11. SHORTRAKER AND OTHER SLOPE ROCKFISH

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11.0 EXECUTIVE SUMMARY

Previously, this chapter included the "shortraker/rougheye" and "other slope rockfish" management categories. However, now that shortraker and rougheye rockfish have been split apart for management purposes, the rougheye assessment is being presented separately in Chapter 10.

11.0.1 Summary of Major Changes

Major new information in this assessment are biomass estimates from the 2005 trawl survey.

Other new information are the first estimates of von Bertalanffy parameters and age at maturity for female shortraker rockfish. However, these estimates are based on an experimental study and need to be confirmed by additional study.

Assessment methodology was the same as that used in past assessments for shortraker/rougheye and "other slope rockfish". Exploitable biomass for shortraker rockfish and "other slope rockfish" was estimated by the unweighted average biomass of the most recent three trawl surveys (2001, 2003, and 2005), excluding the estimated biomass in the 1-100 m depth stratum. The 1-100 m depth stratum was removed from the estimate because most rockfish in this stratum are small juvenile fish younger than the age of recruitment, and thus are not considered exploitable. This results in an exploitable biomass of 37,461 mt for shortraker rockfish and 93,552 mt for "other slope rockfish". Applying an F_{ABC}=0.75M rate to the exploitable biomass of shortraker rockfish (tier 5) results in a recommended ABC of 843 mt in 2006. For "other slope rockfish", applying an $F_{ABC}=F_{40\%}$ rate to the exploitable biomass of sharpchin rockfish (tier 4) and an F_{ABC}=0.75M rate to that of the other species (tier 5) results in ABC's of 1,103 mt and 3,047 mt, respectively, or a combined recommended ABC of 4,150 mt for the "other slope rockfish" management group in 2006.

Geographic apportionment of these ABC's amongst management areas of the Gulf of Alaska is based on a weighted average of the percent exploitable biomass distribution for each area in the three most recent trawl surveys. In these computations, each successive survey is given a progressively heavier weighting using factors of 4, 6, and 9, respectively. The apportionment values for shortraker rockfish are: Western area, 18.13%; Central area, 41.94%; and Eastern area, 39.93%. Applying these percentages to the recommended ABC of 843 mt yields the following apportionments for the Gulf in 2006: Western area, 153 mt; Central area, 353 mt; and Eastern area, 337 mt. Apportionment values for "other slope rockfish" are: Western area, 13.90%; Central area, 9.30%; and Eastern area, 76.80%. Applying these percentages to the recommended ABC of 4,150 mt yields the following apportionments for the Gulf in 2006: Western area, 577 mt; Central area, 386 mt; and Eastern area, 3,187 mt. The Eastern area for "other slope rockfish" is further divided into the West Yakutat area and the East Yakutat/Southeast Outside area. Based on a procedure identical to the other apportionment calculations (a 4:6:9 weighted average biomass of the three most recent trawl surveys), the Eastern area apportionment is subdivided as follows: West Yakutat, 9.88%; and East Yakutat/Southeast Outside, 90.12%. This translates into an ABC of 315 mt for West Yakutat and 2,872 mt for East Yakutat/Southeast Outside in 2006.

Overfishing for a tier 5 species such as shortraker rockfish is defined to occur at a harvest rate of F=M. Therefore, applying the estimate of M for shortraker rockfish (0.03) to the estimate of current exploitable biomass (37,461 mt) yields an overfishing catch limit of 1,124 mt for 2006. Overfishing is defined to occur at the $F_{35\%}$ (in terms of exploitable biomass per recruit) value of 0.064 for sharpchin rockfish, a tier 4 species. For the remaining species of "other slope rockfish", all of which are in tier 5, overfishing is defined to occur at the F=M rate. Applying these F's results in an overfishing catch limit of 5,394 mt for the "other slope rockfish" group in 2006.

11.0.2 Summary of ABC's and Overfishing Levels

Shortraker rockfish ABC: Gulfwide, 843; Western Area, 153; Central Area; 353; Eastern Area, 337.

Shortraker rockfish overfishing level: Gulfwide, 1,124.

"Other slope rockfish": Gulfwide, 4,150; Western Area, 577; Central Area, 386; West Yakutat, 315; East Yakutat/Southeast Outside, 2,872.

"Other slope rockfish" overfishing level: Gulfwide, 5,394.

Since these are tier 5 species and no new survey information will be available in 2006, the projections for management for 2007 will be the same values as those in 2006.

11.0.3 Responses to SSC Comments

There were no SSC comments specific to this assessment, nor were there SSC comments in general that needed to be addressed in this assessment.

11.1 INTRODUCTION

Shortraker rockfish was just separated as its own management category in the Gulf of Alaska by the North Pacific Fishery Management Council (NPFMC) in 2005, whereas "other slope rockfish" have been a separate management category in this region since 1991. Previously, shortraker rockfish had been grouped from 1991 to 2004 with rougheye rockfish in the "shortraker/rougheye" management category because the two species are similar in appearance, share the same habitat on the upper continental slope, and often co-occur in hauls. Both species were assigned a single overall ABC (acceptable biological catch) and TAC (total allowable catch), and fishermen were free to harvest either species within this TAC. However, evidence from the NMFS Alaska Groundfish Observer Program indicated that shortraker rockfish were being harvested disproportionately within the shortraker/rougheye group, which raised the possibility that shortraker could become overexploited (Clausen 2004). Because of this concern, the NPFMC decided to establish separate management categories for shortraker and rougheye rockfish starting with the 2005 fishing season.

The last detailed SAFE report for shortraker, rougheye, and "other slope rockfish" in the Gulf of Alaska (Clausen et al. 2003) dealt with all of these species. Because rougheye rockfish is now a separate management category, and also because it is now assessed for the first time with an age-structured model, it was decided for the present assessment report that rougheye rockfish should be discussed in its own SAFE chapter. Hence, only shortraker rockfish and "other slope rockfish" will be discussed in the present chapter. Although each of the two management groups is assigned its own value of ABC and TAC, they are discussed together in this SAFE chapter because all species in the groups are classified into tiers 4 or 5 in the overfishing definitions. This results in the use of a similar assessment approach to each group based primarily on survey biomass estimates rather than age-structured modeling. The common and scientific names for each species in the two management categories are listed in Table 11-1. One change that occurred in the species list this year was the removal of aurora and shortbelly rockfish from the "other slope rockfish" group. These two species were dropped because current taxonomic information (Mecklenburg et al. 2002) indicates that both do not occur north of southern Vancouver Island.

Shortraker rockfish ranges from southeastern Kamchatka, north into the Bering Sea, and through the Aleutian Islands and Gulf of Alaska south to southern California. Its center of abundance appears to be Alaskan waters. In the Gulf of Alaska, adults of this species inhabit a narrow band along the upper continental slope at depths of 300-500 m; outside of this depth interval, abundance decreases considerably (Ito 1999). Shortraker rockfish attains the largest size of all *Sebastes*, with a maximum reported total length of 120 cm.

In contrast to shortraker rockfish, nearly all the 15 species that comprise the "other slope rockfish" group in the Gulf of Alaska are at the northern edge of their ranges; the center of abundance for all these species is farther south off British Columbia or the U.S. west coast. The one exception is harlequin rockfish, which is mostly an Alaskan species. Within the Gulf of Alaska, "other slope rockfish" are most abundant in the eastern Gulf and become increasingly scarce in areas farther west. (Note: northern rockfish as a member of "other slope rockfish" is a special circumstance that applies only to the eastern Gulf of Alaska and will be discussed later in this section).

Life history information on shortraker rockfish is extremely sparse. The fish are presumed to be viviparous, as other *Sebastes* appear to be, with internal fertilization and incubation of eggs and with the embryos receiving at least some maternal nourishment. (Whether this is true viviparity is still subject to some debate). There have been no fecundity studies on shortraker rockfish. One study on reproductive biology of the fish indicated they had protracted a reproductive period, and that parturition (larval release) may take place from early spring through summer (McDermott 1994). Genetic techniques have been

used recently to identify a few post-larval shortraker rockfish from samples collected in epibenthic waters far offshore in the Gulf of Alaska, which is the only documentation of habitat preference for this life stage. There is no information on when juvenile fish become demersal; in fact, only a few specimens of juvenile shortraker rockfish <35 cm fork length have ever been caught in the Gulf of Alaska, so information on this life stage is virtually unknown. Orlov (2001) has suggested that shortraker rockfish may undergo extensive migrations in the north Pacific. In his theory, which is mostly based on size compositions of shortraker rockfish in various regions, larvae/post-larvae of this species are transported by currents from the Gulf of Alaska to nursery areas in the Aleutian Islands, where they grow and subsequently migrate back to the Gulf of Alaska as young adults. More research is needed to substantiate this scenario. As mentioned previously, adults are particularly concentrated in a narrow band along the 300-500 m depth interval of the continental slope. Much of this habitat is steep and difficult to trawl in the Gulf of Alaska, and observations from a manned submersible also indicated that shortraker rockfish seemed to prefer steep slopes with frequent boulders (Krieger and Ito 1999). Within this habitat, shortraker rockfish tend to have a relatively even distribution when compared with the highly aggregated and patchy distribution of other rockfish such as Pacific ocean perch[1].

Genetic studies of shortraker rockfish have indicated evidence of stock structure in the Gulf of Alaska (Matala et al . 2004; Gharrett et al. 2003), but additional research is needed to better define this structure. No research has been done on the stock structure for any of the "other slope rockfish" species.

In practice, the NPFMC apportions the ABC's and TAC's for both shortraker rockfish and "other slope rockfish" in the Gulf of Alaska into three geographic management areas: the Western, Central, and Eastern Gulf of Alaska. Amendment 58 to the Gulf of Alaska Groundfish Plan, which took effect in 1998, prohibited trawling in the Eastern area east of 140 degrees W. longitude. Since most species of "other slope rockfish" are caught exclusively with trawl gear, this amendment could have concentrated the catch of these fish in the Eastern area in the relatively small area between 140 degrees and 147 degrees W. longitude that remained open to trawling. To ensure that such a geographic over-concentration of harvest would not occur, since 1999 the NPFMC has divided the Eastern area into two smaller management areas: West Yakutat (area between 147 and 140 degrees W. longitude) and East Yakutat/Southeast Outside (area east of 140 degrees W. longitude). Separate ABC's and TAC's are now assigned to each of these smaller areas for "other slope rockfish".

Because of the extremely low abundance of northern rockfish in the Eastern area and the consequent difficulty of managing northern rockfish as a separate species in this area, in 1999 northern rockfish in the Eastern area were reassigned to the "other slope rockfish" category for this area only. Therefore, northern rockfish is listed as an "other slope rockfish" species in Table 11.1, but only for the Eastern area.

