Pacific Coast Groundfish Fishery Management Plan

For the California, Oregon and Washington Groundfish Fishery

Appendix F Overfished Species Rebuilding Plans

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1.1 Introduction

This appendix provides the rebuilding plans for the overfished species managed through the Pacific Coast Groundfish Fishery Management Plan consistent with Section 4.6 (Ending Overfishing and Rebuilding). This appendix contains 3 sections: 1) current rebuilding plans, including the rebuilding strategy and parameters and management measures used to limit the catch of each species; 2) a summary of past rebuilding plan parameters; and 3) a summary of the status of each stock at the time it was declared overfished as well as a detailed description of the rebuilding strategy and the communities affected by rebuilding restrictions for each species.

As described in Section 4.6.3.4, if the numerical specification of the harvest control rule or target year for a given overfished species is changed, the new T_{TARGET} and the harvest control rule (type and numerical value) will be published in Federal groundfish regulations and revised in Section 1.2.1 of this appendix. In addition, subsequent SAFE documents or NEPA documents analyzing new harvest specifications and rebuilding plans may include updated values for the parameters listed in Section 4.6.3.3 and Table F-1 in this appendix.

Through each biennial specifications and management measures process the Council may consider changes to rebuilding plans as necessary to respond to the best scientific information available. Any revisions to the rebuilding periods must be consistent with the MSA; rebuilding time periods must be as short as possible, taking into account the status and biology of the depleted species, the socioeconomic needs of west coast fishing communities, and the interaction of the depleted stocks within the marine ecosystem.

Rebuilding plans were first addressed in this FMP through the implementation of Amendment 12 which established a framework for rebuilding plans. Amendment 16-1 was also implemented to address frameworking issues with rebuilding plans and Amendments 16-2 through 16-5 implemented the first rebuilding plans for overfished species.

1.2 Overfished Species Rebuilding Plans

1.2.1 Current Rebuilding Plan Parameters and ACLs

It is likely that over time the parameters listed in this section will change. Consistent with the specifications developed through the Council's biennial specifications and management measures process, the rebuilding parameters and ACLs in this section would be updated following final implementation by NMFS, usually through the publication of a final rule in the *Federal Register*. Further detail on ACLs and ACTs can be found in the FEIS for 2011-2012 Harvest Specifications and Management Measures on the Council's website at http://www.pcouncil.org/.

Table F-1. Current Rebuilding Parameters and ACLs for 2011 and beyond.

Species	B_0	B_{MSY}	T_{MIN}	$T_{F=0}$	T_{MAX}	T_{TARGET}	2011 Annual Catch Limit (ACL)	Harvest Control Rule Specification
Bocaccio	7,946 B eggs	3,178 B eggs	2018	2018	2031	2022	274 mt	SPR 77.7%
Canary	25,993 mt	10,397 mt	2024	2024	2046	2027	107 mt	SPR 88.7%
Cowcod	2,183 mt	873 mt	2059	2060	2097	2068	3 mt	SPR 82.7%
Darkblotched	32,800 mt	13,112 mt	2012	2016	2037	2025	296 mt	SPR 64.9%
POP	37,780 mt	15,112 mt	2017	2018	2045	2020	183 mt (157 mt ACT)	SPR 86.4%
Petrale sole	25,334 mt	6,334 mt	2014	2014	2021	2016	1,160 mt	25-5 Rule
Widow	40,547 M eggs	16,219 M eggs	2008	2010	2035	2010	600 mt	Constant catch
Yelloweye	994 M eggs	389 M eggs	2044	2047	2089	2074	17 mt	SPR 76%

1.2.2 Rebuilding Strategy

This section describes the rebuilding strategy for each species and the management measures used to attain rebuilding.

1.2.2.1 Bocaccio

The rebuilding strategy for bocaccio is a constant SPR harvest rate. Management measures used to limit the catch of bocaccio, such that projected impacts to the stock attain rebuilding objectives, include depth-based time and area closures for recreational fisheries and Groundfish Conservation Areas (GCAs) for commercial fisheries. GCAs enclose depth ranges where bycatch of overfished species is most likely to occur based on information retrieved from logbooks, the at-sea observer program, surveys, and other sources. The boundaries vary by season and fishery sector, and may be modified in response to new information about the geographic and seasonal distribution of bycatch.

A large proportion of bocaccio catch occurs in recreational fisheries in central and southern California. Recreational depth closures that restrict fishing to shallow waters, bag limits, and seasonal closures have been used to reduce recreational bocaccio catches.

1.2.2.2 Canary

The rebuilding strategy for canary is a constant SPR harvest rate. Management measures used to limit the catch of canary, such that projected impacts to the stock attain the rebuilding objectives, include depth-based closed areas where bycatch of overfished species is most likely to occur, based on information retrieved from logbooks, the at-sea observer program, surveys, and other sources. The boundaries vary by season and fishery sector, and may be modified in response to new information about the geographic

and seasonal distribution of bycatch.

Canary rockfish prefer rocky areas on the continental shelf so management measures in use at the time of rebuilding plan adoption were intended to discourage fishing in these areas. Under the regulations in place since 2003, commercial fishing is prohibited in the gear- and sector-specific GCAs, which encompasses depth ranges where canary rockfish are most frequently caught. In addition, the aforementioned restrictions on the use of trawl nets equipped with large footropes and anti-chafing gear discourage fishing in the rocky habitat preferred by this species. In areas shoreward of the GCA large footrope gear is prohibited, preventing trawlers from accessing rocky habitat in these depths. In areas deeper than the GCA, either small or large footrope gear may be used, although large footrope gear is the preferred type in these depths. In addition, cumulative trip limits, trawl IFQ allocations and accumulation limits, and total catch limits in the at-sea whiting fishery are structured to encourage vessels to fish in deeper water where canary rockfish (and many other overfished species) are not encountered.

Recreational fisheries are managed mainly through bag limits, size limits, and fishing seasons established for each west coast state. Currently, canary rockfish is a prohibited species in west coast recreational fisheries, meaning they are not allowed to be retained or landed. In addition, managers have the option of closing areas to recreational fishing if needed to prevent the canary rockfish ACL from being exceeded.

1.2.2.3 Cowcod

The rebuilding strategy for cowcod is a constant SPR harvest rate. Management measures used to limit the catch of cowcod, such that projected impacts to the stock attain rebuilding objectives, include depth-based closed areas where bycatch of overfished species is most likely to occur, based on information retrieved from logbooks, the at-sea observer program, surveys, and other sources. The boundaries vary by season and fishery sector, and may be modified in response to new information about the geographic and seasonal distribution of bycatch.

Because cowcod is a fairly sedentary species, establishment of two marine protected areas, considered two of the GCAs, is the key strategy for limiting cowcod fishing mortality. The Cowcod Conservation Areas (CCAs) in the Southern California Bight encompass two areas of greatest cowcod density as estimated in 2000, based on historical cowcod catch and catch rates in commercial and recreational fisheries. To aid in enforcement, the CCAs are bounded by straight lines enclosing simple polygons. Dick (2011) concluded that the CCAs have been effective in reducing bycatch to levels projected to allow stock rebuilding. Estimated fishery removals have been at levels sufficient to rebuild the stock, since the CCAs were implemented.

Given the particular life history characteristics of cowcod, the Council will continue to use species-specific area closures to protect cowcod. As new information becomes available on cowcod behavior and fisheries interactions with cowcod, the boundaries or related regulations concerning the current CCAs may change, and additional CCAs may be established by regulation.

1.2.2.4 Darkblotched

The rebuilding strategy for darkblotched is a constant SPR harvest rate. Management measures used to limit the catch of darkblotched such that projected impacts to the stock attain rebuilding objectives, include depth-based closed areas for the trawl fishery (darkblotched rockfish are predominantly caught by trawl gear) where bycatch of overfished species is most likely to occur, based on information retrieved from logbooks, the at-sea observer program, surveys, and other sources. The boundaries vary by season and fishery sector, and may be modified in response to new information about the geographic and

seasonal distribution of bycatch.

To limit darkblotched rockfish bycatch, the outer boundary of the trawl GCA was set to shift fishing activity into deeper water, away from the depth range of higher abundance for this species. Periodically since 2003, this outer boundary was modified during the winter months to allow targeting of petrale sole and other flatfish species in shallower depths while still minimizing bycatch. Trawl IFQ allocations and accumulation limits, as well as total catch limits in the at-sea whiting fishery, are structured to minimize the incidental bycatch of darkblotched in trawl fisheries.

1.2.2.5 Pacific Ocean Perch (POP)

The rebuilding strategy for POP is a constant SPR harvest rate. Management measures used to limit the catch of POP, such that projected impacts to the stock attain rebuilding objectives, include depth-based closed areas where bycatch of overfished species is most likely to occur, based on information retrieved from logbooks, the at-sea observer program, surveys, and other sources. The boundaries vary by season and fishery sector, and may be modified in response to new information about the geographic and seasonal distribution of bycatch.

Because POP tend to co-occur with darkblotched rockfish, management measures applicable to that species also serve to constrain catches of POP. These measures include configuring the outer boundary of the trawl GCA so that vessels fish in deeper water, where POP are less abundant. Trawl IFQ allocations and accumulation limits, as well as total catch limits in the at-sea whiting fishery, are structured to minimize the incidental bycatch of POP in trawl fisheries.

1.2.2.6 Petrale Sole

The rebuilding strategy for petrale sole is to apply a variable harvest strategy for 2012 and beyond, known as the 25-5 control rule (Figure 4-2). This strategy uses a progressively more conservative SPR harvest rate at lower biomass levels (for details on this strategy see Section 4.6.1 in the FMP).

Petrale sole is one of the primary target stocks in the non-whiting trawl fishery and is predominantly caught by that sector. No other sector currently targets petrale sole, although other sectors do incidentally catch petrale sole in relatively small amounts. For this reason, the Council chose to rebuild the petrale sole stock by constraining fishing opportunities for the non-whiting trawl sector, while holding all other sectors harmless.

Petrale sole make seasonal inshore-offshore migrations and are targeted in bottom trawl efforts on the shelf in the summer and in spawning aggregations in discrete areas on the shelf/slope break in the winter. One strategy for faster rebuilding of petrale sole is closing the petrale sole fishing areas where they aggregate and spawn in the winter. The 200 fm seaward boundary line is modified in discrete areas to open the petrale sole fishing areas during the winter months. The 2009 and 2011 petrale assessments and rebuilding analyses indicate larger, more mature fish are caught by the offshore winter fleet. Reducing these fishing opportunities has been shown to rebuild the stock relatively faster than allowing the mix of summer and winter petrale fishing that has occurred prior to 2010. The high productivity exhibited by the petrale sole stock (steepness (h) is estimated to be 0.86) projects rapid rebuilding of petrale sole regardless of whether a winter fishing opportunity is allowed or not. Petrale are mixed on the shelf in the summer months with other flatfish species, all of which are targeted as a mixed assemblage. It appears it may be easier for the trawl fleet fishing offshore in the winter to avoid petrale while targeting other species such as the DTS (Dover sole, thornyheads, and sablefish) assemblage, than it is for the summer fleet when targeting flatfish and other species.

