

SHORTRAKER/ROUGHEYE AND OTHER SLOPE ROCKFISH

by

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9.0 Executive Summary

The shortraker rougheye and other slope rockfish assessment is now reported separately from the Pacific ocean perch and northern rockfish assessments. New information included in this assessment are biomass estimates from the 2003 trawl survey.

As in the past, exploitable biomass for shortraker and rougheye rockfish and “other slope rockfish” was estimated by the unweighted average biomass of the most recent three trawl surveys, 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 73,000 mt for shortraker/rougheye rockfish and 89,460 mt for “other slope rockfish”. Applying a combination of $F=M$ and $F=0.75M$ rates results in ABC's of 1,760 mt for shortraker/rougheye rockfish and 3,900 mt for “other slope rockfish”. Assessing rougheye rockfish with an age-structured model is still in a very preliminary stage, and the model has been hindered by the sparse data from the commercial fishery and the scarcity of age data for this species. At present, further model development is on hold until more data become available.

Response to SSC comments

The SSC reiterated a concern for lumping shortraker and rougheye rockfish into a single ABC. Observer data from 2000-2002 indicates 69-83 % of the composition of the catch is made up of shortraker rockfish, whereas only 43% of the ABC is shortraker rockfish. To address this situation, the combined ABC could be set at a level such that an individual ABC for shortraker (753 mt) is not exceeded. Assuming that 72.7% of the catch (i.e., average of 2000-2002) will be shortraker rockfish, the combined ABC could be set at 1,035 mt (i.e. $753/0.727$). Another alternative would be to set individual ABCs for rougheye and shortraker rockfish. This would result in an ABC of 750 mt for shortraker rockfish and 1,010 mt for rougheye rockfish.

“Shortraker/rougheye rockfish” and “other slope rockfish” were created as separate management categories in the Gulf of Alaska by the North Pacific Fishery Management Council (NPFMC) in 1991. Although each management group is assigned its own value of ABC (acceptable biological catch) and TAC (total allowable catch), they are discussed together in this SAFE chapter because all species in the groups are classified into tiers 4 or higher 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 modeling, although some exploratory modeling has been done for rougheye rockfish. The common and scientific names for each species in the two management groups are listed in Table 9-1.

Shortraker and rougheye rockfish will be the focus of most of this chapter because of their abundance and commercial importance in the Gulf of Alaska, and also because more information is known about them in Alaska than the “other slope rockfish” species. Shortraker rockfish range from southeastern Kamchatka, north into the Bering Sea, and through the Aleutian Islands and Gulf of Alaska south to southern California. Rougheye rockfish are found around the arc of the North Pacific from Japan to southern California, including the Bering Sea. The center of abundance for both species appears to be Alaskan waters. In the Gulf of Alaska, as adults they 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). Both species often co-occur in trawl or longline hauls. This co-occurrence, along with the fact that the two species are similar in appearance and can be difficult to distinguish visually, was the original reason the NPFMC grouped them together as a management category.

In contrast to shortraker and rougheye rockfish, nearly all the 17 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 and rougheye 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 studies on fecundity of either fish in Alaska. One study on reproductive biology of both species indicated that both had protracted reproductive periods, 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 and rougheye 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. Juvenile rougheye rockfish 15-40 cm fork length have been frequently taken in trawl surveys of the Gulf of Alaska at many locations ranging from inshore fiords to offshore waters of the continental shelf. In contrast, 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. As mentioned previously, adults of both species 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 and rougheye rockfish seemed to prefer steep slopes with frequent boulders (Krieger and Ito, 1999). Within

this habitat, shortraker and rougheye rockfish tend to have a relatively even distribution when compared with the highly aggregated and patchy distribution of other rockfish such as Pacific ocean perch¹.

Genetic studies of shortraker and rougheye rockfish have indicated that both species show stock structure in the Gulf of Alaska (Seeb, 1986; Hawkins et al., 1997; Matala et al., 2003a and 2003b; Gharrett et al., 2003a), but additional research is needed to better define this structure. Moreover, one recent study indicates that the genetic differences in stock structure of rougheye rockfish are so large that the fish can be divided into two forms that are “clearly distinct species” (Gharrett et al., 2003b). Each species form is loosely correlated with a color morph: a dark form that appears to be more common in the central and western Gulf of Alaska, and a light form that may be more common in the inside waters of the eastern Gulf of Alaska. In some instances, both species forms were found to co-occur in the same haul. Research is in progress to determine if definitive morphological characteristics can be found to allow visual identification of the two species forms. Clearly, identification of two species of rougheye rockfish could have important management implications in future assessments.

In practice, the NPFMC has apportioned the ABC’s and TAC’s for both shortraker/rougheye 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. (See section 8.1 of the northern rockfish chapter for more discussion about this action). Therefore, northern rockfish is listed as an “other slope rockfish” species in table 9-1, but only for the Eastern area.

9.2

FISHERY

9.2.1 Catch History

Fishery catch statistics for shortraker/rougheye and “other slope rockfish” are only available for the years since 1991 (Table 9-2), when these two management categories were first created. Previous to 1991, these 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/rougheye or “other slope rockfish” species.

Gulfwide catches of shortraker/rougheye have been consistently around 1,500-2,000 mt in the years since 1992. Annual TAC’s have been the major determining factor of these catch amounts, as TAC’s have also ranged between ~1,500-2,000 mt over these years.

¹Clausen, 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.

With the exception of 1993, Gulfwide catches of “other slope rockfish” have always been <1,700 mt. 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 and “other slope rockfish” are shown in Table 9-3.