11.2 FISHERY

11.2.1 Catch History

Official fishery catch statistics for shortraker rockfish are only available for 2005, when the species was first reported separately for management purposes (Table 11-2). However, catch statistics are available for shortraker and rougheye rockfish combined for the years 1991-2004, when both species were classified together into one management group, and these are also listed in Table 11-2. Catch data for

[1]Clausen, D. M., and J. T. Fujioka. Variability in trawl survey catches of shortraker rockfish, rougheye rockfish, and Pacific ocean perch, and possible implications for survey design. Presentation at 2002 Western Groundfish Conference, Ocean Shores, WA, February 12-14, 2002.

"other slope rockfish" are available for the complete period 1991-2005 (Table 11-3). Previous to 1991, shortraker rockfish and all the "other slope rockfish" species were classified into larger management groups that included Pacific ocean perch and other species of *Sebastes*, and it is generally not possible to separate out the catches of shortraker rockfish or "other slope rockfish" species.

Although official catch statistics for shortraker rockfish exist only for 2005, unofficial estimates of the Gulfwide catch of shortraker rockfish for the years 1993-2003 were computed in an appendix to last year's SAFE report (Clausen 2004). These unofficial estimates are shown in Table 11-4. The estimates are based on a combination of observer program and NMFS Alaska regional office data, and take into account differences in catch by area and by gear type. The estimates indicate that annual shortraker catch was generally been around 1,000-1,500 mt during these years. Annual TAC's for the shortraker/rougheye group were the major determining factor of these catch amounts; as shown in Table 11-2, the total Gulfwide catch of shortraker/rougheye for a given year was generally very similar to the corresponding TAC. The 2005 shortraker rockfish official catch was much lower than any of the unofficial estimates in previous years. This low 2005 catch suggests that the separation of shortraker rockfish from the shortraker/rougheye group may have caused a reduction in catch of shortraker rockfish.

With the exception of 1993, Gulfwide catches of "other slope rockfish" have always been <1,700 mt (Table 11-3). In most years, the catch has been considerably less than either the ABC or TAC. Catches of "other slope rockfish" in the Eastern area (where these species are most abundant) have been especially small in the years since 1998, when trawling was prohibited east of 140 degrees W. longitude.

Research catches of shortraker/rougheye, shortraker rockfish, and "other slope rockfish" are shown in Table 11-5.

11.2.2 Description of the Fishery

Throughout the 1991-2004 period that shortraker/rougheye rockfish existed as a management category in the Gulf of Alaska, directed fishing was not allowed, and the fish could only be retained as "incidentally-caught" species. This incidental catch status has continued for shortraker rockfish as a separate category in 2005. Shortraker and rougheye rockfish can both be caught with either bottom trawls or longlines. The percent caught in each gear type is listed in the following table for the years 1993-2004[2]:

Shortraker/Rougheye Rockfish

Gear	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Trawl	66.1	51.9	68.9	67.2	66.3	52.8	55.5	57.1	40.1	57.1	61.1	41.8
Longline	33.9	48.1	31.1	32.8	33.7	47.2	44.5	42.9	59.9	42.9	38.9	58.2

Thus, in all years except 2001 and 2004, the majority of the catch was taken by trawlers. Nearly all the longline catch of shortraker/rougheye appears to have come as "true" incidental catch in the sablefish or halibut longline fisheries. In rockfish trawl fisheries, however, some of the shortraker and rougheye is taken by actual targeting that some fishermen call "topping off" (Ackley and Heifetz 2001) . "Topping off" works in this way: fishery managers assign all vessels in a directed fishery a maximum retainable amount (MRA) for certain species that may be encountered as incidental catch. If a vessel manages to not catch its MRA during the course of a directed fishing trip, or the MRA is set overly high (as data

[2]National Marine Fisheries Service, Alaska Region, Sustainable Fisheries Division, P.O. Box 21668, Juneau, AK 99802.

presented in Ackley and Heifetz (2001) suggest), before returning to port the vessel may be able to make some target hauls on the incidental species and still not exceed its MRA. Such instances of "topping off" for shortraker/rougheye rockfish appear to take place in the Pacific ocean perch trawl fishery, especially because shortraker rockfish is the most valuable species of *Sebastes* rockfish in terms of landed price.

In most years, trawling has accounted for >85% of the "other slope rockfish" catch, as indicated in the following table that shows the percent caught in trawls vs. longlines for years 1993-2004:

Gear	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Trawl	96.8	91.9	92.1	87.6	88.8	86.8	86.1	73.7	55.3	84.9	65.7	86.3
Longline	3.2	8.1	7.9	12.4	11.2	13.2	13.9	26.3	44.7	15.1	34.3	13.7

The predominance of trawl catches is not surprising, as the most abundant "other slope rockfish" species such as sharpchin and harlequin rockfish are thought to feed on plankton and thus are likely not attracted to longlines. There has been little or no directed fishing for "other slope rockfish", with two exceptions: 1) in 1993, it appears some targeting by trawlers occurred in the eastern Gulf of Alaska for silvergrey and yellowmouth rockfish, two larger sized species that can be caught in bottom trawls: and 2) in 2004 and 2005, a small experimental fishery occurred in southeastern Alaska that used modified trolling gear to catch silvergrey rockfish (Alaska Longline Fishermen's Association 2005).

11.2.3 Species Composition of the "Other Slope Rockfish Catch"

Detailed species composition data for the "other slope rockfish" group in the 1992-2002 commercial fishery can be estimated from information collected by the domestic observer program (Table 11-6). One caveat is that these data are based only on trips that had observers on board. Consequently, they may be biased toward larger vessels, which had more complete observer coverage. For "other slope rockfish", however, the problem of bias in the observer coverage may be minor. This is because most of the catch is taken by trawlers, and these are generally larger-sized vessels with relative high rates of observer coverage. Therefore, the percentage data in Table 11-6 can be applied to the commercial catches in Table 11-3 to yield the following Gulfwide estimates of catch in mt for each species:

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Sharpchin rockfish	434	1,345	330	342	278	316	319	169	274	162	276
Redstripe rockfish	261	1,222	207	198	134	291	51	107	51	44	13
Harlequin rockfish	745	1,864	789	667	403	492	443	438	186	281	365
Silvergrey rockfish	130	487	219	123	8	34	8	19	19	18	52
Yellowmouth rockfish	102	498	40	15	6	63	1	2	13	8	15
Redbanded rockfish	-	-	23	22	30	15	20	21	25	36	35
Other "other slope rockfish" species	2	16	4	31	23	6	21	32	10	11	17

These data indicate that for the "other slope rockfish" category, harlequin and sharpchin rockfish have always been the predominant species caught, and that redstripe, silvergrey and yellowmouth rockfish have also sometimes been taken in relatively large amounts.

11.2.4 Bycatch

The only analysis of bycatch in shortraker/rougheye rockfish fisheries of the Gulf of Alaska is that of Ackley and Heifetz (2001), in which they examined data for 1994-96 only. In the hauls they identified as targeted on shortraker/rougheye, the major bycatch was arrowtooth flounder, sablefish, and shortspine thornyhead, in descending order by percent.

11.2.5 Discards

Gulfwide discard rates[3] (% of the total catch discarded within management categories) of fish in the two management categories are listed as follows for the years 1991-2004 (data are not available for "other slope rockfish" in 1991-92):

Year	Shortraker/ Rougheye	Other slope rockfish
1991	42.0	-
1992	10.4	-
1993	26.8	48.9
1994	44.8	65.6
1995	30.7	72.5
1996	22.2	75.6
1997	22.0	52.1
1998	27.9	66.3
1999	30.6	68.7
2000	21.2	52.8
2001	29.1	47.9
2002	20.8	58.0
2003	28.3	56.7
2004	27.6	62.1

The above table indicates that discards of shortraker/rougheye were generally moderate over the years, whereas the rates for "other slope rockfish" were consistently high. The high discard of "other slope rockfish' is not surprising, as most of the abundant species in this category, such as harlequin and sharpchin rockfish, are small in size and of lower economic value. Consequently, fishermen probably have little incentive to retain these fish.

11.3 DATA

11.3.1 Fishery Data

11.3.1.1 Catch

Detailed catch information for shortraker/rougheye, shortraker rockfish, and "other slope rockfish" is listed in Tables 11-2, 11-3, and 11-4.

[3]Source: National Marine Fisheries Service, Alaska Region, Fishery Management Section, P.O. Box 21688, Juneau, AK 99802-1688. Data are from weekly production and observer reports through October 8, 2005.

11.3.1.2 Size and Age Composition

The number of lengths sampled by observers for shortraker rockfish and "other slope rockfish" in the Gulf of Alaska commercial fishery have been too small to yield meaningful data. Few age samples for any of these species have been collected from the fishery, and none have been aged.

11.3.2 Survey Data

11.3.2.1 Longline Surveys in the Gulf of Alaska

Two longline surveys of the continental slope of the Gulf of Alaska provide data on the relative abundance of shortraker rockfish in this region: the earlier Japan-U.S. cooperative longline survey, and the ongoing NMFS domestic longline survey. These surveys compute relative population numbers (RPN's) and relative population weights (RPW's) for fish on the continental slope as indices of stock abundance. The results for both surveys concerning rockfish, however, should be viewed with some caution, as the analyses do not take into account possible effects of competition for hooks with other species caught on the longline.

The cooperative longline survey was conducted annually during 1979-94, but RPN's for rockfish are only available for the years 1979-87 (Sasaki and Teshima 1988). These data are highly variable and difficult to interpret, but suggest that abundance of shortraker rockfish remained stable in the Gulf of Alaska (Clausen and Heifetz 1989). The data also indicate that shortraker rockfish are most abundant in the eastern Gulf of Alaska.

The domestic longline survey has been conducted annually since 1988, and RPN's and RPW's have been computed for each year (Table 11-7[4]). For shortraker rockfish, Gulfwide RPN's have ranged from a low of ~11,000 in 1994 to a high of ~32,000 in 2000. Similarly, lowest and highest Gulfwide RPW values were in these same years. Definite trends in these data over the years are difficult to discern, and the fluctuations in RPN and RPW may reflect random variations in the survey's catch rates, rather than true changes in abundance. It should be noted, however, that the five highest annual Gulfwide RPN's and RPW's for shortraker rockfish were in the years 1997-2001. After 2001, RPN's and RPW's have decreased, and the 2005 values are the lowest since 1994.

Similar to the cooperative longline survey, the domestic survey results show that abundance of shortraker rockfish is highest in the eastern Gulf of Alaska: the Yakutat area consistently has by far the greatest RPN and RPW values for shortraker rockfish.