1.2.2.7 Widow

The ACL alternative for 2011-2012 is a constant catch of 600 mt. This level of catch corresponds to an SPR harvest rate of 91.7% in 2011.

Management measures used to limit the catch of widow, such that projected impacts to the stock attain rebuilding objectives, include depth-based closed areas where bycatch of overfished species is most likely to occur, based on information retrieved from logbooks, the at-sea observer program, surveys, and other sources. The boundaries vary by season and fishery sector, and may be modified in response to new information about the geographic and seasonal distribution of bycatch.

Because widow rockfish occur in midwater and aggregate at night, elimination of target fishery opportunities has been a primary strategy for reducing widow rockfish exploitation. The Council has taken a policy approach of establishing management measures to reduce incidental catch in the Pacific whiting fishery sufficient to constrain total mortality below harvest levels (ACLs) needed to rebuild the stock. At the time of rebuilding plan adoption, catch in other fisheries has been sufficiently small so that rebuilding targets can be met without applying any special measures, beyond those needed to discourage targeting, to reduce widow rockfish fishing mortality in these fishery sectors. Trawl IFQ allocations and accumulation limits, as well as total catch limits in the at-sea whiting fishery, are structured to minimize the incidental bycatch of widow rockfish in trawl fisheries.

Widow rockfish catches in recreational fisheries are relatively modest. Catches in this sector are managed mainly through bag limits, size limits, and fishing seasons established for each west coast state. No recreational bag and size limits have been established for widow rockfish. However, general bag limits for rockfish and depth restrictions designed to reduce impacts on other overfished species has constrained widow recreational catches.

1.2.2.8 Yelloweye

The rebuilding strategy for yelloweye is a constant SPR harvest rate. Management measures used to limit the catch of yelloweye, such that projected impacts to the stock attain rebuilding objectives, include depth-based closed areas where bycatch of overfished species is most likely to occur, based on information retrieved from logbooks, the at-sea observer program, surveys, and other sources. The boundaries vary by season and fishery sector, and may be modified in response to new information about the geographic and seasonal distribution of bycatch.

Yelloweye impacts in commercial fisheries are managed by implementation of gear- and sector-specific GCAs. Also, trawl IFQ allocations and accumulation limits are structured to minimize the incidental bycatch of yelloweye rockfish in the groundfish bottom trawl fishery.

In addition to the more general measures described above, which are intended to reduce bycatch of all overfished species, several Yelloweye Rockfish Conservation Areas (YRCAs) are in place that prevent recreational groundfish and halibut anglers from targeting this species in areas where they are concentrated. Recreational bag and size limits are also used to manage total yelloweye rockfish fishing mortality.

Given the particular life history characteristics of yelloweye rockfish, the Council will continue to use a species-specific area closure or closures to protect yelloweye rockfish. As new information becomes available on yelloweye rockfish behavior and fisheries interactions with yelloweye rockfish, the

boundaries or related regulations concerning the current YRCAs may change, and additional YRCAs may be established by regulation.

1.3 Rebuilding Plan History and Background

This section contains previous rebuilding plan parameters as well as more detailed information on the history of each rebuilding plan since implementation.

1.3.1 Previous Rebuilding Plan Parameters

Table F-2. Specified rebuilding plan parameters at the time of plan adoption under Amendments 16-2 and 16-3.

Species	Year Stock Declared Overfished	Year Rebuilding Plan Adopted	B_0	B_{MSY}	T_{MIN}	T_{MAX}	P_{MAX}	T_{TARGET}	Harvest Control Rule
Bocaccio a/	1999	2004	13,387 B eggs in 2003	5,355 B eggs	2018	2032	70%	2023	F=0.0498
Canary	2000	2003	31,550 mt	12,620 mt	2057	2076	60%	2074	F=0.022
Cowcod	2000	2004	3,367 mt	1,350 mt	2062	2099	60%	2090	F=0.009
Darkblotched	2000	2003	29,044 mt	11,618 mt	2014	2047	80%	2030	F=0.027
Lingcod	1999	2003	28,882 mt N; 20,971 mt S	9,153 mt N; 8,389 mt S	2007	2009	60%	2009	F=0.0531 N; F=0.061 S
POP	1999	2003	60,212 units of spawning output	24,084 units of spawning output	2012	2042	70%	2027	F=0.0082
Widow b/	2001	2004	43,580 M eggs	17,432 M eggs	2026	2042	60%	2038	F=0.0093
Yelloweye	2002	2004	3,875 mt	1,550 mt	2027	2071	80%	2058	F=0.0153

a/ Based on the STATc base model in MacCall (MacCall 2003b).
b/ Based on the Model 8 base model in He, *et al.* (He, *et al.* 2003b).

Table F-3. Specified rebuilding plan parameters revised under Amendment 16-4.

Species	B_0	B_{MSY}	T_{MIN} a/	T_{MAX}	$T_{F=0}$ a/	P_{MAX}	T_{TARGET}	Harvest Control Rule (SPR Harvest Rate)
Bocaccio	13,402 B eggs in 2005	5,361 B eggs	2018	2032	2021	77.7%	2026	77.7%
Canary	34,155 mt	13,662 mt	2048	2071	2053	55.4%	2063	88.7%
Cowcod	3,045 mt	1,218 mt	2035	2074	2035	90.6%	2039	90.0%
Darkblotched	26,650 M eggs	10,660 M eggs	2009	2033	2010	100%	2011	60.7%
POP	37,838 units of spawning output	15,135 units of spawning output	2015	2043	2015	92.9%	2017	86.4%
Widow	49,678 M eggs	19,871 M eggs	2013	2033	2013	95.2%	2015	95.0%
Yelloweye	3,322 mt	1,328 mt	2046	2096	2048	80%	2084	71.9% b/

a/ T_{MIN} is the shortest time to rebuild from the onset of the rebuilding plan or from the first year of a rebuilding plan, which is usually the year after the stock was declared overfished. The shortest possible time to rebuild the stocks with rebuilding plans under consideration in Amendment 16-4 is $T_{F=0}$, which is the median time to rebuild the stock if all fishing-related mortality were eliminated beginning in 2007.

b/ The yelloweye rebuilding plan specifies a harvest rate ramp-down strategy before resuming a constant harvest rate in 2011. F71.9% is the constant harvest rate beginning in 2011.

1.3.2 Rebuilding Plan Background

1.3.2.1 Bocaccio Rockfish South of 40°10' N. Latitude

Status of the Bocaccio Stock and Fisheries Affected by Stock Rebuilding Measures at the Time of Rebuilding Plan Adoption (April 2004)

Assessment scientists and managers have treated west coast bocaccio as independent stocks north and south of Cape Mendocino. The southern stock, which has been declared overfished, occurs south of Cape Mendocino and the northern stock north of 48 □ N. latitude in
The overfished southern bocaccio rockfish stock occurs in Central and Southern California waters, on the continental shelf and in nearshore areas, often in rocky habitat. They are caught in both commercial and recreational fisheries in approximately equal amounts. Commercial catches mainly occur in LE trawl fisheries.

Bocaccio have long been an important component of California rockfish fisheries. Catches increased to high levels in the 1970s and early 1980s as relatively strong year-classes recruited to the stock. The Council began to recommend increasingly restrictive regulations after an assessment of the southern stock

in 1990 (Bence and Hightower 1990) indicated that fishing rates were too high. The southern stock has been assessed six times (Bence and Hightower 1990; Bence and Rogers 1992; MacCall, *et al.* 1999; MacCall 2002; MacCall 2003b; Ralston, *et al.* 1996) and has suffered poor recruitment during the warm water conditions that have prevailed off Southern California since the late 1980s. The 1996 assessment (Ralston, *et al.* 1996) indicated the stock was in severe decline. NMFS formally declared the stock overfished in March 1999 after the groundfish FMP was amended to incorporate the tenets of the Sustainable Fisheries Act. MacCall et al. (MacCall, *et al.* 1999) confirmed the overfished status of bocaccio and estimated spawning output of the southern stock to be 2.1 percent of its unfished biomass and 5.1 percent of the MSY level. The northern stock of bocaccio has not been assessed.

While previous assessments only used data from Central and Northern California, an assessment in 2002 (MacCall and He 2002) also included data for southern California. While relative abundance increased slightly from the last assessment (4.8 percent of unfished biomass), potential productivity appears lower than previously thought, making for a more pessimistic outlook. The Council assumed a medium recruitment scenario for the 1999 year class, which was not assessed (MacCall, *et al.* 1999). The 2002 assessment revealed the 1999 year class experienced relatively lower recruitment. Therefore, although the 1999 year class contributed a substantial quantity of fish to the population, it did not contribute as much to rebuilding as was previously thought.

The 2003 bocaccio assessment differs greatly from the 2002 assessment. It is driven by the strength of the incoming 1999 year class that had not recruited into the indices used for the 2002 assessment and by a revised lower estimate of natural mortality (MacCall 2003b). In addition to the 2001 Triennial Survey data, the 2003 assessment used larval abundance data from recent CalCOFI surveys as well as length and catch per unit effort (CPUE) data from recreational fisheries. In calculating the recreational CPUE information, a new method was used that identifies relevant fishing trips by species composition and adjusts the catch history for regulatory changes that affect the level of discard and avoidance. The results of these calculations suggest that recreational CPUE has increased dramatically in recent years and is at a record high level in Central California north of Pt. Conception. The Stock Assessment Review (STAR) Panel recommended the use of two assessment models as a means of bracketing uncertainty from the very different signals between the Triennial Survey and the recreational CPUE data. Following the STAR Panel meeting, MacCall presented a third "hybrid" model that incorporated the data from all of the indices. The SSC recommended, and the Council approved, the use of this third modeling approach. This resulted in modest improvement in estimated stock size, but significantly affected the estimated productivity of the stock. These results had substantial effects on the rebuilding outlook for bocaccio which, under the 2002 assessment, was not expected to rebuild within T_{MAX} even with no fishing-related mortality. Total mortality in 2003 fisheries was restricted to less than 20 mt as a means of conserving the stock while minimizing adverse socioeconomic impacts to communities. The current rebuilding analysis (MacCall 2003a), using the "hybrid" model, suggests the stock could rebuild to B_{MSY} within 25 years while sustaining an OY of approximately 300 mt in 2004.

The Council adopted a rebuilding plan for bocaccio rockfish at its April 2004 meeting, as described by the parameter values listed in Table F-2. These values are based on a rebuilding analysis conducted by MacCall (2003b).

Amendment 16-4, adopted by the Council at its June 2006 meeting, revised the rebuilding parameters for bocaccio, as listed in Table F-3. These values are based on a rebuilding analysis conducted by MacCall (2006) which had determined that the bocaccio stock was at 10.7 percent of its unfished level in 2005.

Fisheries in central and southern California are affected by the bocaccio rebuilding plan because the overfished population occurs in these waters. Recreational and LE trawl fisheries in this region have accounted for the bulk of landings in recent years.