9.2.2 Description of the Fishery

Since the creation of shortraker/rougheye rockfish as a separate management category in the Gulf of Alaska, they have always been managed as “bycatch” only species. Both species can be caught in either bottom trawls or on longlines. The percent caught in each gear type is listed in the following table for the years 1993-2002²:

Gear	<u>Shortraker/Rougheye Rockfish</u>									
	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Trawl	66.1	51.9	68.9	67.2	66.3	52.8	55.5	57.1	40.1	57.1
Longline	33.9	48.1	31.1	32.8	33.7	47.2	44.5	42.9	59.9	42.9

Thus, in all years except 2001, the majority of the catch has been taken by trawlers. Nearly all the longline catch of shortraker/rougheye appears to come as “true” bycatch in the sablefish or halibut longline fisheries. In rockfish trawl fisheries, however, some of the shortraker/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 bycatch rate for certain species that may be encountered as bycatch. If a vessel manages to not catch this bycatch limit during the course of a directed fishing trip, or the bycatch rate is set unnaturally high (as data presented in Ackley and Heifetz (2001) suggest), before returning to port the vessel may be able to make some target hauls on the bycatch species and still not exceed its bycatch limit. 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 1993-2002:

Gear	<u>Other Slope Rockfish</u>									
	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Trawl	96.8	91.9	92.1	87.6	88.8	86.8	86.1	73.7	55.3	84.9
Longline	3.2	8.1	7.9	12.4	11.2	13.2	13.9	26.3	44.7	15.1

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”, except in 1993 when 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.

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

9.2.3 Species Composition of the Fishery

Detailed species composition data for the "other slope rockfish" and shortraker/rougheye categories in the 1992-2002 commercial fishery can be estimated from information collected by the domestic observer program (Tables 9-4a and 9-4b). 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. This bias may be a particular problem for shortraker/rougheye that were caught by longliners. Much of the longline catch is taken by small vessels that have no observer coverage. Hence, the data in Table 9-4b for shortraker/rougheye probably reflects more what the trawl fishery catches. Even so, the much larger percentage of shortraker rockfish reported by observers most years, combined with the fact that the majority of the catch is usually taken by trawling (see table in preceding Section 9.2.2), strongly suggests that shortraker rockfish comprises more of the overall catch than does rougheye. For "other slope rockfish", the problem of bias in the observer coverage is less important because relatively little of the catch is taken by longliners. Therefore, the percentage data in Table 9-4a can be applied to the commercial catches in Table 9-2 to yield the following Gulfwide estimates of catch in mt for each species:

	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>	<u>1997</u>	<u>1998</u>	<u>1999</u>	<u>2000</u>	<u>2001</u>	<u>2002</u>
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.

9.2.4 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.

9.2.5 Discards

Gulfwide discard rates³ (% of the total catch discarded within management categories) of fish in the two management categories are listed as follows for the years 1991-2002 (data are not available for "other slope rockfish" in 1991-92):

³Source: 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 5, 2002.

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

The above table indicates that discards of shortraker/rougheye have generally been moderate over the years, whereas the rates for “other slope rockfish” have been 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.

9.3

DATA

9.3.1 Fishery Data

9.3.1.1 Catch

Detailed catch information for slope rockfish is listed in Table 9-2.

9.3.1.3 Size and Age Composition

The number of lengths sampled by observers for shortraker and rougheye rockfish and “other slope rockfish” in the Gulf of Alaska commercial fishery have usually been too small to yield meaningful data, although some relatively large numbers of rougheye rockfish lengths are available for the years 1988 and 1990-1992. These lengths have been used as input for the preliminary rougheye rockfish model discussed in section 9.5.1. Few age samples for any of these species have been collected from the fishery, and none have been aged.

9.3.2 Survey Data

9.3.2.1 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 and rougheye 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 these rockfish 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 rougheye and shortraker rockfish remained stable in the Gulf of Alaska (Clausen and Heifetz 1989). The data also indicate that rougheye and 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 9-5⁴). For rougheye rockfish, Gulfwide RPN values from this survey have ranged from a low of ~13,000 in 1988 to a high of ~39,000 in 2000; 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 for each species 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, and relatively high RPN's and RPW's for rougheye rockfish were also seen in these years. In 2002 and 2003, RPN's and RPW's for both species decreased compared to the 1997-2001 period, and this was especially true for shortraker rockfish. Relative to the 1988-2003 average, the average RPW over 2002 and 2003 is about 7.5% lower for shortraker rockfish while for rougheye rockfish, the recent average is less than 1% below the long-term average.

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

9.3.2.2 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 and 2003. The surveys provide much information on shortraker/rougheye 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 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.

9.3.2.2.1 Biomass Estimates for Shortraker and Rougheye Rockfish

Biomass estimates for rougheye rockfish have usually been higher than those for shortraker rockfish, except for 1987 and 2003, when they were nearly equal (Table 9-6). The estimates for rougheye have

⁴ C. Lunsford, National Marine Fisheries Service, Alaska Fisheries Science Center, Auke Bay Laboratory, 11305 Glacier Hwy., Juneau AK 99801. Pers. commun. September 2003.

been very constant among the surveys (with the possible exception of 1993), and the overlapping confidence intervals for this species in all the surveys (Table 9-7; Figure 9-1) indicate that none of the changes in biomass are statistically significant. Shortraker rockfish have shown larger fluctuations in biomass from survey to survey, but similar to rougheye, the survey confidence intervals have all overlapped (Table 9-7; Figure 9-2) and do not appear significant, with one exception: the 2003 estimate (42,023 mt) appears to be significantly greater than the 1990 estimate (12,681 mt). Compared with other species of *Sebastes*, the estimates for both shortraker and rougheye rockfish show relatively tight confidence intervals and low coefficients of variations (cv's; Table 9-7). This is especially true for rougheye rockfish, with cv's for Gulfwide biomass estimates ranging between just 11% and 23%. The low cv's are an indication of the rather even distribution for the two species that was noted in the introduction (Section 9.1).

Despite this precision, however, the trawl surveys are believed to do a relatively poor job of assessing abundance of shortraker and rougheye 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 and rougheye 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 9-5 vs Table 9-7). 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.