11.3.2.2 Biomass Estimates from Bottom Trawl Surveys

Bottom trawl surveys were conducted on a triennial basis in the Gulf of Alaska in 1984, 1987, 1990, 1993, 1996, and 1999, and these surveys became biennial in 2001, 2003, and 2005. The surveys provide much information on shortraker rockfish and "other slope rockfish", including estimates of absolute abundance (biomass) and length compositions. The trawl surveys covered all areas of the Gulf of Alaska out to a depth of 500 m (in some surveys to 1,000 m), but the 2001 survey did not sample the eastern Gulf of Alaska. Also, the 1984 and 1987 survey results should be treated with some caution. A different

[4]C. Lunsford, National Marine Fisheries Service, Alaska Fisheries Science Center, Auke Bay Laboratory, 11305 Glacier Hwy., Juneau AK 99801. Pers. commun. October 2005.

survey design was used in the eastern Gulf of Alaska in 1984; furthermore, much of the survey effort in the western and central Gulf of Alaska in 1984 and 1987 was by Japanese vessels that used a very different net design than what has been the standard used by U.S. vessels throughout the surveys. To deal with this latter problem, fishing power comparisons of rockfish catches have been done for the various vessels used in the surveys (for a discussion see Heifetz et al. 1994). Results of these comparisons have been incorporated into the biomass estimates discussed here, and the estimates are believed to be the best available. Even so, the reader should be aware that an element of uncertainty exists as to the standardization of the 1984 and 1987 surveys.

Biomass estimates for shortraker rockfish have often shown somewhat large fluctuations between surveys but the confidence intervals have all overlapped and differences in the estimates do not appear significant, with two exceptions: the 2003 and 2005 estimates (42,023 and 42,568 mt, respectively) appear to be significantly greater than the 1990 estimate (12,681 mt) (Tables 11-8 and 11-9; Figure 11.1). Compared with other species of *Sebastes*, the estimates for shortraker rockfish show relatively tight confidence intervals and low coefficients of variations (cv's; compare Table 11-9 vs. Table 11-10). The low cv's are an indication of the rather even distribution of shortraker rockfish that was noted in the introduction (Section 11.1).

Despite this precision, however, the trawl surveys are believed to do a relatively poor job of assessing abundance of shortraker rockfish. Nearly all the catch of these fish is found on the upper continental slope at depths of 300-500 m. Most of this area is not trawlable by the survey's gear because of its steep and rocky bottom, except for gully entrances where the bottom is not so steep. Consequently, biomass estimates for both shortraker rockfish are mostly based on the relatively few hauls in gully entrances, and they may not be showing a true picture of abundance or abundance trends. An example of one possible problem in the trawl survey results can be seen when RPW's by statistical area for shortraker rockfish in longline surveys are compared with corresponding biomass estimates in the trawl surveys (see Table 11-7 vs Table 11-9). The longline surveys consistently indicate that shortraker rockfish are most abundant in the Yakutat area, and that this area usually comprises >50% of the Gulfwide RPW for this species. In contrast, the trawl survey results by area are much more variable, and the Yakutat area does not stand out as a particular area of abundance. In this case, the longline survey may be providing a better index of abundance by area, as the longline gear can be fished virtually anywhere in the 300-500 m slope environment inhabited by shortraker rockfish.

For "other slope rockfish", the biomass estimates indicate that five species have comprised most of the biomass for this management group: sharpchin, redstripe, harlequin, silvergrey, and redbanded rockfish (Table 11-8). Geographically, most of the biomass for these species has been found in the eastern Gulf of Alaska, especially the Southeastern statistical area (Table 11-10). The recent 2005 survey is an exception to this trend, as it showed a relatively high biomass for harlequin rockfish in the Shumagin area. Broad confidence intervals are associated with most of these biomass estimates, and the cv's for the estimates are generally much higher than those for shortraker rockfish. For example, cv's for redstripe rockfish range from 36% to 72%, compared to a range of only 17% to 33% for rougheye rockfish.

The biomass estimates for most species of "other slope rockfish" have often been highly variable from survey to survey. One extreme example of this is harlequin rockfish, whose biomass estimate increased from 2,442 mt in 1984 to 63,833 mt in 1987, and then decreased to 17,194 mt in 1990. Again, its biomass increased nearly ten-fold from 2003 to 2005. Such wide fluctuations in biomass do not seem reasonable given the slow growth and low natural mortality rates of all *Sebastes* species; in the particular case of harlequin rockfish, fishing mortality was also considered to be very low over the period of these surveys. Large catches of aggregating species, such as most "other slope rockfish" appear to be, in just a few individual hauls can greatly influence biomass estimates and may be a source of much variability. For example, in the 2003 survey, a very large catch of 5 mt of silvergrey rockfish in one haul was mostly

responsible for the extremely large biomass estimate of that species in the Southeastern area. In past slope rockfish SAFE reports, we have also speculated that a change in availability of rockfish to the survey, caused by unknown behavioral or environmental factors, may explain some of the observed variation in biomass. It seems prudent to repeat this speculation in the present report, while acknowledging that until more is known about rockfish behavior, the actual cause of changes in biomass estimates will remain the subject of conjecture.

11.3.2.3 Trawl Survey Size Compositions

Size compositions for shortraker rockfish from the trawl surveys have all been unimodal, with almost no fish <35 cm in length (Figure 11-2). Mean length of shortraker rockfish progressively declined from 61.0 cm in 1990 to 53.9 cm in 2003 and then increased to 58.1 cm in 2005. The small mean length in 2003 can be attributed mostly to an increase in the numbers of fish in the 35-50 cm range. The 2001 results may be biased by the fact that they do not include fish from the eastern Gulf of Alaska (this area was not sampled that year). Previous Gulfwide trawl surveys (e.g., Martin and Clausen, 1995; Martin, 1997) have shown shortraker rockfish to be larger in the eastern Gulf of Alaska, and the 2001 survey seems to missing many fish >70 cm in length compared to the other surveys.

11.3.2.4 Survey Age Compositions

Age determination for shortraker rockfish is problematic. This species appears to be among the longest-lived of all rockfish species, and interpretation of annuli on otoliths is extremely difficult. To date, the age reading unit at the NMFS Alaska Fisheries Science Center has been unable to read shortraker rockfish otoliths with enough confidence to age the species on a production basis. Recently, however, an experimental aging study developed a new method for aging shortraker rockfish based on using thin sections of otoliths (Hutchinson 2004). The ages determined by this method were partially validated by radiometric aging, and the method appears to hold promise that production aging of shortraker rockfish may be possible in the future.

11.4 ASSESSMENT PARAMETERS

11.4.1 Mortality, Maximum Age, Female Age and Size at 50% Maturity, and Age of Recruitment

Estimates of total mortality (Z) natural mortality (M), maximum age, and female age and size at 50% maturity are shown in Table 11-11. Estimates of Z which were based on catch curves should be considered as upper bounds for M. One researcher has reported an extremely old maximum age for shortraker rockfish in the Gulf of Alaska of 157 years (Munk 2001). If true, this would make shortraker rockfish one of the longest-lived of all fishes. McDermott (1994) used the gonad somatic index method to estimate a range of M for shortraker rockfish between 0.27 and 0.42. Age and size of maturity information is only available for shortraker and sharpchin rockfish. McDermott (1994) determined that size at 50% maturity for female shortraker rockfish was 44.9 cm based on samples collected in several regions of the northeast Pacific, including the Gulf of Alaska. Hutchinson's (2004) experimental aging study of shortraker rockfish computed von Bertalanffy growth parameters for females, and he used these parameters to convert McDermott's size of maturity to an age of 50% maturity of 21.4 years. This is first available estimate of age at maturity for shortraker rockfish. Because it was based on experimental aging, however, and was also determined indirectly, the estimate needs to be confirmed by additional study.

There is no information on age of recruitment for shortraker rockfish or any of the "other slope rockfish species".

11.4.2 Length and Weight at Age

Length-weight coefficients and von Bertalanffy parameters for shortraker and "other slope rockfish" are shown in Tables 11-12 and 11-13. The von Bertalanffy parameters for female shortraker rockfish have just recently become available and are based on an experimental aging study, so they should be used with some caution.

11.5 ANALYTIC APPROACH

Due to the lack of biological information for shortraker rockfish and "other slope rockfish" (especially an absence of age data), past assessments for these two categories have all used a biomass-based approach based on trawl survey data to calculate ABC's. We continue to use this approach in the present assessment. As previously mentioned, research is progressing on establishing acceptable aging techniques for shortraker rockfish, and it is anticipated that routine production aging for these fish may be possible in the future. If age data become available for shortraker rockfish, we expect to begin development of an age-structured model for this species.

11.5.1 Determination of Current Exploitable Biomass

As in the past, the average of the exploitable biomasses in the three most recent surveys (2001, 2003, and 2005) is used to determine current exploitable biomass of shortraker rockfish and "other slope rockfish" (Table 11-14). These estimates are derived from the Gulfwide biomass estimates listed in Table 11-14, which exclude the biomass in the 1-100 m depth stratum. The 1-100 m depth stratum was removed from the estimate because most shortraker rockfish and "other slope rockfish" in this stratum are small juvenile fish younger than the age of recruitment, and thus are not considered exploitable (Clausen and Heifetz

1989). These averages yield the following values of current exploitable biomass: 37,461 mt for shortraker rockfish and 93,552 mt for "other slope rockfish".

11.6 ABC RECOMMENDATIONS AND OVERFISHING LEVELS

11.6.1 ABC Recommendations for Shortraker Rockfish

After the shortraker/rougheye category was created in 1991, the NPFMC's Scientific and Statistical Committee (SSC) recommended estimates of natural mortality M for shortraker rockfish based on data from Table 11-11, which lists estimates of total mortality Z based on catch curve analyses. Because there was no estimate at that time of M or Z for shortraker rockfish, the SSC suggested the following computation for a proxy estimate of M: use the ratio of maximum age of rougheye to shortraker (140/120) from British Columbia and then multiply this value by the mid-point of the range of Z for rougheye rockfish in British Columbia (mid-point = 0.025) to yield an M of 0.03 for shortraker rockfish. In a later study, M for shortraker rockfish was estimated to range between 0.027 and 0.042 (McDermott 1994), so the original estimate of 0.03 for M seems reasonable.

Applying the NPFMC definitions for ABC and OFL based on Amendment 56 to the Gulf of Alaska FMP places shortraker rockfish in tier 5 where $F_{ABC} \leq 0.75M$. Thus, the recommended F_{ABC} for shortraker rockfish is 0.0225 (i.e., 0.75 X 0.03). Applying this F_{ABC} to the estimate of current exploitable biomass of 37,461 mt for shortraker rockfish results in an ABC of 843 mt for 2006.

In all previous years, annual allocation of the Gulfwide ABC for shortraker rockfish amongst the three regulatory areas in the Gulf has been based on the geographic distribution of the species' exploitable biomass in the trawl surveys. Since the 1996 SAFE report, this distribution has been computed as a weighted average of the percent exploitable biomass distribution for each area in the three most recent trawl surveys. In the computations, each successive survey is given a progressively heavier weighting using factors of 4, 6, and 9, respectively. This 4:6:9 weighting scheme was originally recommended by the Gulf of Alaska Groundfish Plan Team, and had already been used for Pacific ocean perch in the 1996 fishery. The Plan Team believed that for consistency among the rockfish assessments, the same weighting should be applied to shortraker/rougheye rockfish. The Plan Team's scheme was adopted for the 1997 fishery, and we have continued to follow it. Therefore, based on a 4:6:9 weighting of the 2001, 2003, and 2005 trawl surveys, the percent distribution of exploitable biomass for shortraker rockfish biomass in the Gulf of Alaska is: Western area, 18.13%; Central area, 41.94%, and Eastern area, 39.93% (Table 11-15). Applying these percentages to the recommended ABC of 843 mt yields the following apportionments for the Gulf in 2006: Western area, 153 mt; Central area, 353 mt; and Eastern area, 337 mt.

