5-12). The 2005 OY is just below this value, while the 2006 OY is just above it. Alternatives 1 through 3, therefore, would not require any change from the current management regime specifically to address bocaccio rebuilding. Alternative 4 would require slight reductions. Depending on the allocation of bycatch allowances among different fisheries, this could have a modest effect on several different fisheries. As noted above, the largest share of estimated bocaccio harvest mortality occurs in the recreational fishery. They are also caught in limited entry trawl fisheries targeting bank and chilipepper rockfish south of Cape Mendocino (or 40º 10' N latitude). These bottom trawl fisheries have greater impacts to habitat than recreational fisheries. Estimated total catch of bocaccio in fixed gear fisheries in 2004, according to Table 5-12, is 24 mt (limited entry fixed gear and directed open access), or less then one-fifth of total estimated fishing mortality. These gear types have a modest impact on habitat.

Widow rockfish are mainly caught in the Pacific whiting fishery. (According to Table 5-12, 211 mt of widow rockfish will be caught in this fishery in 2004, almost four-fifths of the total widow rockfish fishing mortality projected for 2004.) The second largest source of fishing mortality, according to Table 5-12, is the tribal midwater fishery (which primarily targets yellowtail rockfish.) These trawl vessels use midwater nets, which do not make contact with the bottom. The impacts to physical habitat from changes in fishing effort in this sector are, therefore, negligible. According to Table 5-12, the limited entry fixed gear sector will catch an estimated 5 mt, about two percent of the 270 mt total projected fishing mortality for this species. Catches in other sectors (limited entry trawl, open access, recreational, research, and EFP fisheries) are much more modest, totaling 14 mt in 2004, according to these projections. If harvest restrictions are necessary, Council policy is to structure management measures, so limits are first applied to the whiting fishery before implementing measures to reduce incidental catch in non-whiting fisheries. Thus, rebuilding-related OY reductions would first affect the whiting fishery and at very low levels would require restrictions in other fisheries. Projected OYs under Alternative 1 (see Table 2-3) are close to the 2004 OY (under the base model), since this accords to interim rebuilding targets currently in use. Alternatives 2 and 3 would require moderate to substantial reductions in the whiting fishery, but no additional limits on non-whiting fisheries under current Council policy. In the short term, adverse habitat impacts could occur from groundfish fisheries if vessels shift effort from the midwater whiting fishery to bottom trawling. Current management restrictions, primarily the RCA, would make it more likely that the increase in effort and attendant impacts would occur in the deepwater Dover sole/thornyhead/trawl-caught sablefish complex (DTS) fishery. Alternative 4 would require closing the whiting fishery and impose additional restrictions on other sectors, likely reducing overall effort. In the short term at least, Alternative 4 could reduce groundfish fishing-related habitat impacts.

The action alternatives have mixed long-term and cumulative effects. All of the action alternatives are projected to rebuild these overfished stocks. This will have a beneficial effect to the degree that ecosystem structure and biodiversity, as measured by the relative abundance and distribution of species, returns to a state closer to natural conditions. Stock rebuilding will also increase fishing opportunity; although projected OYs for bocaccio and widow rockfish are insufficient to support a directed fishery, the constraints imposed by low OYs for these species on harvesting healthy stocks would be eased. However, rebuilding OYs for canary rockfish, which are caught incidentally in some of the same fisheries (particularly fixed gear and recreational), primarily off of Washington but extending south to Conception in small amounts, would then assume the constraining role. Habitat impacts may be mitigated by the EIS NMFS is currently developing to designate EFH and identify measures to reduce fishing-related impacts.

3.6.3 The Council-Preferred Alternative

The Council-preferred Alternative combines rebuilding strategies in the other alternatives. For widow rockfish the strategy in Alternative 1 (using the base model to compute rebuilding parameters) is adopted, for cowcod and bocaccio the strategy in Alternative 2 (using the base model from the bocaccio stock assessment) is adopted, and for yelloweye rockfish the strategy in Alternative 3 is adopted. This combination of strategies is based on almost the same set of species-specific rebuilding probabilities as were used for the interim policies that guided harvest specifications for groundfish fisheries in 2004. (See the table below.) For the 2005-2006 biennial management cycle the Council adopted OYs at their April 2004 meeting consistent with the rebuilding plans adopted by this EIS. The interim targets used to specify OYs in 2003 differ from those used in the succeeding years, partly because of new stock assessments completed in 2003 and used for subsequent harvest specifications. The change in bocaccio and widow OYs demonstrate the effect that information from new stock assessments can have on harvest levels under the same rebuilding strategy. In the case of bocaccio, the 2002 stock assessment (MacCall 2002b) determined the stock would not rebuild by T_{MAX} even with zero fishing mortality, while the subsequent assessment, using new data and modeling assumptions, predicted a much greater likelihood of rebuilding.