9.3.2.2 Biomass Estimates for "Other Slope Rockfish"

Five species of "other slope rockfish" have comprised most of the biomass for this management group: sharpchin, redstripe, harlequin, silverygrey, and redbanded rockfish (Table 9-6). Geographically, most of the biomass for these species has been found in the eastern Gulf of Alaska, especially the Southeastern statistical area (Table 9-8). 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 and rougheye rockfish. For example, cv's for sharpchin rockfish range from 36% to 77%, compared to a range of only 11% to 23% for rougheye rockfish.

The biomass estimates for most species 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. 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 silverygrey 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.

9.3.2.3 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 9-3). Mean length of shortraker rockfish progressively declined from 61.0 cm in 1990 to 53.9 cm in 2003. The small mean length in 2003, however, can be attributed to an increase in the numbers of fish in the 35-50 cm range, rather than a decline in the numbers of larger fish. 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 be missing many fish >70 cm in length compared to the other surveys.

The size compositions of rougheye rockfish in the 1993, 1996, 1999, 2001, and 2003 surveys all indicated that a sizeable portion of the population each year was <30 cm in length, which suggests that at least a moderate level of recruitment has been occurring throughout these years (Figure 9-4). The 1993, 1996, and 2001 compositions were all skewed to the right, with a mode of about 42-44 cm. Prominent modes were seen in 2001 and 2003 at 42 cm and 44 cm, respectively.

9.3.2.4 Survey Age Compositions

Age determination for both shortraker and rougheye rockfish is problematic. These species appear 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 determine age compositions for any survey. Recently, NMFS age readers have determined that aging of rougheye rockfish can be moved into a production mode, and available age data for this species are being incorporated into development of an age-structured model (see Section 9.5.2). So far, however, age composition data are only available for rougheye rockfish in the 1990 Gulf of Alaska trawl survey (Figure 9-5). These data show especially prominent modes at ages 10 and 14 (corresponding to the 1980 and 1976 year classes, respectively) and a long tail extended into older ages.

9.4

ASSESSMENT PARAMETERS

9.4.1 Natural Mortality, Maximum Age, Age of Recruitment, and Age and Size at 50% Maturity

Estimates of total mortality (Z) natural mortality (M), maximum age, and age of recruitment are shown in Table 9-9. Estimates of Z which were based on catch curves should be considered as upper bounds for M. Recently, one researcher has reported extremely old maximum ages for shortraker and rougheye rockfish in the Gulf of Alaska of 157 and 205 years, respectively (Munk 2001). McDermott (1994) used the gonad somatic index method to estimate a range of M for shortraker and rougheye rockfish.

Age and size of maturity information is only available for three species: shortraker, rougheye, and sharpchin rockfish. McDermott (1994) determined that size at 50% maturity for female shortraker rockfish was 44.9 cm and 44.0 cm for rougheye rockfish based on samples collected in several regions of the northeast Pacific, including the Gulf of Alaska. This size of 50% maturity for rougheye could be

converted to an age of 20.3 years. Information on female age and size at 50% maturity for sharpchin rockfish in the eastern Gulf of Alaska is listed below⁵:

<u>Management area</u>	<u>Sample size</u>	<u>Size at 50% maturity</u>	<u>Age at 50% maturity</u>
Eastern	164	26.5 cm	10

9.4.2 Length and Weight at Age

Length-weight coefficients and von Bertalanffy parameters for shortraker and rougheye rockfish and “other slope rockfish” are shown in Tables 9-10 and 9-11.

9.5 ANALYTIC APPROACH

Due to the lack of biological information for shortraker/rougheye rockfish and “other slope rockfish”, past assessments for these two groups 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. In 2001 we began very preliminary work on using an age-structured model for rougheye rockfish.

9.5.1 Determination of Current Exploitable Biomass

As in the past, the average of the exploitable biomasses in the three most recent surveys (1999, 2001, and 2003) is used to determine current exploitable biomass of shortraker and rougheye rockfish and “other slope rockfish” (Table 9-12). These estimates are derived from the Gulfwide biomass estimates listed in Table 9-12, 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/rougheye 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: 32,723 mt for shortraker rockfish, 40,281 mt for rougheye rockfish, and 89,455 mt for “other slope rockfish”.

9.5.2 Age-Structured Model for Rougheye Rockfish

Development of an age-structured model for rougheye rockfish was initiated in 2001 using the AD Model Builder rockfish template⁶. The rougheye model starts in 1977 and has 40 age bins and 39 length bins. Catch data from Soh (1998), survey biomass estimates and size compositions from 6 triennial trawl survey biomass estimates from 1984-1999, 1 year of trawl survey age composition, and 5 years of fishery size compositions were input to the model template. A size-age transition matrix was derived from a lognormal fit of von Bertalanffy growth curve to data from Malecha and Heifetz (2000). A second survey was added to the model so that 13 years of abundance indices and 3 years of size composition data from the longline survey could be incorporated. There are no available estimates of catch prior to 1977, although they were likely taken in significant numbers during the foreign fisheries in the 1960's and early 1970's. Because the template model assumes the population has been unfished at the start of the model, a lack of old fish in the age composition data for these long-lived species results in a strongly dome-shaped

⁵C. Lunsford, National Marine Fisheries Service, Alaska Fisheries Science Center, Auke Bay Laboratory, 11305 Glacier Hwy., Juneau, AK 99801. Pers. Commun. July 1997.

⁶Rockfish Modeling Workshop, NMFS Auke Bay Laboratory, 11305 Glacier Hwy., Juneau, AK. February, 2001.

fishery and survey selectivity curve. The rougheye model was modified to allow for fishing prior to 1977, giving an alternate explanation for the lack of old fish and much less dome-shaped selectivity curves. Assessing rougheye rockfish with an age-structured model is still in a very preliminary stage, and the model has been hindered by the sparse data from the commercial fishery and the scarcity of age data for this species. At present, further model development is on hold until more data become available.