11.6.2 ABC Recommendations for "Other Slope Rockfish"

In the past, the recommended ABC for "other slope rockfish" was based on a harvest rate set equal to natural mortality M or 0.75 x M. An estimate of M for redstripe rockfish of 0.10 can be obtained directly from Table 11-11. An estimate of M of 0.04 was used for silvergrey rockfish based on the midpoint of the range of Z (0.01-0.07) for British Columbia stocks in Table 11-11. For harlequin and redbanded rockfish and minor species, an M of 0.06 was used based on the average M for northern, sharpchin, redstripe, and silvergrey rockfish. Applying the NPFMC definitions for ABC and OFL from amendment 56 in the Gulf of Alaska FMP places sharpchin rockfish in tier 4 where $F_{ABC} \leq F_{40\%}$, with $F_{40\%}=0.053$. The

remaining species of "other slope rockfish" are in tier 5 where $F_{ABC} \leq 0.75M$. Calculations for ABC of "other slope rockfish" are summarized in the following table:

Species	Tier	current exploit. biomass	M	$F_{40\%}$	F_{ABC} definition	F_{ABC} recommended	$F_{(ABC)}$ recommended value (mt)
Sharpchin	4	20,815	0.05	0.053	$F_{ABC} \leq F_{40\%}$	$F_{ABC} = F_{40\%}$	1,103
Redstripe	5	11,717	0.10	-	$F_{ABC} \leq 0.75 \times M$	$F_{ABC} = 0.75 \times M$	879
Harlequin	5	15,321	0.06	-	$F_{ABC} \leq 0.75 \times M$	$F_{ABC} = 0.75 \times M$	689
Silvergrey	5	38,463	0.04	-	$F_{ABC} \leq 0.75 \times M$	$F_{ABC} = 0.75 \times M$	1,154
Redbanded	5	5,138	0.06	-	$F_{ABC} \leq 0.75 \times M$	$F_{ABC} = 0.75 \times M$	231
minor species	5	2,067	0.06	-	$F_{ABC} \leq 0.75 \times M$	$F_{ABC} = 0.75 \times M$	93
All species		93,552					4,150

Therefore, the recommended combined ABC for "other slope rockfish" in 2006 is 4,150 mt. Geographic apportionment of this ABC is based on the same "4:6:9 weighted average" method as that used for shortraker rockfish. The weighted average values for "other slope rockfish" are: Western area, 13.90%; Central area, 9.30%, and Eastern area, 76.80% (Table 9-15). Applying these percentages to the recommended ABC of 4,150 mt yields the following apportionments for the Gulf in 2006: Western area, 577 mt; Central area, 386 mt; and Eastern area, 3,187 mt.

Because the Eastern area is divided into two management areas for "other slope rockfish", i.e., the West Yakutat area and the East Yakutat/Southeast Outside area, the ABC for "other slope rockfish" in the Eastern area must be further apportioned between these two smaller areas. A procedure identical to that used for the previous geographic apportionments is also applied here: a 4:6:9 weighted average of the biomass estimates in the last three trawl surveys. Since the 2001 survey did not sample the Eastern Gulf of Alaska, the three most recent surveys here were in 1999, 2003, and 2005. The weighted average of the "other slope rockfish" biomass in these three surveys for West Yakutat is 9.88%, and that for East Yakutat/Southeast Outside is 90.12%. This translates into an ABC of 315 mt for West Yakutat and 2,872 mt for East Yakutat/Southeast Outside in 2006.

11.6.3 Overfishing Levels for Shortraker rockfish and "Other Slope Rockfish"

Based on Amendment 56 in the Gulf of Alaska FMP, overfishing for a tier 5 species such as shortraker rockfish is defined to occur at a harvest rate of F=M. Therefore, applying the estimate of M for shortraker rockfish (0.03) to the estimate of current exploitable biomass (37,461 mt) yields an overfishing catch limit of 1,124 mt for 2006.

Overfishing is defined to occur at the $F_{35\%}$ (in terms of exploitable biomass per recruit) value of 0.064 for sharpchin rockfish, a tier 4 species. For the remaining species of "other slope rockfish", all of which are in tier 5, overfishing is defined to occur at the F=M rate. Applying these F's results in an overfishing catch limit of 5,394 mt for the "other slope rockfish" group in 2006.

11.6.4 Summary

A summary of tiers, current exploitable biomass, values of F, and recommended ABC's and OFL's for shortraker rockfish and "other slope rockfish" is in Table 11-16.

11.7 HARVEST SCENARIOS TO SATISFY REQUIREMENTS OF NPFMC'S AMENDMENT 56, NEPA, AND MSFCMA

For species such as shortraker rockfish and "other slope rockfish" that are not assessed with a age/length-structured model, multi-year projections are not possible but yields for just the year 2006 can be computed (Table 11-17).

11.8 ECOSYSTEM CONSIDERATIONS

In general, a determination of ecosystem considerations for shortraker rockfish and "other slope rockfish" is hampered by the lack of biological and habitat information. A summary of the ecosystem considerations presented in this section is listed in Table 11-18.

11.8.1 Ecosystem Effects on the Stock

Prey availability/abundance trends: similar to other rockfish species, stock condition of shortraker rockfish and "other slope rockfish" is probably influenced by periodic abundant year classes. Availability of suitable zooplankton prey items in sufficient quantity for larval or post-larval rockfish may be an important determining factor of year class strength. Unfortunately, there is no information on the food habits of larval or post-larval rockfish to help determine possible relationships between prey availability and year class strength; moreover, identification to the species level for field collected larval rockfish is difficult. Visual identification is not possible, although genetic techniques allow identification to species level for larval slope rockfish (Gharrett et. al 2001). Some juvenile rockfish found in inshore habitat feed on shrimp, amphipods, and other crustaceans, as well as some mollusks and fish (Byerly 2001). Adult shortraker rockfish are apparently opportunistic feeders that prey on squids, shrimp, and deepwater fish such as myctophids (Yang and Nelson 2000; Yang 2003) . Little if anything is known about abundance trends of these rockfish prey items.

Predator population trends: Rockfish are preyed on by a variety of other fish at all life stages, and to some extent marine mammals during late juvenile and adult stages. Whether the impact of any particular predator is significant or dominant is unknown. Predator effects would likely be more important on larval, post-larval, and small juvenile rockfish, but information on these life stages and their predators is nil.

Changes in physical environment: Strong year classes corresponding to the period around 1976-77 have been reported for many species of groundfish in the Gulf of Alaska, including Pacific ocean perch, northern rockfish, sablefish, and Pacific cod. Therefore, it appears that environmental conditions may have changed during this period in such a way that survival of young-of-the-year fish increased for many groundfish species, including slope rockfish. The environmental mechanism for this increased survival remains unknown. Changes in water temperature and currents could have effect on prey item abundance and success of transition of rockfish from pelagic to demersal stage. Rockfish in early juvenile stage have been found in floating kelp patches which would be subject to ocean currents. Changes in bottom habitat

due to natural or anthropogenic causes could alter survival rates by altering available shelter, prey, or other functions.

11.8.2 Fishery Effects on the Ecosystem

Fishery-specific contribution to bycatch of HAPC biota: In the Gulf of Alaska, bottom trawl fisheries for shortraker/rougheye and "other slope rockfish" account for very little bycatch of HAPC biota (Table 11-19). This low bycatch may be explained by the fact that little targeted fishing occurs for these fish.

Fishery-specific concentration of target catch in space and time relative to predator needs in space and time (if known) and relative to spawning components: Unknown

Fishery-specific effects on amount of large size target fish: Unknown

Fishery contribution to discards and offal production: Fishery discard rates during 2002-2004 have been 21 - 28 % for shortraker and rougheye rockfish and 57 - 62% for other slope rockfish. The discard amount of species other than shortraker and rougheye rockfish in hauls targeting these fish is unknown.

Fishery-specific effects on age-at-maturity and fecundity of the target fishery: Unknown.

Fishery-specific effects on EFH non-living substrate: unknown, but the heavy-duty "rockhopper" trawl gear commonly used in the fishery can move around rocks and boulders on the bottom.

11.8.3 Data Gaps and Research Priorities

There is little information on larval, post-larval, or early stage juveniles of these species. There is a particular lack of information on juvenile shortraker rockfish, which are very seldom caught in any sampling gear. Habitat requirements for larval, post-larval, and early stages are mostly unknown. Habitat requirements for later stage juvenile and adult fish are mostly anecdotal or conjectural. Research needs to be done on the bottom habitat of the fishing grounds, on what HAPC biota are found on these grounds, and on what impact bottom trawling has on these.

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Table 11-1.--Species comprising the shortraker rockfish and "other slope rockfish" management categories in the Gulf of Alaska.

Common name	Scientific name	Management category
Shortraker rockfish	*Sebastes borealis*	Shortraker rockfish
Sharpchin rockfish	*S. zacentrus*	Other slope rockfish
Redstripe rockfish	*S. proriger*	Other slope rockfish
Harlequin rockfish	*S. variegates*	Other slope rockfish
Silvergrey rockfish	*S. brevispinis*	Other slope rockfish
Redbanded rockfish	*S. babcocki*	Other slope rockfish
Yellowmouth rockfish	*S. reedi*	Other slope rockfish
Bocaccio	*S. paucispinis*	Other slope rockfish
Greenstriped rockfish	*S. elongates*	Other slope rockfish
Darkblotched rockfish	*S. crameri*	Other slope rockfish
Pygmy rockfish	*S. wilsoni*	Other slope rockfish
Splitnose rockfish	*S. diploproa*	Other slope rockfish
Blackgill rockfish	*S. melanostomus*	Other slope rockfish
Chilipepper	*S. goodie*	Other slope rockfish
Stripetail rockfish	*S. saxicola*	Other slope rockfish
Vermilion rockfish	*S. miniatus*	Other slope rockfish
Northern rockfish[a]	*S. polyspinis*	Other slope rockfish

[a]Northern rockfish are members of the "other slope rockfish" management group only in the Eastern area of the Gulf of Alaska.

Table 11-2.--Commercial catch (mt) of fish in the shortraker/rougheye rockfish and shortraker rockfish management categories in the Gulf of Alaska, with Gulfwide values of acceptable biological catch (ABC) and total allowable catch (TAC), 1991-2005. Updated through October 08, 2005.