	2003 P_{MAX}	2003 OY	2004 P_{MAX}	2004 OY	2005-2006 P_{MAX}	2005-2006 OY
Bocaccio	NA	<20 mt	70%	250 mt	70%	307/309 mt
Cowcod*	55%	4.2	55%	4.0	60%	4.2/4.2
Widow Rockfish	60%	832	60%	284	60%	285/289
Yelloweye Rockfish	92%	22	80%	22	80%	26/27

*OY for Monterey and Conception management areas; rebuilding strategy based on assessment of Conception portion of the stock (Butler, *et al.* 1999).

In the short term the series of OYs displayed in the table above suggest that impacts to habitat and ecosystem may increase slightly in comparison to those occurring in the recent past. This is premised on the correlation between OYs, projected landings, and the intensity of fishing effort. However, this simple approach must be qualified. First, harvest levels (OYs) for overfished species have an indirect effect on total catch of all species, which in turn is unlikely to be linearly correlated with the intensity of fishing effort. For example, CPUE is likely to vary by area and season because of changes in target species' abundance, bottom characteristics, and fishing strategy. In addition, as discussed in evaluating the other alternatives, overfished species may be caught in different fisheries, using different gear types, which impact habitats differently. Bocaccio and cowcod are primarily caught in recreational fisheries in south of 40º10' N latitude and secondarily in trawl fisheries. Recreational fisheries likely have a modest impact on physical habitat because of the lightweight line gear used. Furthermore, the RCAs and CCAs are intended to limit fishing in areas of higher abundance for these species. These closed areas may also reduce fishing-related impacts to important habitat for these species. If considered in isolation, increases in bocaccio OY could allow relaxing constraints imposed on trawl fisheries; but OYs for other overfished species, notably canary rockfish and yelloweye rockfish, require harvest limits that will continue to constrain trawl fisheries south of 40º10' N latitude. As noted above, widow rockfish are caught primarily in fisheries using midwater gear north of 40º10' N latitude, which likely has a modest effect on habitat. The Council-preferred Alternative will likely result in harvest levels that allow these fisheries to be prosecuted. Yelloweye rockfish are primarily caught in recreational fisheries in Oregon and Washington waters. Commercial fixed gear fisheries also catch this species, although management measures currently in place, such as the nontrawl RCA limit targeting by commercial vessels in areas of high yelloweye rockfish abundance. (The YRCA has a similar effect for recreational fisheries.) In addition to redistributing fishing effort, these closed areas may also reduce fishing-related impacts to yelloweye habitat.

Over the long term, the Council-preferred Alternative adopts rebuilding strategies that are likely to rebuild these overfished species within the required time frame. Stock rebuilding will allow higher harvest levels, which could lead to greater fishing effort and resulting habitat impacts. However, cumulative effects could mitigate habitat impacts in various ways. First, new stock assessments could determine that other groundfish species are overfished, requiring the development of rebuilding plans for those species and a related limit on harvest levels. These harvest levels could then impose constraints on the target species harvests, limiting fishing effort and related habitat effects. Changes in the climate regime would likely affect stock productivity, as revealed in future stock assessments. Current evidence suggests that the North Pacific is entering a period favoring higher productivity for many West Coast groundfish stocks. However, given that current evidence suggests the PDO operates on an approximate 20-year cycle, and these overfished species are predicted to rebuild over a longer time period, ocean conditions resulting in lower productivity could affect rebuilding late in the projected period. Aside from changes in the stock that may affect harvest levels and resulting fishing effort, other actions may mitigate the effect of fishing on habitat and the ecosystem. For example, the EFH EIS referenced above could impose mitigation measures intended to reduce overall fishing-related impacts to EFH. The management framework could be modified to more explicitly address ecosystem-based management principles, if scientific understanding is sufficient and legislative mandates put greater emphasis on this approach.