9.6 ABC RECOMMENDATIONS AND OVERFISHING LEVELS

9.6.1 ABC Recommendations for Shortraker/Rougheye 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 these two species based on data from Table 9-9, which lists estimates of total mortality Z based on catch curve analyses. The SSC estimated an M of 0.025 for rougheye rockfish based on the mid-point of the range of Z for British Columbia stocks. Because there was no estimate at that time of M or Z for shortraker rockfish, the ratio of maximum age of rougheye to shortraker (140/120) from British Columbia was multiplied by the rougheye rockfish M of 0.025 to compute 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 on the Gulf of Alaska FMP places shortraker rockfish in tier 5 where $F_{ABC} \leq 0.75M$ and rougheye rockfish in tier 4 where $F_{ABC} \leq F_{40\%}$. Thus, the recommended F_{ABC} for shortraker rockfish is 0.023 (i.e., 0.75×0.03). For rougheye rockfish, we recommend applying a more conservative F than the maximum $F_{40\%}$ allowed by the definitions: $F_{ABC} = M = 0.025$, which is less than $F_{40\%} = 0.032$. We have used this conservative $F_{ABC} = M = 0.025$ approach in recommending ABC for rougheye rockfish since 1991, and we believe this approach is still warranted due to the uncertainty of the trawl survey biomass estimates for this species. Applying these F_{ABC} 's to the estimates of current exploitable biomass of 32,723 mt for shortraker rockfish and 40,281 mt for rougheye rockfish results in ABC's of 753 mt for shortraker rockfish and 1,007 mt for rougheye rockfish, and an ABC for the shortraker/rougheye management group of 1,760 mt in 2004.

There is concern for lumping shortraker and rougheye rockfish into a single ABC. Observer data from 2000-2002 (Table 9-4b) indicates 69-83 % of the composition of the catch is made up of shortraker rockfish, whereas only 43% of the ABC is shortraker rockfish. In addition the combined catch has either exceeded or has been slightly below the combined ABC. To remedy this situation the combined ABC could be set at a level such that individual ABC level for shortraker (753 mt) is not exceeded. Based on the average catch composition for 2000-2002 it can be assumed that 72.7% of the catch will be shortraker rockfish. The combined ABC could be set at 1,035 mt (i.e., $753/0.727$). Another alternative would be to set individual ABCs for rougheye and shortraker rockfish (i.e., shortraker 750 mt; rougheye 1,010 mt).

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 two 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 1999, 2001, and 2003 trawl surveys, the percent distribution of exploitable biomass for shortraker/rougheye

rockfish biomass in the Gulf of Alaska is: Western area, 19.0%; Central area, 49.7%, and Eastern area, 31.2% (Table 9-13). Applying these percentages to the overall recommended ABC of 1,760 mt yields the following apportionments for the Gulf in 2004: Western area, 335 mt; Central area, 875 mt; and Eastern area, 550 mt. If the alternate ABC value of 1,035 mt is used, then apportionments would be: Western area, 200 mt; Central area, 515 mt, and Eastern area, 320 mt.

9.6.2 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 . Estimates of M obtained directly from Table 9-9 are 0.05 for sharpchin rockfish and 0.10 for redstripe rockfish. An estimate of M of 0.04 was used for silvertrey rockfish based on the midpoint of the range of Z (0.01-0.07) for British Columbia stocks in Table 9-9. For harlequin and redbanded rockfish and minor species, an $F=M$ of 0.06 was used based on the average M for northern, sharpchin, redstripe, and silvertrey 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 $F_{ABC} \leq F_{40\%}$, and the remaining species of “other slope rockfish” in tier 5 where $F_{ABC} \leq 0.75M$. Applying $F_{ABC} = M = 0.05$ to the exploitable biomass of sharpchin rockfish and $F_{ABC} = 0.75M$ to the exploitable biomass of the other species results in a recommended combined ABC for “other slope rockfish” of 3,901 mt in 2004. Apportioning this ABC based on the same method used for shortraker/rougheye rockfish results in ABC's of 40 mt in the Western area, 303 mt in the Central area, and 3,557 mt in the Eastern area (Table 9-20).

Because the Eastern area is now 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 1996, 1999, and 2003. The weighted average of the “other slope rockfish” biomass in these three surveys for West Yakutat is 3.58%, and that for East Yakutat/Southeast Outside is 96.42%. This translates into an ABC of 128 mt for West Yakutat and 3,429 mt for East Yakutat/Southeast Outside in 2004.

9.6.3 Overfishing Levels for Rougheye/ Shortraker and “Other Slope Rockfish”

Based on Amendment 56 in the Gulf of Alaska FMP, overfishing is defined to occur at the harvest rate set equal to $F_{35\%}$ (in terms of exploitable biomass per recruit) of 0.038 for rougheye rockfish. The $F=M$ rate of 0.03 is used to define the overfishing level for shortraker rockfish because data are not available to determine $F_{35\%}$ for shortraker rockfish. These harvest rates are applied to estimates of current exploitable biomass to yield an overfishing catch limit of 2,512 mt for the shortraker/rougheye category.

Overfishing is defined to occur at the $F_{35\%}$ (in terms of exploitable biomass per recruit) values of 0.064 for sharpchin rockfish. For the other species of other slope rockfish, overfishing is defined to occur at the $F=M$ rate. Applying these F 's results in an overfishing catch limit of 5,146 mt for the “other slope rockfish” group.

9.6.4 Summary

A summary of current exploitable biomass, exploitation rates, and recommended ABC's and OFL's for shortraker/rougeye rockfish and "other slope rockfish" is in Table 9-14.

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

For species such as shortraker and rougeye rockfish that are not assessed with a age/length- structured model, multi-year projections are not possible but yields for just the year 2004 can be computed (Table 9-15).

9.8 ECOSYSTEM CONSIDERATIONS

In general, a determination of ecosystem considerations for shortraker/rougeye 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 9-17.

9.8.1 Ecosystem Effects on the Stock

Prey availability/abundance trends: similar to many other rockfish species, stock condition of rougeye rockfish appears to be 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 slope rockfish is difficult. Visual identification is not possible though 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 rockfish such as shortraker and rougeye are probably opportunistic feeders with more mollusks and fish in their diet. Little if anything is known about abundance trends of likely 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.