	Area of Gulf			Gulfwide	Gulfwide	Gulfwide
Year	Western	Central	Eastern	total	ABC	TAC
			Shortraker/Rougheye Rockfish			
1991	123	408	171	702	2,000	2,000
1992	115	1,367	683	2,165	1,960	1,960
1993	85	1,197	650	1,932	1,960	1,764
1994	114	996	722	1,832	1,960	1,960
1995	216	1,222	812	2,250	1,910	1,910
1996	127	941	593	1,661	1,910	1,910
1997	137	931	541	1,609	1,590	1,590
1998	129	870	735	1,734	1,590	1,590
1999	194	580	537	1,311	1,590	1,590
2000	137	887	721	1,745	1,730	1,730
2001	126	998	852	1,976	1,730	1,730
2002	263	631	429	1,323	1,620	1,620
2003	225	856	321	1,402	1,620	1,620
2004	277	337	383	997	1,318	1,318
			Shortraker Rockfish			
2005	68	221	195	484	753	753

Sources: Catch: National Marine Fisheries Service, Alaska Region, P.O. Box 21668, Juneau, AK 99802; ABC and TAC: 1991-2003, Clausen et al. (2003); 2004 and 2005, North Pacific Fishery Management Council News and Notes, Vol. 5-03 (Dec. 2003) and Vol. 5-04 (Dec. 2004). North Pacific Fishery Management Council, 605 W. 4th. Avenue, Suite 306, Anchorage, AK 99501-2252.

Table 11-3.--Commercial catch (mt) of fish in the "other slope rockfish" management category in the Gulf of Alaska, with Gulfwide values of acceptable biological catch (ABC) and total allowable catch (TAC), 1991-2005. Updated through October 08, 2005.

	Area of Gulf			Gulfwide	Gulfwide	Gulfwide
Year	Western	Central	Eastern	Total	ABC	TAC
			Other Slope Rockfish			
1991	n.a.	n.a.	n.a.	278[a]	10,100[b]	10,100[b]
1992	76[a]	854[a]	745[a]	1,674[a]	14,060[b]	14,060[b]
1993	342	2,423	2,658	5,423	8,300	5,383
1994	101	715	797	1,613	8,300	2,235
1995	31	883	483	1,397	7,110	2,235
1996	19	618	244	881	7,110	2,020
1997	68	941	208	1,217	5,260	2,170
1998	46	701	114	861	5,260	2,170
1999	39	614	135	788	5,270	5,270
2000	49	363	165	577	4,900	4,900
2001	25	318	216	559	4,900	1,010
2002	223	481	70	774	5,040	990
2003	130	700	248	1,078	5,050	990
2004	245	534	106	885	3,900	670
2005	78	537	106	721	3,900	670

n.a. = data not available

[a]Catch estimated based on data from the Groundfish Observer Program.
[b]Includes northern rockfish, which were part of the "other slope rockfish" group in these years .

Sources: Catch: National Marine Fisheries Service, Alaska Region, P.O. Box 21668, Juneau, AK 99802; ABC and TAC: 1991-2003, Clausen et al. (2003); 2004 and 2005, North Pacific Fishery Management Council News and Notes, Vol. 5-03 (Dec. 2003) and Vol. 5-04 (Dec. 2004). North Pacific Fishery Management Council, 605 W. 4th. Avenue, Suite 306, Anchorage, AK 99501-2252.

Table 11-4.--Estimated commercial catch (mt) of shortraker rockfish in the Gulf of Alaska, 1993-2004, based on data from the NMFS Alaska Observer Program database. Estimate not available for 2004. (See text for an explanation of how these numbers were estimated). For comparison, also listed is the catch of shortraker rockfish in 2005 as of Oct. 08, 2005 (from Table 11-2).

Year	Catch
1993	1,348
1994	1,254
1995	1,545
1996	1,102
1997	1,065
1998	1,069
1999	992
2000	1,214
2001	1,385
2002	1,051
2003	1,010
2004	n.a.
2005	484

Table 11-5.--Catch (mt) of shortraker/rougheye rockfish, shortraker rockfish, and "other slope rockfish" taken during research cruises in the Gulf of Alaska, 1977-2005. Catch of shortraker rockfish not available for years before 2003. (Does not include catches in longline surveys before 1996; tr=trace)

Year	Shortraker/ rougheye	Shortraker rockfish	Other slope rockfish
1977	0.7	-	0.8
1978	2.8	-	9.5
1979	1.9	-	0.4
1980	1.9	-	0.4
1981	12.5	-	16.3
1982	5.4	-	2.9
1983	3.2	-	0.1
1984	23.7	-	3.4
1985	10.5	-	1.7
1986	2.6	-	0.0
1987	28.1	-	19.8
1988	0.0	-	0.7
1989	0.6	-	0.1
1990	7.6	-	11.8
1991	Tr	-	tr
1992	0.1	-	0.0
1993	12.8	-	11.3
1994	0.1	-	0.0
1995	Tr	-	0.0
1996	23.1	-	16.9
1997	26.6	-	0.0
1998	82.1	-	2.4
1999	145.4	-	51.6
2000	19.8	-	0.0
2001	16.9	-	0.7
2002	11.9	-	tr
2003	-	9.3	8.7
2004	-	4.7	0.0
2005	-	8.6	11.0

Tables 11-6.--Estimated species composition (percent by weight) of the "other slope rockfish" management category in the Gulf of Alaska commercial catch, 1992-2002, by regulatory area, based on vessels that had observer coverage. (tr=trace; Redbanded rockfish is not included in the 1992 and 1993 data.)

	Regulatory area			
Species	Western	Central	Eastern	Gulf of Alaska
	1992			
Sharpchin rockfish	5.6	20.2	34.7	25.9
Redstripe rockfish	0.0	8.8	25.0	15.6
Harlequin rockfish	93.0	65.8	15.2	44.5
Silvergrey rockfish	tr	0.9	16.5	7.8
Yellowmouth rockfish	1.4	4.4	8.5	6.1
Other species	tr	tr	0.2	0.1
	1993			
Sharpchin rockfish	1.8	23.9	28.6	24.8
Redstripe rockfish	5.6	25.2	22.3	22.5
Harlequin rockfish	92.3	48.0	14.5	34.4
Silvergrey rockfish	tr	2.3	15.9	8.2
Yellowmouth rockfish	tr	0.7	18.1	9.2
Other species	0.2	tr	0.6	0.3
	1994			
Sharpchin rockfish	2.1	14.8	27.9	20.5
Redstripe rockfish	0.0	3.9	22.5	12.9
Harlequin rockfish	97.3	77.7	17.0	49.0
Silvergrey rockfish	0.0	0.6	26.9	13.6
Yellowmouth rockfish	0.1	0.9	4.2	2.5
Redbanded rockfish	0.5	2.0	1.0	1.4
Other species	tr	tr	0.5	0.2
	1995			
Sharpchin rockfish	6.1	26.0	23.0	24.5
Redstripe rockfish	1.5	6.4	29.2	14.1
Harlequin rockfish	73.1	63.6	17.2	47.8
Silvergrey rockfish	0.0	0.2	25.0	8.8
Yellowmouth rockfish	6.6	0.1	2.5	1.1
Redbanded rockfish	12.6	1.2	1.6	1.6
Other species	1.6	2.5	1.5	2.2

Table 11-6.--Species composition of "other slope rockfish" (continued).

Species	Regulatory area			
	Western	Central	Eastern	Gulf of Alaska
	1996			
Sharpchin rockfish	18.3	29.0	48.1	31.6
Redstripe rockfish	6.8	14.7	19.2	15.2
Harlequin rockfish	67.6	52.0	7.1	45.7
Silvergrey rockfish	0.0	0.6	2.8	0.9
Yellowmouth rockfish	0.0	tr	4.8	0.7
Redbanded rockfish	6.6	2.4	8.2	3.4
Other species	0.7	1.3	9.9	2.6
	1997			
Sharpchin rockfish	36.2	26.3	22.6	26.0
Redstripe rockfish	37.0	26.3	8.2	23.9
Harlequin rockfish	21.8	44.9	17.7	40.4
Silvergrey rockfish	0.0	1.5	11.2	2.8
Yellowmouth rockfish	0.5	tr	35.5	5.2
Redbanded rockfish	3.3	0.8	3.5	1.2
Other species	1.1	0.3	1.2	0.5
	1998			
Sharpchin rockfish	23.6	41.7	tr	37.0
Redstripe rockfish	0.5	1.2	51.4	5.9
Harlequin rockfish	72.5	52.1	35.8	51.5
Silvergrey rockfish	tr	0.6	3.7	0.9
Yellowmouth rockfish	0.0	tr	0.4	0.1
Redbanded rockfish	3.4	2.2	3.0	2.3
Other species	0.0	2.2	5.7	2.4
	1999			
Sharpchin rockfish	6.0	25.9	18.7	21.5
Redstripe rockfish	23.1	11.1	14.4	13.6
Harlequin rockfish	45.0	58.7	53.2	55.6
Silvergrey rockfish	0.0	0.7	10.1	2.4
Yellowmouth rockfish	0.0	0.1	1.0	0.3
Redbanded rockfish	1.5	3.2	2.1	2.7
Other species	24.3	0.2	0.5	4.0

Table 11-6.--Species composition of "other slope rockfish" (continued).

Species	Regulatory area: Western	Central	Eastern	Gulf of Alaska
	2000			
Sharpchin rockfish	0.0	56.0	24.6	47.4
Redstripe rockfish	0.8	6.5	33.4	8.9
Harlequin rockfish	91.2	26.3	25.7	32.2
Silvergrey rockfish	0.0	2.4	12.2	3.3
Yellowmouth rockfish	5.7	2.0	0.4	2.2
Redbanded rockfish	2.3	4.6	3.4	4.3
Other species	0.0	2.2	0.2	1.7
	2001			
Sharpchin rockfish	31.8	31.6	13.2	28.9
Redstripe rockfish	20.2	6.2	11.7	7.9
Harlequin rockfish	26.7	50.1	60.9	50.2
Silvergrey rockfish	0.0	3.6	2.8	3.2
Yellowmouth rockfish	19.2	0.2	0.7	1.5
Redbanded rockfish	2.0	6.0	10.3	6.4
Other species	0.0	2.3	0.3	1.9
	2002			
Sharpchin rockfish	46.5	29.3	13.2	35.6
Redstripe rockfish	0.2	2.0	15.4	1.7
Harlequin rockfish	42.4	50.1	55	47.2
Silvergrey rockfish	0.0	11.2	10.9	6.7
Yellowmouth rockfish	3.9	0.8	0	2
Redbanded rockfish	1.9	6.3	5.6	4.5
Other species	5.0	0.2	0	2.2

Table 11-7.--Relative population number (RPN) and relative population weight (RPW) for shortraker rockfish in the Gulf of Alaska domestic longline survey, 1988-2005. Data are for the upper continental slope only, 201-1,000 m. depth (gullies are not included).