Methods Used to Calculate Stock Rebuilding Parameters

The methods used in the rebuilding analysis (MacCall 2003a) upon which the original rebuilding plan was based, and those used for the rebuilding plan revision under Amendment 16-4 (MacCall 2006) do not differ substantially from the approach described in Section 4.6.2.

Rebuilding Parameter Values at the Time of Rebuilding Plan Adoption

Table F-2 lists the numerical values for B_0, B_{MSY}, T_{MIN}, T_{MAX}, P_{MAX}, T_{TARGET} and F. The values of B_0, B_{MSY}, T_{MIN}, and T_{MAX} are derived from the rebuilding analysis used in formulating the rebuilding plan (MacCall 2003a). Using the STAT base model from the most recent stock assessment (MacCall 2003b), the Council chose a value of 70 percent for P_{MAX}, based on a harvest control rule of F = 0.0498. This results in a target year of 2023.

Rebuilding Parameter Values from the Amendment 16-4 Rebuilding Plan Update

Table F-3 lists the numerical values for B_0, B_{MSY}, T_{MIN}, T_{MAX}, $T_{F=0}$, P_{MAX}, T_{TARGET} and an SPR harvest rate. The values of B_0, B_{MSY}, T_{MIN}, $T_{F=0}$, and T_{MAX} are derived from the rebuilding analysis used in formulating the rebuilding plan (MacCall 2006). The Council chose a target rebuilding year of 2026.

Bocaccio Fishing Communities

Amendment 16-4 revised the Council's approach to rebuilding plans, requiring an analysis of the needs of fishing communities in relation to overfished species rebuilding times, in addition to the traditional analysis of rebuilding times in relation to the status and biology of the stock. For Amendment 16-4 and the 2007-2008 fisheries, fishing community needs are described and analyzed in an Environmental Impact Statement (EIS) (PFMC 2006). Chapter 7 of that EIS discusses the communities that make up the socio-economic environment of the Pacific Coast groundfish fisheries. In general, bocaccio is a continental shelf species that is most frequently taken south of 40°10' N. latitude in all of the groundfish fisheries, commercial and recreational. All groundfish fishing communities off the southern U.S. west coast are affected by bocaccio rebuilding measures.

Bocaccio Rockfish Rebuilding Strategy

As shown in Table F-2, at the inception of the rebuilding plan the harvest control rule for bocaccio rockfish was a fishing mortality rate of 0.0498. Based on the 2003 rebuilding analysis, this harvest rate is likely to rebuild the stock by the target year of 2023. This value is likely to change over time as stock size and structure changes. Any updated value will be published in Federal groundfish regulations. The fishing mortality rate is applied to the exploitable biomass estimate to determine the OY for a given fishing period.

Management measures are implemented through the biennial harvest specification and management process described in Chapter 5. The types of management measures that may be implemented through this process are described in Chapter 6. In 2004, at the time of rebuilding plan adoption, measures intended to limit bycatch of overfished species included prohibiting retention of certain overfished species during some parts of the year, reducing landing limits (cumulative trip limits) on co-occurring species, establishing extensive time/area closures, and restricting the use of trawl nets equipped with large footropes. (By using large footropes with heavy roller gear, bottom trawlers can access rocky habitat on the continental shelf. This is the preferred habitat for some overfished species.)

Beginning in 2002, time/area closures known as Groundfish Conservation Areas (GCAs) came into use as a way of decreasing bycatch of overfished species. GCAs enclose depth ranges where bycatch of overfished species is most likely to occur, based on information retrieved from logbooks and the at-sea observer program. The boundaries vary by season and fishery sector, and may be modified in response to new information about the geographic and seasonal distribution of bycatch.

As noted, a large proportion of bocaccio catch occurs in recreational fisheries in Central and Southern California. Recreational depth closures, restricting fishing to shallow waters, bag limits, and seasonal closures have been used to reduce recreational bocaccio catches.

The Council's rebuilding measures for 2007-2008, adopted at the same time as the Council's adoption of Amendment 16-4, continue the Council's strategy of constraining bocaccio total mortality by restricting fishing on co-occurring healthy stocks, particularly chilipepper rockfish, and preventing fishing in areas where bocaccio may be taken incidentally.

1.3.2.2 Canary Rockfish

Status of the Canary Rockfish Stock and Fisheries Affected by Stock Rebuilding Measures at the Time of the Council's Rebuilding Plan Adoption (June 2003)

Canary rockfish exploitation began in the early 1940s when World War II increased demand for protein (Alverson, *et al.* 1964; Browning 1980). Through this decade the trawl fishery expanded in Oregon and Washington, accounting for most of the canary rockfish catch; in California, longlines were mainly used to target rockfish during this period. Other gear historically used to catch canary rockfish include hook-and-line (primarily vertical longline), shrimp trawls, and pots and traps. From 1966 until 1976, foreign trawlers were responsible for most of the harvest. After passage of the Magnuson Act in 1977 domestic vessels became the dominant harvesters of this species. In recent years, canary rockfish have become an important recreational target north of Cape Mendocino.

Overfishing, or exceeding the MFMT, was detected by a 1994 stock assessments and subsequent update (Sampson 1996; Sampson and Stewart 1994). In both cases the harvest rate exceeded the $F_{20\%}$ threshold. In 1999, two age-based stock assessments showed that the stock was overfished in a northern area comprising the Columbia and U.S.-Vancouver management zones (Crone, *et al.* 1999) and in a southern area comprising Conception, Monterey, and Eureka management zones (Williams, *et al.* 1999). Based on these assessments, the stock was declared overfished in January 2000.

The first rebuilding analysis (Methot 2000a) used results from the northern area assessment to project rates of potential stock recovery. The stock was found to have extremely low productivity, defined as production of recruits in excess of the level necessary to maintain the stock at its current low level. According to the analysis, rates of recovery are highly dependent on the level of recent recruitment, which could not be estimated with high certainty.

A subsequent assessment (Methot and Piner 2002c) treated the stock as a single coastwide unit (covering the area from the Monterey zone through the U.S. Vancouver zone). This differed from past assessments, where northern and southern areas were treated separately. The lack of older, mature females in surveys and other assessment indices was another consideration in this assessment. Older females may simply have a higher natural mortality rate, or survey and fishing gear may be less effective at catching them. If these fish are in fact un-sampled, productivity estimates should be higher because older, larger fish are more fecund. Methot and Piner (Methot and Piner 2002c) combined these two hypotheses in a single age-structured version of the SSC-endorsed stock synthesis assessment model (Methot 2000b). They estimated the 2002 abundance of canary rockfish coastwide was about 8 percent of B_0.

The canary rockfish rebuilding plan was adopted by the Council at its June 2003 meeting and is based on a 2002 rebuilding analysis (Methot and Piner 2002a). The 2002 rebuilding analysis updated the first rebuilding analysis for canary rockfish, completed in 2000, using information from the aforementioned stock assessment. The Council's rebuilding strategy, when combined with the results of this rebuilding analysis, required a substantial reduction in the OY for 2003. As a result, fisheries must be managed for canary rockfish bycatch, often limiting the amount of target species that may be harvested.

Amendment 16-4, adopted by the Council at its June 2006 meeting, revised the rebuilding parameters for canary rockfish, as listed in Table F-3. These values are based on a rebuilding analysis conducted by Methot (2006) which had determined that the canary rockfish stock was at 9.4 percent of its unfished level in 2005.

Canary rockfish are encountered in a relatively wide variety of both commercial and recreational fisheries. However, LE trawlers targeting flatfish and arrowtooth flounder account for a large proportion of the landed catch, mainly north of Cape Mendocino. Much smaller amounts are caught in the whiting and DTS LE trawl fisheries, and by fixed gear vessels targeting groundfish on the continental shelf. Charter vessels account for most of recreationally-caught canary rockfish, mainly off of Northern California and Oregon.

Methods Used to Calculate Stock Rebuilding Parameters

The methods used in the rebuilding analysis (Methot and Piner 2002a) upon which the original rebuilding plan was based, and those used for the rebuilding plan revision under Amendment 16-4 (Methot and Stewart 2006), do not differ substantially from the approach described in Section 4.6.2.

Rebuilding Parameter Values at the Time of Rebuilding Plan Adoption

Table F-2 lists the numerical values for B_0, B_{MSY}, T_{MIN}, T_{MAX}, P_{MAX}, T_{TARGET} and F. The values of B_0, B_{MSY}, T_{MIN}, and T_{MAX} are derived from the rebuilding analysis used in formulating the rebuilding plan (Methot and Piner 2002a). The Council chose a value of 60 percent for P_{MAX}, based on a harvest control rule of F = 0.022. This results in a target year of 2074.

Rebuilding Parameter Values from the Amendment 16-4 Rebuilding Plan Update

Table F-3 lists the numerical values for B_0, B_{MSY}, T_{MIN}, T_{MAX}, $T_{F=0}$, P_{MAX}, T_{TARGET} and an SPR harvest rate. The values of B_0, B_{MSY}, T_{MIN}, $T_{F=0}$, and T_{MAX} are derived from the rebuilding analysis used in formulating the rebuilding plan (Methot and Stewart 2006). The Council chose a target rebuilding year of 2063.

Canary Rockfish Fishing Communities

Amendment 16-4 revised the Council's approach to rebuilding plans, requiring an analysis of the needs of fishing communities in relation to overfished species rebuilding times, in addition to the traditional analysis of rebuilding times in relation to the status and biology of the stock. For Amendment 16-4 and the 2007-2008 fisheries, fishing community needs are described and analyzed in an EIS (PFMC 2006). Chapter 7 of that EIS discusses the communities that make up the socio-economic environment of the Pacific Coast groundfish fisheries. In general, canary rockfish is a continental shelf species that is taken coastwide in all of the groundfish fisheries, commercial and recreational, as well as in many commercial and recreational fisheries targeting species other than groundfish. All groundfish fishing communities and many non-groundfish fishing communities off the U.S. west coast are affected by canary rockfish

rebuilding measures.

Canary Rockfish Rebuilding Strategy

As shown in Table F-2, at the inception of the rebuilding plan the harvest control rule for canary rockfish was a fishing mortality rate of 0.022. Based on the 2002 canary rockfish rebuilding analysis (Methot and Piner 2002a), this harvest rate is likely to rebuild the stock by the target year of 2074. This value is likely to change over time as stock size and structure changes. Any updated value will be published in Federal groundfish regulations. The fishing mortality rate is applied to the exploitable biomass estimate to determine the OY for a given fishing period.

Management measures are implemented through the biennial harvest specification and management process described in Chapter 5. The types of management measures that may be implemented through this process are described in Chapter 6. In 2003, at the time of rebuilding plan adoption, measures intended to limit bycatch of overfished species included prohibiting retention of certain overfished species during some parts of the year, reducing landing limits (cumulative trip limits) on co-occurring species, establishing extensive time/area closures, and restricting the use of trawl nets equipped with large footropes. (By using large footropes with heavy roller gear, bottom trawlers can access rocky habitat on the continental shelf. This is the preferred habitat for some overfished species.)