9.8.2 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 9-16). This low bycatch may be explained by the fact that little targeted fishing exists 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 2000-2002 have been 21 - 30 % for shortraker and rougheye rockfish and 48 - 53% 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.

9.8.3 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 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.

9.9

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Table 9-1.--Species comprising the “shortraker/roughey rockfish” and “other slope rockfish” management groups in the Gulf of Alaska.

Common name	Scientific name	Management group
Shortraker rockfish	<i>Sebastes borealis</i>	Shortraker/roughey
Roughey rockfish	<i>S. aleutianus</i>	Shortraker/roughey
Sharpchin rockfish	<i>S. zacentrus</i>	Other slope rockfish
Redstripe rockfish	<i>S. proriger</i>	Other slope rockfish
Harlequin rockfish	<i>S. variegatus</i>	Other slope rockfish
Silvergrey rockfish	<i>S. brevispinis</i>	Other slope rockfish
Redbanded rockfish	<i>S. babcocki</i>	Other slope rockfish
Yellowmouth rockfish	<i>S. reedi</i>	Other slope rockfish
Bocaccio	<i>S. paucispinis</i>	Other slope rockfish
Greenstriped rockfish	<i>S. elongatus</i>	Other slope rockfish
Darkblotched rockfish	<i>S. crameri</i>	Other slope rockfish
Pygmy rockfish	<i>S. wilsoni</i>	Other slope rockfish
Splitnose rockfish	<i>S. diploproa</i>	Other slope rockfish
Aurora rockfish	<i>S. aurora</i>	Other slope rockfish
Blackgill rockfish	<i>S. melanostomus</i>	Other slope rockfish
Chilipepper	<i>S. goodei</i>	Other slope rockfish
Shortbelly rockfish	<i>S. jordani</i>	Other slope rockfish
Stripetail rockfish	<i>S. saxicola</i>	Other slope rockfish
Vermilion rockfish	<i>S. miniatus</i>	Other slope rockfish
Northern rockfish ^a	<i>S. polyspinis</i>	Other slope rockfish

^aNorthern rockfish are members of the “other slope rockfish” management group only in the Eastern area of the Gulf of Alaska.

Table 9-2.--Commercial catch (mt) of fish in the shortraker/rougheye rockfish and “other slope rockfish” management groups in the Gulf of Alaska, with Gulfwide values of acceptable biological catch (ABC) and total allowable catch (TAC), 1991-2003. Updated through October 11, 2003.

Year	Western	Central	Eastern	Gulfwide total	Gulfwide ABC	Gulfwide TAC
<u>Shortraker/Rougheye Rockfish</u>						
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	211	929	384	1,524	1,620	1,620
<u>Other Slope Rockfish</u>						
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	122	687	245	1,054	5,050	990

n.a. = data not available

^aCatch estimated based on data from the Groundfish Observer Program.

^bIncludes 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: 1991-2002, Heifetz et al., (2002); 2003, North Pacific Fishery Management Council News and Notes, Vol. 5-02, Dec. 2002. 605 W. 4th. Avenue, Suite 306, Anchorage, AK 99501-2252.

Table 9-3.--Catch (mt) of shortraker/rougheye rockfish and “other slope rockfish” taken during research cruises in the Gulf of Alaska, 1977-2002. (Does not include catches in longline surveys before 1995; tr=trace)

Year	Shortraker/ rougheye	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

Tables 9-4a and 9-4b.--Estimated species composition (percent by weight) of the “other slope rockfish” and shortraker/rougeye management categories 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.)

Table 9-4a--Species composition of “other slope rockfish” in the commercial catch.

Species	Regulatory area			Gulf of Alaska
	Western	Central	Eastern	
	<u>1992</u>			
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
	<u>1993</u>			
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
	<u>1994</u>			
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
	<u>1995</u>			
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 9-4a.--Species composition of "other slope rockfish" (continued).

Species	Regulatory area			Gulf of Alaska
	Western	Central	Eastern	
	<u>1996</u>			
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
	<u>1997</u>			
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
	<u>1998</u>			
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
	<u>1999</u>			
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 9-4a.--Species composition of "other slope rockfish" (continued).

Species	Regulatory area			Gulf of Alaska
	Western	Central	Eastern	
	<u>2000</u>			
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
	<u>2001</u>			
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
	<u>2002</u>			
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 9-4b.--Species composition of shortraker/rougheye rockfish in the commercial catch.

Species	Regulatory area			
	Western	Central	Eastern	Gulf of Alaska
	<u>1992</u>			
Shortraker rockfish	45.8	49.1	70.1	55.5
Rougheye rockfish	54.2	50.9	29.9	44.5
	<u>1993</u>			
Shortraker rockfish	73.3	62.7	82.8	69.9
Rougheye rockfish	26.7	37.3	17.2	30.1
	<u>1994</u>			
Shortraker rockfish	58.3	62.6	85.4	71.3
Rougheye rockfish	41.7	37.4	14.6	28.7
	<u>1995</u>			
Shortraker rockfish	44.3	65.8	81.1	69.3
Rougheye rockfish	55.7	34.2	18.9	30.7
	<u>1996</u>			
Shortraker rockfish	57.9	55.7	80.0	62.8
Rougheye rockfish	42.1	44.3	20.0	37.2
	<u>1997</u>			
Shortraker rockfish	82.5	52.8	78.6	63.6
Rougheye rockfish	17.5	47.2	21.4	36.4
	<u>1998</u>			
Shortraker rockfish	61.4	30.8	94.3	51.0
Rougheye rockfish	38.6	69.2	5.7	49.0
	<u>1999</u>			
Shortraker rockfish	79.7	62.6	85.1	72.5
Rougheye rockfish	20.3	37.4	14.9	27.5
	<u>2000</u>			
Shortraker rockfish	46.4	66.6	85.2	68.7
Rougheye rockfish	53.6	33.4	14.8	31.3
	<u>2001</u>			
Shortraker rockfish	45.8	65.8	78.5	66.9
Rougheye rockfish	54.2	34.2	21.5	33.1
	<u>2002</u>			
Shortraker rockfish	87.0	78.1	88.4	82.6
Rougheye rockfish	13.0	21.9	11.6	17.4