	Year																	
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Shortraker RPN:																		
Shumagin	4,492	3,272	3,015	3,074	1,660	1,523	2,549	5,765	4,098	2,888	4,630	5,011	9,481	5,150	3,386	3,576	6,477	2,041
Chirikof	1,290	858	773	776	572	229	613	531	646	918	973	823	1,298	1,031	951	809	474	274
Kodiak	2,332	2,691	3,476	2,412	1,374	1,067	1,040	1,325	2,231	2,200	2,498	3,078	2,904	3,703	1,982	1,510	1,409	1,807
Yakutat	5,830	6,492	9,281	10,575	9,130	7,121	5,222	7,992	8,409	12,408	15,295	13,394	13,995	14,177	9,942	7,312	7,519	6,963
Southeastern	1,420	1,972	1,403	2,247	1,479	2,199	1,862	2,427	1,967	2,459	3,258	3,167	4,025	2,646	3,098	3,951	2,874	1,905
Total	15,364	15,285	17,948	19,085	14,214	12,139	11,286	18,039	17,352	20,873	26,654	25,473	31,703	26,706	19,358	17,158	18,754	12,990
Shortraker RPW:																		
Shumagin	4,869	4,301	5,004	5,953	2,078	2,192	3,956	7,940	5,946	4,468	6,716	6,954	15,050	7,314	4,978	5,874	9,678	3,458
Chirikof	2,591	1,449	1,216	1,384	914	293	1,174	812	1,007	1,471	1,422	1,165	1,607	1,682	1,324	1,420	624	378
Kodiak	5,043	5,833	6,787	4,874	2,802	1,912	2,649	2,554	4,657	4,273	5,201	5,562	5,553	7,413	3,305	2,908	2,496	3,144
Yakutat	13,320	13,335	19,093	20,585	17,033	14,411	11,046	15,248	17,352	26,830	30,685	26,500	28,754	28,382	18,314	14,583	14,292	12,751
Southeastern	2,474	3,384	2,214	3,546	2,053	4,124	3,102	4,034	3,377	3,970	5,818	4,569	7,099	4,574	5,598	7,455	5,045	2,946
Total	28,297	28,302	34,313	36,343	24,880	22,932	21,927	30,588	32,338	41,013	49,842	44,750	58,063	49,365	33,518	32,240	32,134	22,677

Table 11-8.--Comparison of Gulfwide biomass estimates (mt) for the shortraker rockfish and "other slope rockfish" management categories in the Gulf of Alaska, based on bottom trawl surveys conducted between 1984 and 2005. Note: these are estimates of total biomass for all areas and depths sampled in the surveys. For estimates of exploitable biomass, see Table 11-14.

	Year								
Species	1984	1987	1990	1993	1996	1999	2001*	2003	2005
Shortraker rockfish	18,557	42,851	12,681	19,710	20,258	28,231	27,914	42,023	42,568
"Other Slope Rockfish"									
Sharpchin rockfish	6,612	80,439	38,334	23,676	64,570	20,841	34,169	7,094	21,193
Redstripe rockfish	5,364	26,519	27,064	29,619	14,964	8,226	17,564	8,025	21,691
Harlequin rockfish	2,625	72,405	17,664	9,281	20,026	9,877	14,480	3,545	33,125
Silvergrey rockfish	4,817	5,426	14,149	18,979	24,127	37,641	24,032	51,916	39,837
Redbanded rockfish	1,430	1,822	3,285	3,675	4,594	10,941	6,409	3,441	5,667
Darkblotched rockfish	7	37	174	291	121	272	227	91	232
Splitnose rockfish	0	3	3	0	0	7	2	5	42
Greenstriped rockfish	14	65	174	268	352	467	362	423	392
Vermilion rockfish	0	0	0	20	0	0	7	0	0
Bocaccio	505	36	173	106	137	0	81	132	0
Pygmy rockfish	0	406	88	3	283	187	141	127	137
Yellowmouth rockfish	497	260	1,876	3,563	923	5,570	3,346	387	0
Total, other slope rockfish	21,870	187,416	102,983	89,480	130,096	94,027	100,819	75,184	122,315

*The 2001 survey did not sample the eastern Gulf of Alaska. Substitute estimates of biomass for this region in 2001 were obtained by averaging the eastern Gulf biomass in the 1993, 1996, and 1999 surveys. These eastern Gulf of Alaska estimates have been included in the 2001 biomass estimates listed in this table.

Table 11-9.--Detailed biomass estimates (mt) for shortraker rockfish in the Gulf of Alaska, by statistical area, based on bottom trawl surveys conducted between 1984 and 2005. Gulfwide 95% confidence bounds, variance, and coefficient of variation (cv) are also shown for each year. Note: these are estimates of total biomass for all areas and depths sampled in the surveys. For estimates of exploitable biomass, see Table 11-14.

	Statistical areas						Gulfwide			
							95% Conf. bounds			
Year	Shumagin	Chirikof	Kodiak	Yakutat	South-eastern	Gulfwide Total	Lower	Upper	Biomass variance	Biomass cv (%)
					Shortraker Rockfish					
1984	4,874	659	4,685	6,288	2,051	18,557	4,600	32,515	34,829,252	31.8
1987	3,232	13,182	18,950	4,408	3,079	42,851	13,392	72,311	196,602,336	32.7
1990	284	1,729	3,027	6,037	1,604	12,681	6,412	18,951	9,085,499	23.8
1993	2,775	2,320	4,973	7,740	1,903	19,710	11,575	27,845	15,297,336	19.8
1996	1,905	2,406	7,726	4,523	3,699	20,258	10,652	29,865	20,532,868	22.4
1999	2,208	3,931	8,459	9,788	3,845	28,231	16,798	39,664	30,388,211	19.5
2001*	4,313	1,589	11,513	7,350	3,149	27,914	18,819	37,008	21,530,717	16.6
2003	11,166	2,996	14,292	11,936	1,633	42,023	23,572	60,474	81,168,454	21.4
2005	5,946	6,342	10,741	16,866	2,673	42,568	25,603	59,532	69,018,739	19.5

*The 2001 survey did not sample the eastern Gulf of Alaska (Yakutat and Southeastern areas). Substitute estimates of biomass for these areas in 2001 were obtained by averaging the Yakutat and Southeastern biomass in the 1993, 1996, and 1999 surveys. These eastern Gulf of Alaska estimates have been included in the 2001 biomass estimates, confidence bounds, biomass variances, and biomass cv's listed in this table.

Table 11-10.--Detailed biomass estimates (mt) for major species of "other slope rockfish" (sharpchin, redstripe, harlequin, silvergrey, and redbanded rockfish) in the Gulf of Alaska, by statistical area, based on bottom trawl surveys conducted between 1984 and 2005. Gulfwide 95% confidence bounds, variance, and coefficient of variation (cv) are also shown for each year. Note: these are estimates of total biomass for all areas and depths sampled in the surveys. For estimates of exploitable biomass, see Table 11-14.

	Statistical areas						Gulfwide			
							95% Conf. bounds			
Year	Shumagin	Chirikof	Kodiak	Yakutat	South-eastern	Gulfwide Total	Lower	Upper	Biomass variance	Biomass cv (%)
					Sharpchin Rockfish					
1984	0	25	1,921	2,332	2,334	6,612	1,693	11,531	5,803,215	36.4
1987	3,366	12	31	20,367	56,663	80,439	13,859	147,018	995,675,631	39.2
1990	2	3	3,360	2,706	32,263	38,334	9,326	67,341	201,789,069	37.1
1993	74	1	7,046	5,314	11,241	23,676	8,063	39,289	58,459,837	32.3
1996	72	840	1,081	18,871	43,705	64,570	23,139	106,001	420,270,040	31.7
1999	0	15	2,841	15,125	2,860	20,841	0	54,401	188,096,993	65.8
2001*	23	4	1,770	13,103	19,269	34,169	0	85,559	687,440,998	76.7
2003	38	24	266	1,638	5,128	7,094	0	14,338	10,571,214	45.8
2005	195	28	10,730	4,827	5,413	21,193	7,442	34,943	46,289,971	32.1
					Redstripe Rockfish					
1984	0	5	134	9	5,216	5,364	922	9,806	4,732,655	40.6
1987	1,263	0	1,820	1,785	21,651	26,519	0	53,639	157,644,113	47.3
1990	0	0	15	3,147	23,903	27,064	0	56,675	195,093,233	51.6
1993	5	96	16	2	29,500	29,619	0	64,739	268,061,624	55.3
1996	152	91	0	13	14,709	14,964	0	31,716	65,560,357	54.1
1999	0	8	131	40	8,047	8,226	0	16,618	16,374,663	49.2
2001*	3	7	117	18	17,419	17,564	0	42,415	160,764,784	72.2
2003	5	0	175	0	7,845	8,025	2,109	13,942	8,313,938	35.9
2005	2,796	5	12,822	137	5,931	21,691	0	51,372	157,510,783	57.9
					Harlequin Rockfish					
1984	65	29	1,284	555	692	2,625	972	4,277	682,693	31.5
1987	7,491	407	19,842	15,233	29,433	72,405	28,945	115,865	452,965,027	29.4
1990	125	434	13,150	1,141	2,814	17,664	0	36,735	80,922,933	50.9
1993	84	258	8,271	384	284	9,281	301	18,260	19,280,318	47.3
1996	773	258	2,625	2,073	14,298	20,026	0	46,293	164,490,940	64.0
1999	7	167	8,396	1,046	261	9,877	1,313	18,440	17,587,024	42.5
2001*	2,987	221	5,157	1,167	4,948	14,480	0	34,638	105,778,063	71.0
2003	25	968	530	1,097	924	3,545	313	6,776	2,504,458	44.6
2005	26,668	222	1,708	4,408	119	33,125	0	77,144	454,826,845	64.4

(Table continued on next page).

Table 11-10.--(Continued)

	Statistical areas						Gulfwide			
							95% Conf. bounds			
Year	Shumagin	Chirikof	Kodiak	Yakutat	South-eastern	Gulfwide Total	Lower	Upper	Biomass variance	Biomass cv (%)
					Silvergrey Rockfish					
1984	0	0	52	1,071	3,693	4,817	1,336	8,298	1,833,053	28.1
1987	37	6	144	1,917	3,322	5,426	858	9,994	4,642,273	39.7
1990	0	4	277	5,178	8,691	14,149	1,996	26,301	35,417,352	42.1
1993	0	82	462	1,244	17,191	18,979	6,682	31,276	33,645,705	30.6
1996	0	28	1,525	2,934	19,641	24,127	10,958	37,297	41,592,853	26.7
1999	0	0	6,745	6,456	24,440	37,641	12,371	62,911	153,140,523	32.9
2001*	0	16	47	3,545	20,424	24,032	13,742	34,321	27,558,377	21.8
2003	0	37	28	3,067	48,784	51,916	0	130,981	1,453,296,905	73.4
2005	18	652	421	10,834	27,912	39,837	8,250	71,424	244,273,608	39.2
					Redbanded Rockfish					
1984	0	39	130	727	534	1,430	531	2,330	198,019	31.1
1987	21	391	213	762	435	1,822	600	3,044	353,367	32.6
1990	0	32	187	1,420	1,646	3,285	887	5,683	1,302,634	34.7
1993	11	116	318	1,084	2,147	3,675	1,513	5,837	1,105,665	28.6
1996	61	40	160	1,497	2,836	4,594	1,476	7,711	2,379,370	33.6
1999	118	45	358	1,344	9,076	10,941	1,350	20,532	20,254,925	41.1
2001*	61	51	303	1,308	4,686	6,409	0	15,063	19,497,202	68.9
2003	19	672	218	548	1,984	3,441	1,907	4,974	563,886	21.8
2005	41	180	830	2,211	2,405	5,667	3,051	8,283	1,466,795	21.4

*The 2001 survey did not sample the eastern Gulf of Alaska (Yakutat and Southeastern areas). Substitute estimates of biomass for these areas in 2001 were obtained by averaging the Yakutat and Southeastern biomass in the 1993, 1996, and 1999 surveys. These eastern Gulf of Alaska estimates have been included in the 2001 biomass estimates, confidence bounds, biomass variances, and biomass cv's listed in this table.