Beginning in 2002 time/area closures, referred to as GCAs, came into use as a way of decreasing bycatch of overfished species. GCAs enclose depth ranges where bycatch of overfished species is most likely to occur, based on information retrieved from log books and the at-sea observer program. The boundaries vary by season and fishery sector, and may be modified in response to new information about the geographic and seasonal distribution of bycatch.

Canary rockfish prefer rocky areas on the continental shelf, so management measures in use at the time of rebuilding plan adoption were intended to discourage fishing in these areas. Under the regulations in place during 2003, bottom trawling is prohibited in the GCA, which encompasses depth ranges where canary rockfish are most frequently caught. In addition, the aforementioned restrictions on the use of trawl nets equipped with large footropes discourage fishing in the rocky habitat preferred by this species. In areas shoreward of the GCA, large footrope gear is prohibited, preventing trawlers from assessing rocky habitat in these shallower depths. In areas deeper than the GCA, either small or large footrope gear may be used, although large footrope gear is the preferred type in these depths. In addition, cumulative trip limits are structured to encourage vessels to fish exclusively in deep water where canary rockfish (as well as some other overfished species) are not encountered. Vessels are allowed to use all gear configurations during any given cumulative limit period (currently two months). However, vessels which use the small footrope configuration are restricted to lower cumulative trip limits than vessels using large footrope configurations. Since the large footrope configuration may only be used offshore of the GCA, these measures encourage fishing exclusively in deeper water to take advantage of the higher limits afforded this gear type.

Recreational fisheries are managed mainly through bag limits, size limits, and fishing seasons established for each west coast state. Bag and size limits have been established for canary rockfish. In addition, managers have the option of closing areas to recreational fishing if needed to prevent the canary rockfish OY from being exceeded.

The Council's rebuilding measures for 2007-2008, adopted at the same time as the Council's adoption of Amendment 16-4, continue the Council's strategy of constraining canary rockfish total mortality by restricting fishing on co-occurring healthy stocks and preventing fishing in areas where canary rockfish may be taken incidentally. Additionally, the Council has adopted a requirement that trawl vessels

operating north of 40°10' N. latitude use selective flatfish trawl gear when operating in nearshore waters, a gear that minimizes rockfish bycatch during flatfish trawl fishing. The Council has also adopted canary rockfish bycatch limits for the Pacific whiting fishery, which has some canary rockfish incidental catch.

1.3.2.3 Cowcod

Status of the Cowcod and Fisheries Affected by Stock Rebuilding Measures at the Time of Rebuilding Plan Adoption (April 2004)

Relatively little is known about cowcod, a species of large rockfish that ranges from Ranger Bank and Guadalupe Island in central Baja California to Usal, Mendocino County, California (Miller and Lea 1972), and may infrequently occur as far north as Newport, Oregon. Cowcod have been assessed only once (Butler, *et al.* 1999). Adult cowcod are primarily found over high relief rocky areas (Allen 1982). They are generally solitary, but occasionally aggregate (Love, *et al.* 1990).

While cowcod are not a major component of the groundfish fishery, they are highly desired by both recreational and commercial fishers because of their bright color and large size. In recent years small amounts have been caught by LE trawl vessels and recreational anglers in Southern California. The cowcod stock south of Cape Mendocino has experienced a long-term decline. The cowcod stock in the Conception area was assessed in 1998 (Butler, *et al.* 1999). Abundance indices decreased approximately tenfold between the 1960s and the 1990s, based on commercial passenger fishing vessel logs (Butler, *et al.* 1999). Recreational and commercial catch also declined substantially from peaks in the 1970s and 1980s, respectively.

B_0 was estimated to be 3,370 mt, and 1998 spawning biomass was estimated at 7 percent of B_0, well below the 25 percent overfishing threshold. As a result, NMFS declared cowcod in the Conception and Monterey management areas overfished in January 2000. Large areas off Southern California (the Cowcod Conservation Areas [CCAs]) have been closed to fishing for cowcod. The stock's low productivity and declined spawning biomass also necessitates an extended rebuilding period, estimated at 62 years with no fishing-related mortality (T_{MIN}), to achieve a 1,350 mt B_{MSY} for the Conception management area.

There is relatively little information about the cowcod stock, and there are major uncertainties in the one assessment that has been conducted. The assessment authors needed to make estimates of early landings based on more recent data and reported total landings of rockfish. Age and size composition of catches are poorly sampled, population structure is unknown, and the assessment was restricted to Southern California waters.

A cowcod rebuilding review was completed in 2003, which validated the assumption that non-retention regulations and area closures have been effective in constraining cowcod fishing mortality (Butler, *et al.* 2003). These results, although encouraging, are based on cowcod fishery-related removals from catch per fishing vessel observations and angler-reported discards. Non-retention regulations and limited observation data have increased the need for fishery independent population indices.

The Council adopted a rebuilding plan for cowcod at its April 2004 meeting, as described by the parameter values listed in Table F-2. These values are based on a rebuilding analysis conducted by Butler and Barnes (Butler and Barnes 2000).

Amendment 16-4, adopted by the Council at its June 2006 meeting, revised the rebuilding parameters for cowcod, as listed in Table F-3. These values are based on a rebuilding analysis conducted by Piner (2006) which had determined that the cowcod stock was between 14 percent and 21 percent of its

unfished level in 2005.

Methods Used to Calculate Stock Rebuilding Parameters

The Cowcod rebuilding analysis (Butler and Barnes 2000) was completed before the SSC default rebuilding analysis methodology (Punt 2002), described in Section 4.6.2, had been developed. Instead, it uses a surplus production model using a log-normal distribution fitted to recruitment during 1951-1998. At the time of rebuilding plan adoption (2004) a new cowcod stock assessment and rebuilding analysis had not been completed. In April 2004 the SSC recommended that future cowcod stock assessments use a model whose output can be used in the default rebuilding analysis methodology.

The methods in the rebuilding analysis (Piner 2006) used to develop the revised cowcod rebuilding plan under Amendment 16-4 do not differ substantially from the approach described in Section 4.6.2.

Rebuilding Parameter Values at the Time of Rebuilding Plan Adoption

Table F-2 lists the numerical values for B_0, B_{MSY}, T_{MIN}, T_{MAX}, P_{MAX}, T_{TARGET} and F. The values of B_0, B_{MSY}, T_{MIN}, and T_{MAX} are derived from the rebuilding analysis (Butler and Barnes 2000) used in formulating the rebuilding plan. The Council chose a value of 60 percent for P_{MAX}, based on a harvest control rule of F = 0.009. This results in a target year of 2090.

Rebuilding Parameter Values from the Amendment 16-4 Rebuilding Plan Update

Table F-3 lists the numerical values for B_0, B_{MSY}, T_{MIN}, T_{MAX}, $T_{F=0}$, P_{MAX}, T_{TARGET} and an SPR harvest rate. The values of B_0, B_{MSY}, T_{MIN}, $T_{F=0}$, and T_{MAX} are derived from the rebuilding analysis used in formulating the rebuilding plan (Piner 2006). The Council chose a target rebuilding year of 2039.

Cowcod Fishing Communities

Amendment 16-4 revised the Council's approach to rebuilding plans, requiring an analysis of the needs of fishing communities in relation to overfished species rebuilding times, in addition to the traditional analysis of rebuilding times in relation to the status and biology of the stock. For Amendment 16-4 and the 2007-2008 fisheries, fishing community needs are described and analyzed in an EIS (PFMC 2006). Chapter 7 of that EIS discusses the communities that make up the socio-economic environment of the Pacific Coast groundfish fisheries. In general, cowcod is a sedentary and site-loyal continental shelf species that is most frequently taken off southern California in commercial non-trawl and recreational fisheries. All groundfish fishing communities off the southern U.S. west coast are affected by cowcod rebuilding measures.

Cowcod Rebuilding Strategy

As shown in Table F-2, at the inception of the rebuilding plan the harvest control rule for cowcod was a fishing mortality rate of 0.009. Based on the 2000 cowcod rebuilding analysis (Butler and Barnes 2000), this harvest rate is likely to rebuild the stock by the target year of 2090. This value is likely to change over time as stock size and structure changes. Any updated value will be published in Federal groundfish regulations. The fishing mortality rate is applied to the exploitable biomass estimate to determine the OY for a given fishing period.

Management measures are implemented through the biennial harvest specification and management process described in Chapter 5. The types of management measures that may be implemented through this process are described in Chapter 6. In 2004, at the time of rebuilding plan adoption, measures

intended to limit bycatch of overfished species included prohibiting retention of certain overfished species during some parts of the year, reducing landing limits (cumulative trip limits) on co-occurring species, establishing extensive time/area closures, and restricting the use of trawl nets equipped with large footropes. (By using large footropes with heavy roller gear, bottom trawlers can access rocky habitat on the continental shelf. This is the preferred habitat for some overfished species.)

Beginning in 2002, time/area closures known as GCAs came into use as a way of decreasing bycatch of overfished species. GCAs enclose depth ranges where bycatch of overfished species is most likely to occur, based on information retrieved from logbooks and the at-sea observer program. The boundaries vary by season and fishery sector, and may be modified in response to new information about the geographic and seasonal distribution of bycatch.

Because cowcod is a fairly sedentary species, establishment of a marine protected area, considered one of the GCAs, is the key strategy for limiting cowcod fishing mortality. The CCAs in the Southern California Bight encompass two areas of greatest cowcod density, as estimated in 2000, based on historical cowcod catch and catch rates in commercial and recreational fisheries. To aid in enforcement, the CCAs are bounded by straight lines enclosing simple polygons. Butler, et al. (Butler, *et al.* 2003) concluded that the CCAs have been effective in reducing bycatch to levels projected to allow stock rebuilding. Estimated fishery removals have been at levels sufficient to rebuild the stock, since the CCAs were implemented, except in 2001 when 5.6 mt was caught in the Conception management area. Most of this catch occurred in the spot prawn trawl fishery, which subsequently has been phased out.

Given the particular life history characteristics of cowcod, the Council will continue to use species-specific area closures to protect cowcod. As new information becomes available on cowcod behavior and fisheries interactions with cowcod, the boundaries or related regulations concerning the current CCAs may change, and additional CCAs may be established by regulation.

The Council's rebuilding measures for 2007-2008, adopted at the same time as the Council's adoption of Amendment 16-4, continue the Council's strategy of constraining cowcod total mortality by restricting or eliminating fishing in areas where cowcod commonly occur and may be taken incidentally.

1.3.2.4 Darkblotched Rockfish

Status of the Darkblotched Stock and Fisheries Affected by Stock Rebuilding Measures at the Time of the Council's Rebuilding Plan Adoption (June 2003)

Historically, darkblotched rockfish were managed as part of a coastwide Sebastes complex, which was later segregated into north and south management units divided at 40º30' N. latitude. As a result, fishery-dependent data from this period are generally unavailable. The first darkblotched rockfish stock assessment estimated the proxy MSY harvest rate and overfishing rate for the stock (Lenarz 1993).