Table 9-5.--Relative population number (RPN) and relative population weight (RPW) for rougheye and shorttraker rockfish in the Gulf of Alaska domestic longline survey. 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
<u>Rougheye RPN:</u>																
Shumagin	2,663	5,355	4,832	3,670	7,425	6,774	3,923	9,487	5,686	7,027	5,983	6,303	10,748	8,237	9,359	6,056
Chirikof	937	1,922	1,034	1,091	970	1,507	743	1,476	1,009	1,244	1,163	1,670	2,021	4,489	1,749	1,684
Kodiak	2,523	3,198	5,522	5,005	4,196	4,028	1,951	4,526	4,494	4,290	5,065	4,987	7,852	4,068	4,438	2,183
Yakutat	2,921	4,092	3,557	4,934	4,097	5,100	2,973	4,169	4,616	4,945	3,753	5,512	5,294	4,388	4,711	3,537
Southeastern	4,453	9,322	5,390	11,370	4,996	6,027	10,184	7,555	10,224	16,922	9,632	11,132	13,461	7,441	7,089	10,922
Total	13,497	23,889	20,335	26,070	21,684	23,436	19,773	27,214	26,029	34,428	25,596	29,604	39,375	28,624	27,345	24,382
<u>Rougheye RPW:</u>																
Shumagin	3,177	6,609	5,352	3,914	7,681	6,303	3,970	11,624	5,519	8,095	6,872	6,273	10,787	8,245	10,878	7,379
Chirikof	1,185	2,414	1,281	1,287	1,279	1,743	914	1,787	1,375	1,619	1,527	2,053	2,416	5,616	2,182	1,865
Kodiak	2,786	3,751	6,409	5,338	4,504	4,091	1,994	4,728	4,621	4,224	5,598	4,900	7,705	4,407	4,059	2,233
Yakutat	3,815	5,116	4,398	6,480	4,513	5,025	3,313	4,394	5,069	5,495	4,271	5,629	6,051	4,105	5,030	3,573
Southeastern	5,975	13,069	7,412	15,555	6,871	8,807	15,593	10,311	14,001	23,754	12,728	14,372	19,450	10,765	9,763	14,398
Total	16,938	30,959	24,852	32,574	24,849	25,970	25,784	32,843	30,585	43,187	30,996	33,227	46,408	33,138	31,911	29,448
<u>Shorttraker RPN:</u>																
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
Chirikof	1,290	858	773	776	572	229	613	531	646	918	973	823	1,298	1,031	951	809
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
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
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
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
<u>Shorttraker RPW:</u>																
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
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
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
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
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
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

Table 9-6.--Comparison of Gulfwide biomass estimates (mt) for species in the shortraker/rougheye rockfish and “other slope rockfish” management categories in the Gulf of Alaska, based on bottom trawl surveys conducted between 1984 and 2003. (Biomass estimates for the 1984, 1987, 1990, and 2001 surveys have been slightly revised compared to those listed in previous SAFE reports for slope rockfish.) Note: these are estimates of total biomass for all areas and depths sampled in the surveys. For estimates of exploitable biomass, see Table 9-12.

Species	Year							
	1984	1987	1990	1993	1996	1999	2001*	2003
<u>Shortraker/Rougheye Rockfish</u>								
Shortraker rockfish	18,557	42,851	12,681	19,710	20,258	28,231	27,914	42,023
Rougheye rockfish	45,091	43,681	45,506	61,833	45,913	39,620	43,721	43,208
Total, shortraker/rougheye	63,649	86,532	58,188	81,543	66,171	67,850	71,635	85,231
<u>“Other Slope Rockfish”</u>								
Sharpchin rockfish	6,612	80,439	38,334	23,676	64,570	20,841	34,169	7,094
Redstripe rockfish	5,364	26,519	27,064	29,619	14,964	8,226	17,564	8,025
Harlequin rockfish	2,625	72,405	17,664	9,281	20,026	9,877	14,480	3,545
Silvergrey rockfish	4,817	5,426	14,149	18,979	24,127	37,641	24,032	51,916
Redbanded rockfish	1,430	1,822	3,285	3,675	4,594	10,941	6,409	3,441
Darkblotched rockfish	7	37	174	291	121	272	227	91
Splitnose rockfish	0	3	3	0	0	7	2	5
Greenstriped rockfish	14	65	174	268	352	467	362	423
Vermilion rockfish	0	0	0	20	0	0	7	0
Bocaccio	505	36	173	106	137	0	81	132
Pygmy rockfish	0	406	88	3	283	187	141	127
Yellowmouth rockfish	497	260	1,876	3,563	923	5,570	3,346	387
Total, other slope rockfish	21,870	187,416	102,983	89,480	130,096	94,027	100,819	75,184

*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 9-7.--Detailed biomass estimates (mt) for shortraker and rougheye rockfish in the Gulf of Alaska, by statistical area, based on bottom trawl surveys conducted between 1984 and 2003. Gulfwide 95% confidence bounds, variance, and coefficient of variation (cv) are also shown for each year. (Biomass estimates for the 1984, 1987, 1990, and 2001 surveys have been slightly revised compared to those listed in previous SAFE reports for slope rockfish.) Note: these are estimates of total biomass for all areas and depths sampled in the surveys. For estimates of exploitable biomass, see Table 9-12.