Table 11-11.-- Mortality rates, maximum age, and female age and size at 50% maturity for shortraker rockfish and some species of "other slope rockfish". Size is fork length in cm. Area indicates location of study: West Coast of USA (WC), British Columbia (BC), Gulf of Alaska (GOA), Aleutians (AL), and eastern Bering Sea (EBS). All mortality rates except where noted are for instantaneous rate of total mortality (Z) estimated with catch-curves.

Species	Mortality rate	Maximum age	Age at Maturity	Size at Maturity	Area	References
Shortraker	-	120	-	-	BC	2
	0.027-0.042[a]	-	21.4	44.9	WC,GOA,AL,EBS	6,4
	-	157	-	-	GOA	7
Sharpchin	0.05	46	-	-	BC	1
	-	58	10	26.5	GOA	5,3
Yellowmouth	0.06	71	-	-	BC	1,2
	-	99	-	-	BC	7
Darkblotched	0.07	48	-	-	BC	1
Harlequin	-	43	-	-	BC	2
	-	34	-	-	GOA	5
Redstripe	0.1	41	-	-	BC	1,2
	-	55	-	-	BC	7
Silvergrey	0.01-0.07	80	-	-	BC	1,2
	-	75	-	-	GOA	5

1) Archibald et al. 1981; 2) Chilton and Beamish 1982; 3) Heifetz et al. 1997; 4) Hutchinson 2004; 5) Malecha and Heifetz 2000; 6) McDermott 1994; 7) Munk 2001. [a]M based on the gonad somatic index method (McDermott 1994).

Table 11-12.-- Length-weight coefficients for shortraker and sharpchin rockfish in the Gulf of Alaska. Length-weight coefficients are from the formula $W = aL^b$ where W = weight in kg and L = length in cm. (Based on data in Martin 1997).

Species	Sex	a	b
Shortraker	combined	9.85×10^{-6}	3.13
	males	1.26×10^{-5}	3.07
	females	1.02×10^{-5}	3.12
Sharpchin	combined	1.13×10^{-5}	3.07
	males	8.89×10^{-6}	3.15
	females	1.19×10^{-5}	3.06

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Table 11-13.--Von Bertalanffy parameters for shortraker, sharpchin, silvergrey, and harlequin rockfish, by area and sex. (BC = British Columbia; GOA = Gulf of Alaska; AI = Aleutian Islands: EBS = Eastern Bering Sea).

Species	Area	Sex	t_0	k	L_{inf} (cm)	Reference
Shortraker	GOA/AI/EBS	female	-3.62	0.030	84.60	2
Sharpchin	BC	combined	-2.21	0.095	34.90	1
	GOA	combined	-0.81	0.131	32.64	3
	GOA	male	-0.48	0.167	28.44	3
	GOA	female	-0.75	0.122	35.02	3
Silvergrey	GOA	combined	-1.68[a]	0.100	59.80	3
	GOA	male	-1.68[a]	0.110	57.14	3
	GOA	female	-1.68[a]	0.093	62.25	3
Harlequin	GOA	combined	-3.86	0.099	31.51	3
	GOA	male	-4.76	0.091	30.60	3
	GOA	female	-3.26	0.110	32.32	3

1) Archibald et al. 1981; 2) Hutchinson 2004; 3) Malecha and Heifetz 2000.

[a] t_0 for silvergrey rockfish could not be accurately estimated from the data, therefore t_0 was constrained at the average value for all other rockfish species.

Table 11-14.--Estimates of exploitable biomass of shortraker rockfish and "other slope rockfish" in the Gulf of Alaska, by NPFMC regulatory area, based on the 2001, 2003, and 2005 trawl surveys.

Species	Exploitable biomass (mt) Western	Central	Eastern	Total
		2001[a]		
Shortraker rockfish	4,313	13,102	10,499	27,914
Sharpchin rockfish	23	1,774	32,372	34,169
Redstripe rockfish	0	124	17,433	17,557
Harlequin rockfish	2,986	5,333	6,098	14,416
Silvergrey rockfish	0	16	23,888	23,904
Redbanded rockfish	61	304	5,983	6,347
Minor species[b]	0	0	4,265	4,265
Total, "other slope rockfish"	3,070	7,551	90,056	100,676
		2003		
Shortraker rockfish	11,166	17,288	13,569	42,023
Sharpchin rockfish	38	281	6,764	7,083
Redstripe rockfish	0	175	7,844	8,019
Harlequin rockfish	17	561	2,016	2,594
Silvergrey rockfish	0	9	51,825	51,834
Redbanded rockfish	19	850	2,532	3,402
Minor species[b]	0	0	1,035	1,035
Total, "other slope rockfish"	74	1,876	72,015	73,965
		2005		
Shortraker rockfish	5,809	17,083	19,538	42,431
Sharpchin rockfish	195	10,757	10,241	21,193
Redstripe rockfish	2,783	760	6,033	9,575
Harlequin rockfish	26,569	1,930	438	28,937
Silvergrey rockfish	0	1,008	38,642	39,650
Redbanded rockfish	41	1,010	4,616	5,667
Minor species[b]	0	1	900	901
Total, "other slope rockfish"	29,588	15,466	60,870	105,923

[a] Values for Eastern area are the averages of 1993, 1996, and 1999 values because this area was not sampled in 2001.

[b] Estimates for minor species in the Eastern area include northern rockfish.

Table 11-15.-- Percentage of exploitable biomass by area for shortraker rockfish and "other slope rockfish" based on the 2001, 2003, and 2005 Gulf of Alaska trawl surveys. Weighted average uses weights of 4:6:9 for the 2001, 2003, and 2005 surveys, respectively.

	Western	Central	Eastern
2001[a]			
Shortraker rockfish	15.45%	46.94%	37.61%
"Other slope rockfish" [b]	3.05%	7.50%	89.45%
2003			
Shortraker rockfish	26.57%	41.14%	32.29%
"Other slope rockfish" [b]	0.10%	2.54%	97.36%
2005			
Shortraker rockfish	13.69%	40.26%	46.05%
"Other slope rockfish" [b]	27.93%	14.60%	57.47%
Weighted average			
Shortraker rockfish	18.13%	41.94%	39.93%
"Other slope rockfish"[b]	13.90%	9.30%	76.80%

[a] Values for Eastern area are the averages of 1993, 1996, and 1999 values.
[b] Includes northern rockfish in the Eastern area.

Table 11-16.--Summary of computations of ABC's and overfishing levels for shortraker rockfish and "other slope rockfish" for 2006. Biomass and yields are in mt. Since actual ABC's and overfishing levels for "other slope rockfish" are based on the overall management category, individual species are shown only for illustrative purposes.

		Exploit.	ABC		Overfishing	
Species	Tier	biomass	F	Yield	F	Yield
Shortraker rockfish	5	37,461	F=0.75M=0.023	843	F=M=0.030	1,124
Sharpchin rockfish	4	20,815	$F_{40\%}$=0.053	1,103	$F_{35\%}$=0.064	1,332
Redstripe rockfish	5	11,717	F=0.75M=0.075	879	F=M=0.100	1,172
Harlequin rockfish	5	15,321	F=0.75M=0.045	689	F=M=0.060	919
Silvergrey rockfish	5	38,463	F=0.75M=0.030	1,154	F=M=0.040	1,539
Redbanded rockfish	5	5,138	F=0.75M=0.045	231	F=M=0.060	308
Minor species	5	2,067	F=0.75M=0.045	93	F=M=0.060	124
Total, other slope rockfish		93,552		4,150		5,394

Table 11-17.--Set of projections of yield for shortraker rockfish and "other slope rockfish" for 2006 in the Gulf of Alaska. This set of projections encompasses scenarios designed to satisfy the requirements of Amendment 56, the National Environmental Protection Act, and the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). Biomass and yields are in mt.

	Exploitable	Scenario 1		Scenario 2		Scenario 3		Scenario 4	
Species	Biomass	F	Yield	F	Yield	F	Yield	F	Yield
Shortraker	37,461	0.023	843	0.023	843	0.0113	421	-	-
Sharpchin	20,815	0.053	1,103	0.053	1,103	0.0265	552	-	-
Redstripe	11,717	0.075	879	0.075	879	0.0375	439	-	-
Harlequin	15,321	0.045	689	0.045	689	0.0225	345	-	-
Silvergrey	38,463	0.030	1,154	0.030	1,154	0.0150	577	-	-
Redbanded	5,138	0.045	231	0.045	231	0.0225	116	-	-
Minor spp	2,067	0.045	93	0.045	93	0.0225	47	-	-
Total, other slope rockfish	93,552		4,150		4,150		2,075	0.008	758

Scenario 1: F is set equal to max F_{ABC}.
Scenario 2: F is set equal to the recommended $F_{ABC.}$
Scenario 3: F is set equal to 50% of max F_{ABC}.
Scenario 4: F is set equal to the average F for 2001-2005 (i.e., the most recent five years with catch data). (Scenario 4 calculations were not done for shortraker rockfish because official catch information for this management category is only available for 2005).

Table 11-18.-- Analysis of ecosystem considerations for shortraker rockfish and "other slope rockfish".

Indicator	*Observation*	*Interpretation*	*Evaluation*
ECOSYSTEM EFFECTS ON STOCK			
Prey availability or abundance trends	important for larval and post-larval survival, but no information known	may help to determine year class strength	possible concern if some information available
Predator population trends	unknown		little concern for adults
Changes in habitat quality	variable	variable recruitment	possible concern
FISHERY EFFECTS ON ECOSYSTEM			
Fishery contribution to bycatch			
Prohibited species	unknown		
Forage (including herring, Atka mackerel, cod, and pollock)	unknown		
HAPC biota (seapens/whips, corals, sponges, anemones)	fishery disturbing hard-bottom biota, i.e., corals, sponges	could harm the ecosystem by reducing shelter for some species	concern
Marine mammals and birds	probably few taken		little concern
Sensitive non-target species	unknown		
Fishery concentration in space and time	little overlap between fishery and reproductive activities	fishery does not hinder reproduction	little concern
Fishery effects on amount of large size target fish	unknown		

Indicator	***Observation***	***Interpretation***	***Evaluation***
Fishery contribution to discards and offal production	discard rates moderate to high for other slope rockfish	some unnatural input of food into the ecosystem	some concern
Fishery effects on age-at-maturity and fecundity	unknown		

Table 11-19. Average bycatch (kg) and bycatch rates during 1997 - 99 of living substrates in the Gulf of Alaska; POT - pot gear; BTR - bottom trawl; HAL - Hook and line (source - Draft Programmatic SEIS).