Rogers et al. (Rogers, *et al.* 2000) assessed darkblotched stock status in 2000 and determined the stock was at 14 percent to 31 percent of its unfished level. This range in biomass estimates encompasses the MSST threshold of 25 percent; uncertainty in past catches by foreign vessels, which targeted Pacific ocean perch and also caught darkblotched rockfish, was the most important contributor to this wide range for the biomass estimate. A larger unfished biomass (B_0) is computed using larger historic catch estimates. Since the MSST is expressed as a percent of unfished biomass, a larger B_0 increases the absolute value of this threshold, making an overfished determination more likely. Without definitive information on foreign catches, managers assumed darkblotched comprised 10 percent of this catch, leading to the conclusion that the spawning stock biomass was 22 percent of its unfished level. Because this is below the MSST, the stock was declared overfished in 2000.

The Council adopted a rebuilding plan for darkblotched rockfish at its June 2003 meeting, as described by the parameter values listed in Table F-2. These values are based on a rebuilding analysis conducted by Methot and Rogers (Methot and Rogers 2001).

Darkblotched rockfish occur on the outer continental shelf and continental slope, mainly north of Point Reyes. Because of this distribution, they are caught exclusively by commercial vessels. Most landings have been made by bottom trawl vessels targeting flatfish on the continental shelf, rockfish on the continental slope, and the Dover sole-thornyhead-sablefish complex, also on the slope.

Methods Used to Calculate Stock Rebuilding Parameters

The methods used in the rebuilding analysis (2001) upon which the original rebuilding plan was based, and those used for the rebuilding plan revision under Amendment 16-4 (2006), do not differ substantially from the approach described in Section 4.6.2.

Rebuilding Parameter Values at the Time of Rebuilding Plan Adoption

Table F-2 lists the numerical values for B_0, B_{MSY}, T_{MIN}, T_{MAX}, P_{MAX}, T_{TARGET} and F. The values of B_0, B_{MSY}, T_{MIN}, and T_{MAX} are derived from the rebuilding analysis used in formulating the rebuilding plan (Methot and Rogers 2001). The Council chose a value of 80 percent for P_{MAX}, based on a harvest control rule of F = 0.027. This results in a target year of 2030.

Rebuilding Parameter Values from the Amendment 16-4 Rebuilding Plan Update

Table F-3 lists the numerical values for B_0, B_{MSY}, T_{MIN}, T_{MAX}, $T_{F=0}$, P_{MAX}, T_{TARGET} and an SPR harvest rate. The values of B_0, B_{MSY}, T_{MIN}, $T_{F=0}$, and T_{MAX} are derived from the rebuilding analysis used in formulating the rebuilding plan (Rogers 2006). The Council chose a target rebuilding year of 2011.

Darkblotched Rockfish Fishing Communities

Amendment 16-4 revised the Council's approach to rebuilding plans, requiring an analysis of the needs of fishing communities in relation to overfished species rebuilding times, in addition to the traditional analysis of rebuilding times in relation to the status and biology of the stock. For Amendment 16-4 and the 2007-2008 fisheries, fishing community needs are described and analyzed in an EIS (PFMC 2006). Chapter 7 of that EIS discusses the communities that make up the socio-economic environment of the Pacific Coast groundfish fisheries. In general, darkblotched rockfish is a continental slope species that is most frequently taken in the commercial trawl fisheries north of 38° N. latitude. Fishing communities that participate in the slope trawl fisheries of the northern U.S. west coast are most strongly affected by darkblotched rebuilding measures.

Darkblotched Rockfish Rebuilding Strategy

As shown in Table F-2, at the inception of the rebuilding plan the harvest control rule for darkblotched rockfish was a fishing mortality rate of 0.027. Based on the 2001 rebuilding analysis, this harvest rate is likely to rebuild the stock by the target year of 2030. This value is likely to change over time as stock size and structure changes. Any updated value will be published in Federal groundfish regulations. The fishing mortality rate is applied to the exploitable biomass estimate to determine the OY for a given fishing period.

Management measures are implemented through the biennial harvest specification and management

process described in Chapter 5. The types of management measures that may be implemented through this process are described in Chapter 6. In 2003, at the time of rebuilding plan adoption, measures intended to limit bycatch of overfished species included prohibiting retention of certain overfished species during some parts of the year, reducing landing limits (cumulative trip limits) on co-occurring species, establishing extensive time/area closures, and restricting the use of trawl nets equipped with large footropes. (By using large footropes with heavy roller gear, bottom trawlers can access rocky habitat on the continental shelf. This is the preferred habitat for some overfished species.)

Beginning in 2002, time/area closures, referred to as GCAs, came into use as a way of decreasing bycatch of overfished species. GCAs enclose depth ranges where bycatch of overfished species is most likely to occur, based on information retrieved from log books and the at-sea observer program. The boundaries vary by season and fishery sector, and may be modified in response to new information about the geographic and seasonal distribution of bycatch.

To limit darkblotched rockfish bycatch, an outer boundary of the GCA was set to move fishing activity into deeper water, away from the depth range of higher abundance for this species. In 2003 this outer boundary was modified during the winter months to allow targeting of petrale sole and other flatfish in shallower depths while still minimizing bycatch. The cumulative trip limits for minor slope rockfish north of Cape Mendocino, the species complex that darkblotched rockfish are managed under, and for splitnose rockfish, a co-occurring target species, were also lowered. Trip limits for other target species also may be adjusted to reduce darkblotched rockfish bycatch.

The Council's rebuilding measures for 2007-2008, adopted at the same time as the Council's adoption of Amendment 16-4, continue the Council's strategy of constraining darkblotched rockfish total mortality by restricting fishing on co-occurring healthy stocks and preventing fishing in areas where darkblotched rockfish may be taken incidentally. Additionally, the Council has adopted darkblotched rockfish bycatch limits for the Pacific whiting fishery, which has some darkblotched rockfish incidental catch.

1.3.2.5 Pacific Ocean Perch

Status of the Pacific Ocean Perch Stock and Fisheries Affected by Stock Rebuilding Measures at the Time of the Council's Rebuilding Plan Adoption (June 2003)

Pacific ocean perch (POP) were targeted by Soviet and Japanese factory trawlers between 1965 and 1975. Their large catches during this period substantially contributed to a decline in the west coast stock. In 1981, just before this FMP was implemented, the Council declared the POP stock depleted and recommended conservative harvest policies. Although management measures discouraged targeting POP while allowing continued fishing of other species, the stock did not recover, and the Council recommended still more restrictive measures. A 1998 stock assessment (Ianelli and Zimmerman 1998) estimated POP biomass was 13 percent of the unfished level, leading NMFS to declare the stock overfished in 1999.

The Council adopted a rebuilding plan for POP at its June 2003 meeting, as described by the parameter values listed in Table F-2. These values are based on a 2000 stock assessment (Ianelli, *et al.* 2000) and subsequent rebuilding analysis (Punt and Ianelli 2001). A retrospective analysis of foreign fleet catches, underway at the time of rebuilding plan adoption, may change the rebuilding period estimates on which the rebuilding plan is based.

Amendment 16-4, adopted by the Council at its June 2006 meeting, revised the rebuilding parameters for POP, as listed in Table F-3. These values are based on a rebuilding analysis conducted by Hamel (2006), which had determined that the POP stock was at 23.4 percent of its unfished level in 2005.

POP tend to occur at similar depths as darkblotched rockfish, although they have a more northerly geographic distribution. As a result, POP are caught in similar fisheries as darkblotched rockfish, but only north of Cape Mendocino. At the time the rebuilding plan was adopted, LE trawl vessels targeting flatfish, including petrale sole and arrowtooth flounder, accounted for more than 90 percent of all POP landings. POP are not an important component of the recreational fishery.

Methods Used to Calculate Stock Rebuilding Parameters

The methods in the rebuilding analysis (Punt and Ianelli 2001) upon which the original rebuilding plan was based, and those used for the rebuilding plan revision under Amendment 16-4 (Hamel 2006), do not differ substantially from the approach described in Section 4.6.2.

Rebuilding Parameter Values at the Time of Rebuilding Plan Adoption

Table F-2 lists the numerical values for B_0, B_{MSY}, T_{MIN}, T_{MAX}, P_{MAX}, T_{TARGET} and F. The values of B_0, B_{MSY}, T_{MIN}, and T_{MAX} are derived from the rebuilding analysis used in formulating the rebuilding plan (Punt and Ianelli 2001). The Council chose a value of 70 percent for P_{MAX}, based on a harvest control rule of F = 0.0082. This results in a target year of 2027.

Rebuilding Parameter Values from the Amendment 16-4 Rebuilding Plan Update

Table F-3 lists the numerical values for B_0, B_{MSY}, T_{MIN}, T_{MAX}, $T_{F=0}$, P_{MAX}, T_{TARGET} and an SPR harvest rate. The values of B_0, B_{MSY}, T_{MIN}, $T_{F=0}$, and T_{MAX} are derived from the rebuilding analysis used in formulating the rebuilding plan (Hamel 2006). The Council chose a target rebuilding year of 2017.

Pacific Ocean Perch Fishing Communities

Amendment 16-4 revised the Council's approach to rebuilding plans, requiring an analysis of the needs of fishing communities in relation to overfished species rebuilding times, in addition to the traditional analysis of rebuilding times in relation to the status and biology of the stock. For Amendment 16-4 and the 2007-2008 fisheries, fishing community needs are described and analyzed in an EIS (PFMC 2006). Chapter 7 of that EIS discusses the communities that make up the socio-economic environment of the Pacific Coast groundfish fisheries. In general, POP is a continental slope species that is most frequently taken in the commercial trawl fisheries north of 40° 10' N. latitude. Fishing communities that participate in the slope trawl fisheries of the northern U.S. west coast are most strongly affected by POP rebuilding measures.

Pacific Ocean Perch Rebuilding Strategy

As shown in Table F-2, at the inception of the rebuilding plan the harvest control rule for POP was a fishing mortality rate of 0.0082. Based on the 2001 POP rebuilding analysis (Punt and Ianelli 2001), this harvest rate is likely to rebuild the stock by the target year of 2027. This value is likely to change over time as stock size and structure changes. Any updated value will be published in Federal groundfish regulations. The fishing mortality rate is applied to the exploitable biomass estimate to determine the OY for a given fishing period.

Management measures are implemented through the biennial harvest specification and management process described in Chapter 5. The types of management measures that may be implemented through this process are described in Chapter 6. In 2003, at the time of rebuilding plan adoption, measures intended to limit bycatch of overfished species included prohibiting retention of certain overfished species

during some parts of the year, reducing landing limits (cumulative trip limits) on co-occurring species, establishing extensive time/area closures, and restricting the use of trawl nets equipped with large footropes. (By using large footropes with heavy roller gear, bottom trawlers can access rocky habitat on the continental shelf. This is the preferred habitat for some overfished species.)