Year	Statistical areas					Gulfwide Total	Gulfwide 95% Conf. bounds		Biomass variance	Biomass cv
	Shumagin	Chirikof	Kodiak	Yakutat	South- eastern		Lower	Upper		
<u>Shortraker Rockfish</u>										
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
<u>Rougheye Rockfish</u>										
1984	8,779	8,786	23,630	2,656	1,240	45,091	30,312	59,871	53,480,107	16.2
1987	2,737	5,514	16,368	10,817	8,246	43,681	33,784	53,577	23,977,857	11.2
1990	1,329	11,732	24,405	6,240	1,802	45,506	26,485	64,528	86,772,808	20.5
1993	10,860	9,444	32,172	6,924	2,434	61,833	32,701	90,965	207,782,416	23.3
1996	3,449	10,093	18,303	6,292	7,776	45,913	30,892	60,934	55,241,144	16.2
1999	6,156	3,449	17,333	8,552	4,131	39,620	28,034	51,205	33,556,125	14.6
2001*	6,945	3,592	21,148	7,256	4,780	43,721	28,445	58,998	60,747,781	17.8
2003	8,921	10,288	14,329	1,783	7,888	43,208	29,761	56,655	45,206,166	15.6

*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 9-8.--Detailed biomass estimates (mt) for major species of “other slope rockfish” (sharpchin, redstripe, harlequin, silverygrey, and redbanded rockfish) in the Gulf of Alaska, by statistical area, based on bottom trawl surveys conducted between 1984 and 2003. Gulfwide 95% confidence bounds, variance, and coefficient of variation (cv) are also shown for each year. (Biomass estimates for the 1984, 1987, 1990, and 2001 surveys have been slightly revised compared to those listed in previous SAFE reports for slope rockfish.) Note: these are estimates of total biomass for all areas and depths sampled in the surveys. For estimates of exploitable biomass, see Table 9-12.

Year	Statistical areas						Gulfwide				
	Shumagin	Chirikof	Kodiak	Yakutat	South-eastern	Gulfwide Total	95% Conf. bounds		Biomass variance	Biomass cv	
							Lower	Upper			
<u>Sharpchin Rockfish</u>											
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	
<u>Redstripe Rockfish</u>											
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	
<u>Harlequin Rockfish</u>											
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	

(Table continued on next page).

Table 9-8.--(Continued)

Year	Statistical areas					Gulfwide Total	Gulfwide		Biomass variance	Biomass cv
	Shumagin	Chirikof	Kodiak	Yakutat	South- eastern		95% Conf. bounds			
							Lower	Upper		
<u>Silvergrey Rockfish</u>										
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
<u>Redbanded Rockfish</u>										
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

*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 9-9.-- Mortality rates, maximum age, and age of recruitment for shorttraker and rougheye rockfish and some species of “other slope rockfish”. Area indicates location of study; West Coast of USA (WC), British Columbia (BC), Gulf of Alaska (GOA), Aleutians (AL), Bering Sea (BS). All mortality rates except where noted are for instantaneous rate of total mortality (Z) estimated with catch-curves.

Species	Mortality rate	Maximum age	Age of recruitment	Area	Reference
Rougheye	0.01-0.04	140	-	BC	1,2
	0.030-0.039 ^a	-	-	WC,BS,AL,GOA	7
	0.04	95	30	GOA	5,6
	-	205	-	GOA	3
Shorttraker	-	120	-	BC	2
	0.027-0.042 ^a	-	-	WC,BS,AL,GOA	7
	-	157	-	GOA	3
Sharpchin	0.05	46	-	BC	1
	-	58	-	GOA	4
Yellowmouth	0.06	71	-	BC	1,2
	-	99	-	BC	3
Darkblotched	0.07	48	-	BC	1
Harlequin	-	43	-	BC	2
	-	34	-	GOA	4
Redstripe	0.1	41	-	BC	1,2
	-	55	-	BC	3
Silvergrey	0.01-0.07	80	-	BC	1,2
	-	75	-	GOA	4

1) Archibald et al. 1981; 2) Chilton and Beamish 1982; 3) Munk 2001; 4) Malecha and Heifetz 2000; 5) Nelson and Quinn 1987; 6) Nelson 1986; 7) McDermott 1994. ^aM based on the gonad somatic index method (McDermott 1994).

Table 9-10.-- Length-weight coefficients for some species of slope rockfish. Length-weight coefficients are 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
Rougheye	combined	1.98×10^{-5}	2.94
	males	2.04×10^{-5}	2.94
	females	1.89×10^{-5}	2.97
Sharpchin	combined	1.13×10^{-5}	3.07
	males	8.89×10^{-6}	3.15
	females	1.19×10^{-5}	3.06
Shortraker	combined	9.85×10^{-6}	3.13
	males	1.26×10^{-5}	3.07
	females	1.02×10^{-5}	3.12

Table 9-11.-- Von Bertalanffy parameters for rougheye, sharpchin, silvergrey, and harlequin rockfish, by area and sex. (BC = British Columbia; GOA = Gulf of Alaska).

Species	Area	Sex	t_0	k	L_{inf} (cm)	Reference
Rougheye	GOA	combined	-4.21	0.050	54.70	3
	GOA	combined	0.63	0.108	49.63	2
	GOA	male	1.14	0.119	49.79	2
	GOA	female	0.18	0.100	49.57	2
Sharpchin	BC	combined	-2.21	0.095	34.90	1
	GOA	combined	-0.81	0.131	32.64	2
	GOA	male	-0.48	0.167	28.44	2
	GOA	female	-0.75	0.122	35.02	2
Silvergray	GOA	combined	-1.68 ^a	0.100	59.80	2
	GOA	male	-1.68 ^a	0.110	57.14	2
	GOA	female	-1.68 ^a	0.093	62.25	2
Harlequin	GOA	combined	-3.86	0.099	31.51	2
	GOA	male	-4.76	0.091	30.60	2
	GOA	female	-3.26	0.110	32.32	2

1) Archibald et al. 1981; 2) Malecha and Heifetz 2000; 3) Nelson 1986.

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

Table 9-12.--Estimates of exploitable biomass of shortraker and rougheye rockfish and “other slope rockfish” in the Gulf of Alaska, by NPFMC regulatory area, based on the 1999 - 2003 trawl surveys.