		Bycatch (kg)				Target	Bycatch rate (kg/mt target)			
Target fishery	Gear	Coral	Anemone	Sea whips	Sponge	catch (mt)	Coral	Anemone	Sea whips	Sponge
Arrowtooth flounder	POT	0	0	0	0	4	0.0000	0.0000	0.0000	0.0000
Arrowtooth flounder	BTR	58	99	13	24	2,097	0.0276	0.0474	0.0060	0.0112
Deep water flatfish	BTR	1,626	481	5	733	2,001	0.8124	0.2404	0.0024	0.3663
Rex sole	BTR	321	306	11	317	2,157	0.1488	0.1417	0.0053	0.1468
Shallow water flatfish	POT	0	0	0	0	5	0.0000	0.0000	0.0000	0.0000
Shallow water flatfish	BTR	53	4,741	115	403	2,024	0.0261	2.3420	0.0567	0.1993
Flathead sole	BTR	3	267	1	136	484	0.0071	0.5522	0.0019	0.2806
Pacific cod	HAL	28	4,419	961	33	10,765	0.0026	0.4105	0.0893	0.0030
Pacific cod	POT	0	14	0	1,724	12,863	0.0000	0.0011	0.0000	0.1340
Pacific cod	BTR	34	5,767	895	788	37,926	0.0009	0.1521	0.0236	0.0208
Pollock	BTR	1,153	55	0	23	2,465	0.4676	0.0222	0.0000	0.0092
Pollock	PTR	41	110	0	0	97,171	0.0004	0.0011	0.0000	0.0000
Demersal shelf rockfish	HAL	0	0	0	141	226	0.0000	0.0000	0.0000	0.6241
Northern rockfish	BTR	25	90	0	103	1,938	0.0127	0.0464	0.0000	0.0532
Other slope rockfish	HAL	0	0	0	0	14	0.0000	0.0000	0.0000	0.0000
Other slope rockfish	BTR	0	0	0	0	193	0.0000	0.0000	0.0000	0.0000
Pelagic shelf rockfish	HAL	0	0	0	0	203	0.0000	0.0000	0.0000	0.0000
Pelagic shelf rockfish	BTR	324	176	3	245	1,812	0.1788	0.0969	0.0017	0.1353
Pacific ocean perch	BTR	549	90	5	1,968	6,564	0.0837	0.0136	0.0007	0.2999
Pacific ocean perch	PTR	7	0	0	55	1,320	0.0052	0.0000	0.0000	0.0416
Shortraker/rougheye	HAL	6	0	0	0	19	0.3055	0.0000	0.0000	0.0000
Shortraker/rougheye	BTR	0	18	0	0	21	0.0000	0.8642	0.0000	0.0000
Sablefish	HAL	156	154	68	27	11,143	0.0140	0.0138	0.0061	0.0025
Sablefish	BTR	0	0	0	0	27	0.0000	0.0000	0.0000	0.0000
Shortspine thornyhead	HAL	0	0	0	0	2	0.0000	0.0000	0.0000	0.0000
Shortspine thornyhead	BTR	0	9	0	1	2	0.0000	4.8175	0.0000	0.4069

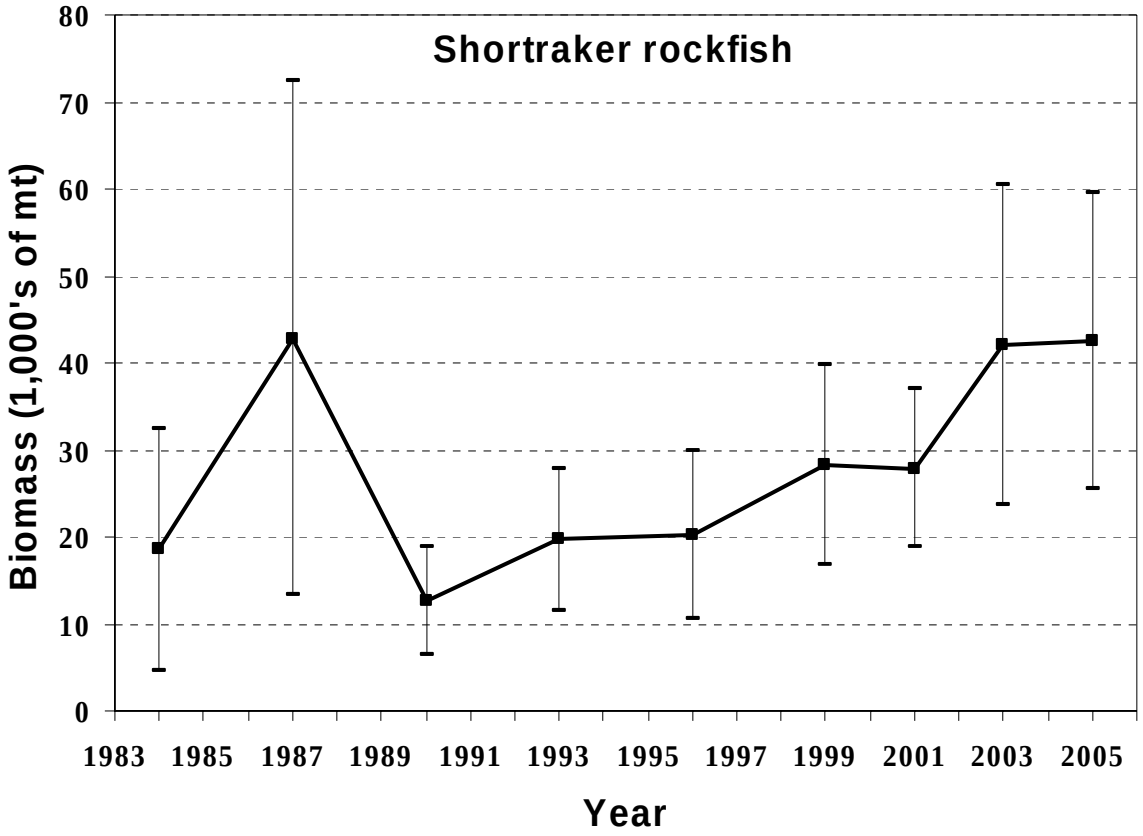

Figure 11-1.--Estimated biomass of shortraker rockfish in the Gulf of Alaska based on results of bottom trawl surveys from 1984 through 2005. The vertical bars show the 95% confidence limits associated with each estimate. The eastern Gulf of Alaska was not sampled in the 2001 survey, but substitute estimates of biomass and variance for this region in 2001 were calculated and included in the above graph.

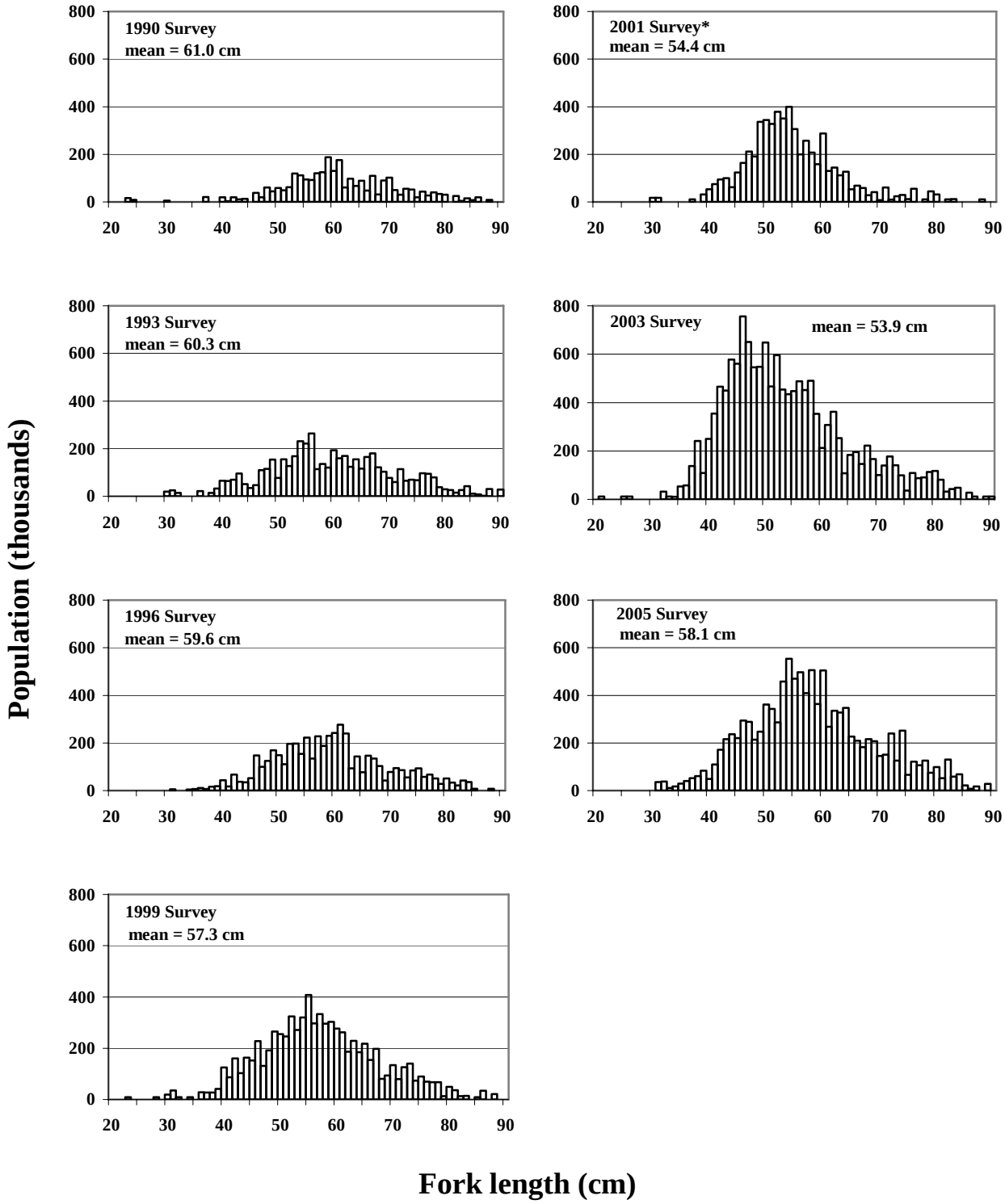

Figure 11-2.--Length frequency distribution of the estimated population of shortraker rockfish in the Gulf of Alaska, based on trawl surveys from 1990 through 2005. *2001 survey did not sample the eastern Gulf of Alaska.

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