Beginning in 2002 time/area closures, referred to as GCAs, came into use as a way of decreasing bycatch of overfished species. GCAs enclose depth ranges where bycatch of overfished species is most likely to occur, based on information retrieved from log books and the at-sea observer program. The boundaries vary by season and fishery sector, and may be modified in response to new information about the geographic and seasonal distribution of bycatch.

Because POP tend to co-occur with darkblotched rockfish, management measures applicable to that species also serve to constrain catches of POP. These measures include configuring the outer boundary of the GCA so that vessels fish in deeper water, where POP are less abundant. A cumulative trip limit, which represents the maximum amount of an identified species or species group that may be landed within the cumulative limit period (in 2003, two months) is also established for this species. Trip limits for overfished species are intended to discourage targeting on them while permitting any incidental catch to be landed. (Bycatch discarded at sea is more difficult to monitor.) As with darkblotched rockfish, trip limits for target species also may be adjusted in order to minimize bycatch of overfished species.

The Council's rebuilding measures for 2007-2008, adopted at the same time as the Council's adoption of Amendment 16-4, continue the Council's strategy of constraining POP total mortality by restricting fishing on co-occurring healthy stocks and preventing fishing in areas where POP may be taken incidentally.

1.3.2.6 Petrale Sole

Status of the Petrale Sole Stock and Fisheries Affected by Stock Rebuilding Measures at the Time of Rebuilding Plan Adoption (June 2010)

A new petrale sole (*Eopsetta jordani*) assessment was done in 2009 (Haltuch and Hicks 2009b), which indicated that the coastwide stock had declined to an overfished status at 11.6 percent of unfished biomass. Past assessments (Demory 1984; Sampson and Lee 1999; Turnock, *et al.* 1993) considered petrale sole in the Columbia and U.S. Vancouver INPFC areas a single stock. Sampson and Lee (1999) assumed that petrale sole in the Eureka and Monterey INPFC areas represented two additional distinct stocks. The more recent 2005 petrale sole assessment (Lai, *et al.* 2006) assumed two stocks, northern (U.S. Vancouver and Columbia INPFC areas) and southern (Eureka, Monterey and Conception INPFC areas), to maintain continuity with previous assessments. Lai et al. (2006) estimated the relative depletion of the northern and southern stocks to be $B_{34\%}$ and $B_{29\%}$, respectively. The 2005 assessment introduced a significant amount of reconstructed historical catch extending the catch history back to 1876, which increased the estimate of unfished biomass and lowered the relative depletion of the stock.

The most significant change in the 2009 assessment was that a single coastwide model was used, rather than independent assessments of northern and southern components of the stock. Other changes included incorporation of discard data in the model, addressing problems with petrale sole age data and ageing error information, and estimation of different natural mortality rates for females and males. Despite these changes, the new assessment estimates of stock size and trend are highly consistent with the previous assessment. The most notable exception is that the previous assessment showed a strong increase in stock size in the last years of the assessment. The current assessment now shows a recent decline in stock size that is driven by four consecutive years of decline in the NWFSC trawl survey index since 2005.

The 2009 assessment indicates that, according to the No Action proxy reference points, fishing mortality on petrale sole has continually exceeded the target of $F_{40\%}$ since the 1940s, and that the stock has been below the $B_{25\%}$ overfished threshold since 1953. These results are to a large degree driven by two basic pieces of information: 1) the high landings of petrale sole during the 1940s and 1950s, and 2) age and size composition data that are consistent with a high exploitation rate (e.g., the recent age composition data show that very few old fish are present in the population).

The SSC was concerned that certain assessment results were so extreme that the overall plausibility of the assessment was called into question. Attention focused primarily on the estimated catchability of the NWFSC survey, the estimate of stock-recruit steepness (0.95), and confounding of estimated model parameters. The assessment used two indices of abundance, the National Marine Fisheries Science Alaska Fisheries Science Center (AFSC) triennial survey from 1980 to 2004, and NWFSC survey from 2003 to 2008. The estimated catchability of the AFSC survey was 0.52 and 0.72 for early and late periods, while the estimated catchability of the NWFSC survey was 3.07. A catchability of 1.0 would imply that the survey net captured all the fish in front of the net and that fish density is the same in trawlable and untrawlable areas. Catchability greater than 1.0 could be a result of two general processes: herding of fish into the net and lower densities of fish in untrawlable areas. Although it is reasonable to expect that these factors may be important for petrale sole, it is difficult to reconcile a catchability of 3.07 with the likely magnitude of these factors inferred from studies of flatfish herding by research trawls in other areas, and initial estimates of trawlable and untrawlable areas off the west coast.

The SSC developed a list of analytical requests for the Council's petrale sole stock assessment team (STAT) to address. The SSC's groundfish subcommittee and the STAT reviewed the model and proxies of $F_{40\%}$ and $B_{40\%}$. After further consideration by the SSC's groundfish subcommittee, the full SSC endorsed the petrale sole stock assessment model approved by the Council's STAR Panel, and recommended that proxies of $B_{25\%}$ for B_{MSY} and $F_{30\%}$ for F_{MSY} be established for all assessed flatfish species.

The SSC agreed that the base petrale sole model represents the best available scientific information, and endorsed its use for status determination and management in the Council process. The SSC concluded that there is no basis for rejecting the assessment based on the estimated catchability coefficient (q) for NWFSC trawl survey. However the SSC encouraged further investigation of the catchability coefficient of the survey by experimental evaluation of trawl performance, quantification of trawlable and untrawlable habitat off the west coast, or by synthesis of available information and expert knowledge through development of an informative prior, as had been anticipated from the 2008 survey catchability workshop. The SSC also endorsed further evaluation of fishery CPUE data in the next petrale sole assessment.

A rebuilding plan for petrale sole was adopted under Amendment 16-5 (also referred to as Secretarial Amendment 1[1]) in 2010. The new rebuilding plan specified a target rebuilding year of 2016, or two years longer than T_{MIN} (Table F-1). The rebuilding strategy is to set the 2011 ACL equal to the ABC, and then assume a variable harvest rate strategy using the 25-5 ACL harvest control rule beginning in 2012.

[1] The Council's preferred petrale sole rebuilding plan was part of Amendment 16-5, which also included modifications to rebuilding plans established for other species. The Secretary of Commerce disapproved the Council's preferred modifications to the cowcod and yelloweye rebuilding plans. The process required the Council to consider amending their preferred alternative for Amendment 16-5; however, when this decision was presented to the Council in June 2011 they declined to take action to better ensure new regulations would be implemented on time in 2012. Therefore, NMFS acted under their authority to pursue a Secretarial amendment, which required no further Council process, and hence referred to Amendment 16-5 as Secretarial Amendment 1.

Status Determination Criteria for Petrale Sole and Other Flatfish Species

The proxy status determination criteria (SDC) for petrale sole and other flatfish species were revised under Amendment 16-5. The default proxy F_{MSY} harvest rate of $F_{40\%}$; B_{MSY} target of $B_{40\%}$, and the minimum stock size threshold (MSST) of $B_{25\%}$, were revised to $F_{30\%}$, $B_{25\%}$, and $B_{12.5\%}$, respectively.

The SSC recommended a change in these SDC used to manage west coast flatfish species based on a meta-analysis of the relative productivity of assessed west coast flatfish species and other assessed *Pleuronectid* species internationally. Figure F-1 depicts the depletion of petrale sole from 1945 to present relative to the No Action and Preferred biomass reference points recommended by the SSC. The level of depletion estimated at the beginning of 2009 for the coastwide petrale sole stock is 11.6 percent of its unfished biomass, which is below the MSST under the SDC currently used to manage flatfish ($B_{25\%}$), as well as the new proposed MSST of $B_{12.5\%}$ for flatfish. Therefore, a new rebuilding plan for petrale sole was adopted under Amendment 16-5 which specified rebuilding to the new proxy B_{MSY} target of $B_{25\%}$ by 2016.

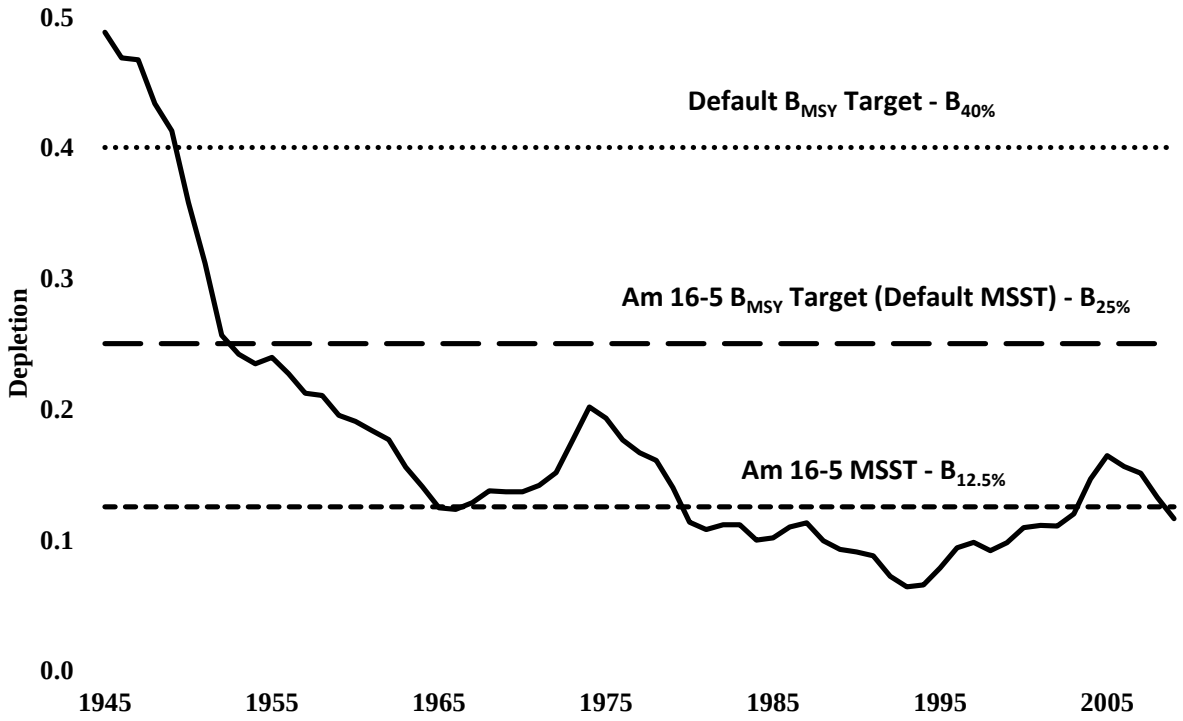

Figure F-1. Petrale sole depletion time series, 1945 - 2009, relative to default (i.e., previous to amendment) and Amendment 16-5 status determination criteria adopted for petrale sole and other assessed west coast flatfish species.

Methods Used to Calculate Stock Rebuilding Parameters

The methods used in the rebuilding analysis (Haltuch and Hicks 2009) upon which the rebuilding plan was based do not differ substantially from the approach described in Section 4.6.2. The new proxy F_{MSY} harvest rate $F_{30\%}$ was used to calculate the OFL and the new B_{MSY} target of $B_{25\%}$ was used in projecting future ACLs under the 25-5 rule.

Rebuilding Parameter Values at the Time of Rebuilding Plan Adoption under Amendment 16-5

The rebuilding parameters adopted under the Amendment 16-5 petrale sole rebuilding plan are shown in Table F-1. A target rebuilding year of 2016, which is two years longer than T_{MIN}, was adopted. The 2011 ACL was set equal to the ABC (decided using a P* of 0.45) and ACLs in 2012 and beyond are based on the 25-5 ACL harvest control rule.

Petrale Sole Fishing Communities

Coastwide U.S. west coast fishing communities dependent on the non-whiting groundfish trawl industry will be impacted by implementation of the Amendment 16-5 petrale sole rebuilding plan. Ports most dependent on the non-whiting groundfish trawl fishery are north of 40º10' N. latitude.

Petrale Sole Rebuilding Strategy

Petrale sole is one of the primary target stocks in the non-whiting trawl fishery and is predominantly caught by that sector. No other sector currently targets petrale sole, although other sectors do incidentally catch petrale sole in relatively small amounts. For this reason, the Council chose to rebuild the petrale sole stock by constraining fishing opportunities for the non-whiting trawl sector and holding all other sectors harmless. This is analogous to the widow rockfish rebuilding strategy where the whiting sectors are constrained but all other sectors are not.

Petrale sole make seasonal inshore-offshore migrations and are targeted in bottom trawl efforts on the shelf in the summer and in spawning aggregations in discrete areas on the shelf/slope break in the winter. One strategy for faster rebuilding of petrale sole is closing the petrale sole fishing areas where they aggregate and spawn in the winter. The 200 fm seaward boundary line is modified in discrete areas to open the petrale sole fishing areas. The 2009 petrale assessment and rebuilding analysis indicate larger, more mature fish are caught by the offshore winter fleet. Reducing these fishing opportunities has been shown to rebuild the stock relatively faster than allowing the mix of summer and winter petrale fishing that has occurred prior to 2010. The high productivity exhibited by the petrale sole stock (steepness (h) is estimated to be 0.95) projects rapid rebuilding of petrale sole regardless of whether a winter fishing opportunity is allowed or not. Petrale are mixed on the shelf in the summer months with other flatfish species, all of which are targeted as a mixed assemblage. It appears it may be easier for the trawl fleet fishing offshore in the winter to avoid petrale while targeting other species such as the DTS (Dover sole/thornyheads, and sablefish) assemblage, than it is for the summer fleet when targeting flatfish and other species.

1.3.2.7 Widow Rockfish

Status of the Widow Rockfish Stock and Fisheries Affected by Stock Rebuilding Measures at the Time of Rebuilding Plan Adoption (April 2004)

Widow rockfish are an important commercial species from British Columbia to central California, particularly since 1979, when an Oregon trawl fisherman demonstrated the ability to make large catches at night using midwater trawl gear. Since that time, many more participants entered the fishery and landings of widow rockfish increased rapidly (Love, *et al.* 2002). Because widow rockfish are commonly distributed in the mesopelagic (midwater) zone they are most commonly caught in with midwater trawl gear, which sweeps this zone (in contrast to bottom trawl gear used to target most groundfish species). Historically, widow rockfish were a major target species. Landings peaked at 12,473 mt in 1989 and as recently as 2000 stood at 3,866 mt (PFMC 2002). Target fisheries were eliminated after widow rockfish were declared overfished in 2001. Currently, the Pacific whiting fishery accounts for about three-quarters

of widow rockfish catches; a small directed fishery for yellowtail rockfish, prosecuted by Washington treaty Indian Tribes, and the LE fixed gear sector account for almost all of the remaining incidental catches. Most catches occur in the U.S.-Vancouver, Columbia, and Eureka management areas.

Williams, et al. (Williams, *et al.* 2000) assessed the widow rockfish in 2000. The spawning output level (8,223 mt), based on that assessment and a revised rebuilding analysis (Punt and MacCall 2002) adopted by the Council in June 2001, was at 23.6 percent of the unfished level (33,490 mt) in 1999. This result was computed using the average recruitment from 1968 to 1979 multiplied by the spawning output per recruit at F = 0. The analysis concluded the rebuilding period in the absence of fishing is 22 years, and with a mean generation time of 16 years, the maximum allowable time to rebuild (T_{MAX}) is 38 years. Widow rockfish were declared overfished in 2001 based on these analyses.

The most recent assessment (He, *et al.* 2003b) concluded that the widow rockfish stock size is 22.4 percent of the unfished biomass, but indicates stock productivity is considerably lower than previously thought. Data sparseness was a significant problem in this widow rockfish assessment (Conser, *et al.* 2003; He, *et al.* 2003b). Limited logbook data prior to 1990 is available from bottom trawl fisheries, a questionable data source for a midwater species. The NMFS laboratory at Santa Cruz conducts a midwater trawl survey from which a juvenile index is derived. This index has been highly variable in its ability to predict recruitment, in part, due to the survey's limited geographical area relative to the overall distribution of widow rockfish. The widow rockfish rebuilding analysis considered a wide range of model formulations that investigated different hypothesis on natural mortality, stock recruitment variability, and the use of a power coefficient to reduce variability of the Santa Cruz midwater juvenile survey. The SSC recommended model formulations that pre-specify the recruitment for 2003-2005, do not use a stock recruitment relationship (recruits per spawner ratios were used instead to project future recruitment), and vary the power coefficient between two and four in the Santa Cruz midwater juvenile survey. The SSC did not recommend a power coefficient higher than four because the relationship between the Santa Cruz midwater survey recruitment index and other recruitment indices changed dramatically with higher powers. The previous rebuilding analysis (Punt and MacCall 2002) had used a power coefficient of 10 that dampened the estimate of recruitment variability and suggested much higher stock productivity.

Many of the rebuilding parameters for widow rockfish did not change dramatically with the new rebuilding analysis. The rebuilding period in the absence of fishing increased to 25 years and, with a mean generation time of 16 years; the maximum allowable time to rebuild (T_{MAX}) is 41 years. However, the harvest rate associated with different rebuilding strategies dropped significantly in response to the new understanding of decreased stock productivity. Thus, the interim rebuilding OY for 2003 using the 2000 rebuilding analysis was 832 mt, while in 2004, using the 2003 rebuilding analysis (He, *et al.* 2003a), the OY was 284 mt (using the base model, Model 8, which uses a power coefficient of three).

The Council adopted a rebuilding plan for widow rockfish at its April 2004 meeting, as described by the parameter values listed in Table F-2. These values are based on a rebuilding analysis conducted by He, et al. (He, *et al.* 2003a).

Amendment 16-4, adopted by the Council at its June 2006 meeting, revised the rebuilding parameters for widow rockfish, as listed in Table F-3. These values are based on a rebuilding analysis conducted by He, et al. (2006) which had determined that the widow rockfish was at 31.1 percent of its unfished level in 2004.

Methods Used to Calculate Stock Rebuilding Parameters

The methods used in the rebuilding analysis (He, *et al.* 2003a) upon which the original rebuilding plan

was based, and those used for the rebuilding plan revision under Amendment 16-4 (He, *et al.* 2006), do not differ substantially from the approach described in Section 4.6.2.

Rebuilding Parameter Values at the Time of Rebuilding Plan Adoption

Table F-2 lists the numerical values for B_0, B_{MSY}, T_{MIN}, T_{MAX}, P_{MAX}, T_{TARGET}, and F. The values of B_0, B_{MSY}, T_{MIN}, and T_{MAX} are derived from the rebuilding analysis used in formulating the rebuilding plan (He, *et al.* 2003a). Using Model 8, the base model from the 2003 stock assessment (He, *et al.* 2003b), the Council chose a value of 60 percent for P_{MAX}, based on a harvest control rule of F = 0.0093. This results in a target year of 2038.

Rebuilding Parameter Values from the Amendment 16-4 Rebuilding Plan Update

Table F-3 lists the numerical values for B_0, B_{MSY}, T_{MIN}, T_{MAX}, $T_{F=0}$, P_{MAX}, T_{TARGET} and an SPR harvest rate. The values of B_0, B_{MSY}, T_{MIN}, $T_{F=0}$, and T_{MAX} are derived from the rebuilding analysis used in formulating the rebuilding plan (He, *et al.* 2006). The Council chose a target rebuilding year of 2015.

Widow Rockfish Fishing Communities

Amendment 16-4 revised the Council's approach to rebuilding plans, requiring an analysis of the needs of fishing communities in relation to overfished species rebuilding times, in addition to the traditional analysis of rebuilding times in relation to the status and biology of the stock. For Amendment 16-4 and the 2007-2008 fisheries, fishing community needs are described and analyzed in an EIS (PFMC 2006). Chapter 7 of that EIS discusses the communities that make up the socio-economic environment of the Pacific Coast groundfish fisheries. In general, widow rockfish is a continental shelf species that is most frequently taken as incidental catch in the mid-water trawl Pacific whiting fisheries north of 40°10' N. latitude, but which is also taken incidentally in all groundfish fishing sectors in this area. Measures to rebuild widow rockfish by eliminating its directed harvest and to preventing its incidental catch affect all groundfish fishing communities off the central and northern U.S. west coast.

Widow Rockfish Rebuilding Strategy

As shown in Table F-2, at the inception of the rebuilding plan the harvest control rule for canary rockfish was a fishing mortality rate of 0.0093. Based on the 2003 widow rockfish rebuilding analysis (He, *et al.* 2003a), this harvest rate is likely to rebuild the stock by the target year of 2038. This value is likely to change over time as stock size and structure changes. Any updated value will be published in Federal groundfish regulations. The fishing mortality rate is applied to the exploitable biomass estimate to determine the OY for a given fishing period.

Management measures are implemented through the biennial harvest specification and management process described in Chapter 5. The types of management measures that may be implemented through this process are described in Chapter 6. In 2004, at the time of rebuilding plan adoption, measures intended to limit bycatch of overfished species included prohibiting retention of certain overfished species during some parts of the year, reducing landing limits (cumulative trip limits) on co-occurring species, establishing extensive time/area closures, and restricting the use of trawl nets equipped with large footropes. Because widow rockfish are mainly caught in the water column, bottom trawl gear restrictions have little effect on widow rockfish catch rates.

Beginning in 2002, time/area closures known as GCAs came into use as a way of decreasing bycatch of overfished species. GCAs enclose depth ranges where bycatch of overfished species is most likely to occur, based on information retrieved from logbooks and the at-sea observer program. The boundaries

vary by season and fishery sector, and may be modified in response to new information about the geographic and seasonal distribution of bycatch.

Because widow rockfish occur in midwater and aggregate at night, elimination of target fishery opportunities is a relatively easy way of reducing widow rockfish bycatch. The Council has taken a policy approach of establishing management measures to reduce incidental catch in the Pacific whiting fishery sufficient to constrain total mortality below harvest levels (OYs) needed to rebuild the stock. At the time of rebuilding plan adoption, catch in other fisheries is sufficiently small so that rebuilding targets can be met without applying any special measures, beyond those needed to discourage targeting, to reduce widow rockfish fishing mortality in these fishery sectors.

Widow rockfish catches in recreational fisheries are relatively modest. Catches in this sector are managed mainly through bag limits, size limits, and fishing seasons established for each west coast state. No recreational bag and size limits have been established for widow rockfish. However, general bag limits for rockfish may have some constraining effect on widow recreational catches.

The Council's rebuilding measures for 2007-2008, adopted at the same time as the Council's adoption of Amendment 16-4, continue the Council's strategy of constraining widow rockfish total mortality by eliminating the directed mid-water yellowtail and widow rockfish fishery, restricting fishing on co-occurring healthy stocks and preventing fishing in areas where widow rockfish may be taken incidentally. Additionally, the Council has adopted a requirement that trawl vessels operating north of 40°10' N. latitude use selective flatfish trawl gear when operating in nearshore waters, a gear that minimizes rockfish bycatch during flatfish trawl fishing. The Council has also adopted widow rockfish bycatch limits for the Pacific whiting fishery, which tends to take widow rockfish incidentally.

1.3.2.8 Yelloweye Rockfish

Status of the Yelloweye Rockfish Stock and Fisheries Affected by Stock Rebuilding Measures at the Time of Rebuilding Plan Adoption (April 2004)

Yelloweye rockfish are common from Central California northward to the Gulf of Alaska. They are bottom-dwelling, generally solitary, rocky reef fish, found either on or just over reefs (Eschmeyer, *et al.* 1983; Love 1991; Miller and Lea 1972; 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). Yelloweye rockfish are potentially caught in a range of both commercial and recreational fisheries. Because of their preference for rocky habitat, they are more vulnerable to hook-and-line gear.

The first ever yelloweye rockfish stock assessment was conducted in 2001 (Wallace 2002). This assessment incorporated two area assessments: one from Northern California using CPUE indices constructed from Marine Recreational Fisheries Statistical Survey (MRFSS) sample data and California Department of Fish and Game (CDFG) data collected onboard commercial passenger fishing vessels, and the other from Oregon using Oregon Department of Fish and Wildlife (ODFW) sampling data. The assessment concluded current yelloweye rockfish stock biomass is about 7 percent of unexploited biomass in Northern California and 13 percent of unexploited biomass in Oregon. The assessment revealed a 30-year declining biomass trend in both areas with the last above average recruitment occurring in the late 1980s. The assessment's conclusion that yelloweye rockfish biomass was well below the 25 percent of unexploited biomass threshold for overfished stocks led to this stock being separated from the rockfish complexes in which it was previously listed. Until 2002, when yelloweye rockfish were

declared overfished, they were listed in the remaining rockfish complex on the shelf in the Vancouver, Columbia, and Eureka management areas and the "other rockfish" complex on the shelf in the Monterey and Conception areas. As with the other overfished stocks, yelloweye rockfish harvest is now tracked separately.

In June 2002 the SSC recommended that managers should conduct a new assessment incorporating Washington catch and age data. This recommendation was based on evidence that the biomass distribution of yelloweye rockfish on the west coast was centered in waters off Washington and that useable data from Washington were available. Based on that testimony, the Council recommended completing a new assessment in the summer of 2002, before a final decision was made on 2003 management measures. Methot et al. (Methot and Piner 2002b) did the assessment, which was reviewed by a STAR Panel in August 2002. The assessment result was much more optimistic than the one prepared by Wallace (Wallace 2002), largely due to the incorporation of Washington fishery data. While the overfished status of the stock was confirmed (24 percent of unfished biomass), Methot et al. (Methot and Piner 2002b) provided evidence of higher stock productivity than originally assumed. The assessment also treated the stock as a coastwide assemblage. This assessment was reviewed and approved by the SSC and the Council at the September 2002 Council meeting. Methot and Piner (2002) prepared a rebuilding analysis based on this assessment.

The Council adopted a rebuilding plan for yelloweye rockfish at its April 2004 meeting, as described by the parameter values listed in Table F-2. These values are based on a rebuilding analysis conducted by Methot and Piner (Methot and Piner 2002a).

Amendment 16-4, adopted by the Council at its June 2006 meeting, revised the rebuilding parameters for yelloweye rockfish, as listed in Table F-3. These values are based on a rebuilding analysis conducted by Tsou and Wallace (2006) which had determined that the yelloweye rockfish stock was at 17.7 percent of its unfished level in 2006.

Because yelloweye rockfish prefer rocky reef habitat on the continental shelf, they are most vulnerable to recreational and commercial fixed gear fisheries. In the past, the groundfish trawl sector has accounted for a large proportion of the catch: from 1990 to 1997, trawlers took an average of 46 percent of the catch coastwide (although most catches occur in Washington and Oregon waters). (This discussion is based on data in the table on page 3 of Methot, *et al.* 2003). Trip limit reductions after 1997 and the imposition of restrictions on large footrope trawl gear in 2000 have substantially diminished the amount of yelloweye rockfish caught by the trawl sector. (Large footrope gear had made it possible for trawlers to access the rocky habitat where yelloweye live.) Trawl vessels accounted for only 14 percent of the catch on average from 1998 to 2001. Commercial fixed gear catches have also taken a significant share of the catch, 38 percent in the years 1990-1997. However, the implementation of the non-trawl RCA, which encloses much yelloweye habitat, has resulted in their share falling also. Open access directed groundfish fisheries and the Pacific halibut longline fleet also catch small amounts of yelloweye rockfish. Recreational catches have become more significant with the reduction in commercial catches. Comparing the 1990-1997 and 1998-2001 periods, their share of the total coastwide catch almost doubled to 30 percent, although actual average catches declined slightly. Most recreational catches occur in Washington State waters.

Methods Used to Calculate Stock Rebuilding Parameters

The methods used in the rebuilding analysis (Methot and Piner 2002a) upon which the original rebuilding plan was based, and those used for the rebuilding plan revision under Amendment 16-4 (Tsou and Wallace 2006), do not differ substantially from the approach described in Section 4.6.2.

Rebuilding Parameter Values at the Time of Rebuilding Plan Adoption

Table F-2 lists the numerical values for B_0, B_{MSY}, T_{MIN}, T_{MAX}, P_{MAX}, T_{TARGET}, and F. The values of B_0, B_{MSY}, T_{MIN}, and T_{MAX} are derived from the rebuilding analysis used in formulating the rebuilding plan (Methot and Piner 2002a). The Council chose a value of 80 percent for P_{MAX}, based on a harvest control rule of F = 0.0153. This results in a target year of 2058.

Rebuilding Parameter Values from the Amendment 16-4 Rebuilding Plan Update

Table F-3 lists the numerical values for B_0, B_{MSY}, T_{MIN}, T_{MAX}, $T_{F=0}$, P_{MAX}, T_{TARGET} and an SPR harvest rate. The values of B_0, B_{MSY}, T_{MIN}, $T_{F=0}$, and T_{MAX} are derived from the rebuilding analysis used in formulating the rebuilding plan (Tsou and Wallace 2006). The Council chose a target rebuilding year of 2084.

Yelloweye Rockfish Fishing Communities

Amendment 16-4 revised the Council's approach to rebuilding plans, requiring an analysis of the needs of fishing communities in relation to overfished species rebuilding times, in addition to the traditional analysis of rebuilding times in relation to the status and biology of the stock. For Amendment 16-4 and the 2007-2008 fisheries, fishing community needs are described and analyzed in an EIS (PFMC 2006). Chapter 7 of that EIS discusses the communities that make up the socio-economic environment of the Pacific Coast groundfish fisheries. In general, yelloweye rockfish is a site-loyal continental shelf species that is most frequently taken in recreational and commercial hook-and-line fisheries north of 40°10' N. latitude. Measures to rebuild yelloweye rockfish by eliminating its directed harvest and preventing its incidental catch affect all hook-and-line groundfish fishing off the northern U.S. west coast.

Yelloweye Rockfish Rebuilding Strategy

As shown in Table F-2, at the inception of the rebuilding plan the harvest control rule for canary rockfish was a fishing mortality rate of 0.0153. Based on the 2002 rebuilding analysis (Methot and Piner 2002), this harvest rate is likely to rebuild the stock by the target year of 2058. This value is likely to change over time as stock size and structure changes. Any updated value will be published in Federal groundfish regulations. The fishing mortality rate is applied to the exploitable biomass estimate to determine the OY for a given fishing period.

Management measures are implemented through the biennial harvest specification and management process described in Chapter 5. The types of management measures that may be implemented through this process are described in Chapter 6. In 2004, at the time of rebuilding plan adoption, measures intended to limit bycatch of overfished species included prohibiting retention of certain overfished species during some parts of the year, reducing landing limits (cumulative trip limits) on co-occurring species, establishing extensive time/area closures, and restricting the use of trawl nets equipped with large footropes. (By using large footropes with heavy roller gear, bottom trawlers can access rocky habitat on the continental shelf. This is the preferred habitat for some overfished species.)

Beginning in 2002, time/area closures known as GCAs came into use as a way of decreasing bycatch of overfished species. GCAs enclose depth ranges where bycatch of overfished species is most likely to occur, based on information retrieved from logbooks and the at-sea observer program. The boundaries vary by season and fishery sector, and may be modified in response to new information about the geographic and seasonal distribution of bycatch.

In addition to the more general measures described above, which are intended to reduce bycatch of all

overfished species, the Yelloweye Rockfish Conservation Area (YRCA), a C-shaped closed area off the Washington coast, near Cape Flattery, prevents recreational groundfish and halibut anglers from targeting this species in an area where they are concentrated. Recreational bag and size limits are also used to manage total yelloweye rockfish fishing mortality.

Given the particular life history characteristics of yelloweye rockfish, the Council will continue to use a species-specific area closure or closures to protect yelloweye rockfish. As new information becomes available on yelloweye rockfish behavior and fisheries interactions with yelloweye rockfish, the boundaries or related regulations concerning the current YRCA may change, and additional YRCAs may be established by regulation.

The Council's rebuilding measures for 2007-2008, adopted at the same time as the Council's adoption of Amendment 16-4, continue the Council's strategy of constraining yelloweye rockfish total mortality by restricting fishing on co-occurring healthy stocks and preventing fishing in areas where yelloweye rockfish may be taken incidentally. Additionally, the Council has adopted yelloweye rockfish rebuilding measures in the Pacific halibut fisheries and new YRCAs for the commercial groundfish and salmon fisheries operating off the northern U.S. west coast.

The Council recognized the need to restrict the fisheries based on the new yelloweye rockfish assessment, but also took into account the potentially widespread negative effects of an immediate reduction in OY and recommended an OY ramp-down strategy over a 5-year period (see the footnote to Table F-3). The ramp-down strategy provides time to collect much-needed additional data that could better inform new management measures for greater yelloweye rockfish protection, and reduces the immediate adverse impacts to fishing communities while altering the rebuilding period by less than one year.