Species	Exploitable biomass (mt)			Total
	Western	Central	Eastern	
1999				
Shortraker rockfish	2,208	12,391	13,633	28,232
Rougheye rockfish	<u>6,036</u>	<u>18,781</u>	<u>12,373</u>	<u>37,189</u>
Subtotal, shortraker/rougheye	8,244	31,172	26,005	65,421
Sharpchin rockfish	0	2,857	17,985	20,842
Redstripe rockfish	0	125	8,077	8,201
Harlequin rockfish	7	8,560	1,307	9,874
Silvergrey rockfish	0	6,746	30,755	37,500
Redbanded rockfish	118	404	10,421	10,943
Minor species	<u>0</u>	<u>6</u>	<u>6,483</u>	<u>6,489</u>
Subtotal, other slope rockfish	126	18,698	75,027	93,850
2001*				
Shortraker rockfish	4,313	13,102	10,499	27,914
Rougheye rockfish	<u>6,848</u>	<u>23,183</u>	<u>11,818</u>	<u>41,849</u>
Total, shortraker/rougheye	11,161	36,285	22,317	69,763
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	<u>0</u>	<u>0</u>	<u>4,160</u>	<u>4,160</u>
Total, “other slope rockfish”	3,070	7,551	89,934	100,554
2003				
Shortraker rockfish	11,166	17,288	13,569	42,023
Rougheye rockfish	<u>88,498</u>	<u>23,923</u>	<u>9,035</u>	<u>41,806</u>
Total, shortraker/rougheye	20,015	41,211	22,603	83,830
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	<u>0</u>	<u>0</u>	<u>1,031</u>	<u>1,031</u>
Total, “other slope rockfish”	74	1,876	72,010	73,960

* Values for Eastern area are the averages of 93, 96, and 99 values because this area was not sampled in 2001.

Table 9-13.-- Percentage of exploitable biomass by area for shortraker/rougheye rockfish and “other slope rockfish” based on the 1999, 2001, and 2003 Gulf of Alaska trawl surveys. Weighted average uses weights of 4:6:9 for the 1999, 2001, and 2003 surveys, respectively.

	Western	Central	Eastern
<u>1999</u>			
Shortraker/rougheye rockfish	12.60%	47.65%	39.75%
“Other slope rockfish”	0.13%	19.92%	79.94%
<u>2001*</u>			
Shortraker/rougheye rockfish	16.00%	52.01%	31.99%
“Other slope rockfish”	3.05%	7.51%	89.44%
<u>2003</u>			
Shortraker/rougheye rockfish	23.88%	49.16%	26.96%
“Other slope rockfish”	0.10%	2.54%	97.36%
<u>Weighted average</u>			
Shortraker/rougheye rockfish	13.31%	51.91%	34.78%
“Other slope rockfish”	1.04%	7.77%	91.19%

* Values for Eastern area are the averages of 93, 96, 99 values.

Table 9-14.--Summary of computations of ABC's and overfishing levels for shortraker/rougheye and "other slope rockfish" for 2004. Since ABC's and overfishing levels are based on management categories, individual species are shown only for illustrative purposes.

Species	Exploitable biomass (mt)	ABC		Overfishing	
		F	Yield (mt)	F	Yield (mt)
Shortraker rockfish	32,723	F=0.75M=0.023	753	F=M=0.030	982
Rougheye rockfish	40,281	F=M=0.025	1,007	F35%=0.038	1,531
Total, shortraker/rougheye	73,004		1,760		2,512
Sharpchin rockfish	20,698	F=M=0.050	1,035	F35%=0.064	1,325
Redstripe rockfish	11,259	F=0.75M=0.075	844	F=M=0.100	1,126
Harlequin rockfish	8,961	F=0.75M=0.045	403	F=M=0.060	538
Silvergrey rockfish	37,746	F=0.75M=0.030	1,132	F=M=0.040	1,510
Redbanded rockfish	6,897	F=0.75M=0.045	310	F=M=0.060	414
Minor species	3,893	F=0.75M=0.045	175	F=M=0.060	234
Total, other slope rockfish	89,455		3,901		5,146

Table 9-15.--Set of projections of yield for slope rockfish for 2004 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). All units in mt.

Species	Exploitable Biomass	Scenario 1		Scenario 2		Scenario 3		Scenario 4	
		F	Yield	F	Yield	F	Yield	F	Yield
Shortraker	32,723	0.023	753	0.023	753	0.0113	370		
Rougheye	40,281	0.032	1,289	0.025	1,007	0.0160	644		
Total shortraker rougheye	73,004		2,042		1,760		1,014	0.025	1,825
Sharpchin	20,698	0.053	1,097	0.050	1,035	0.027	559		
Redstripe	11,259	0.075	844	0.075	844	0.038	428		
Harlequin	8,961	0.045	403	0.045	403	0.023	206		
Silvergrey	37,746	0.030	1,132	0.030	1,132	0.015	566		
Redbanded	6,897	0.045	310	0.045	310	0.023	159		
Minor spp	3,893	0.045	175	0.045	175	0.023	90		
Total other slope rockfish	89,455		3,963		3,901		2,007	0.010	895

Table 9-16. 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).

Target fishery	Gear	Bycatch (kg)			Target			Bycatch rate (kg/mt target)		
		Coral	Anemone	Sea whips	Sponge	catch (mt)	Coral	Anemone	Sea whips	
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

Table 9-17.-- Analysis of ecosystem considerations for shortraker/rougheye and "other slope rockfish".

<i>Indicator</i>	<i>Observation</i>	<i>Interpretation</i>	<i>Evaluation</i>
<i>ECOSYSTEM EFFECTS ON STOCK</i>			
<i>Prey availability or abundance trends</i>	important for larval and post-larval survival, but no information known	may help to determine year class strength	possible concern if some information available
<i>Predator population trends</i>	unknown		little concern for adults
<i>Changes in habitat quality</i>	variable	variable recruitment	possible concern

FISHERY EFFECTS ON ECOSYSTEM

<i>Fishery contribution to bycatch</i>			
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		
<i>Fishery concentration in space and time</i>	little overlap between fishery and reproductive activities	fishery does not hinder reproduction	little concern
<i>Fishery effects on amount of large size target fish</i>	unknown		

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

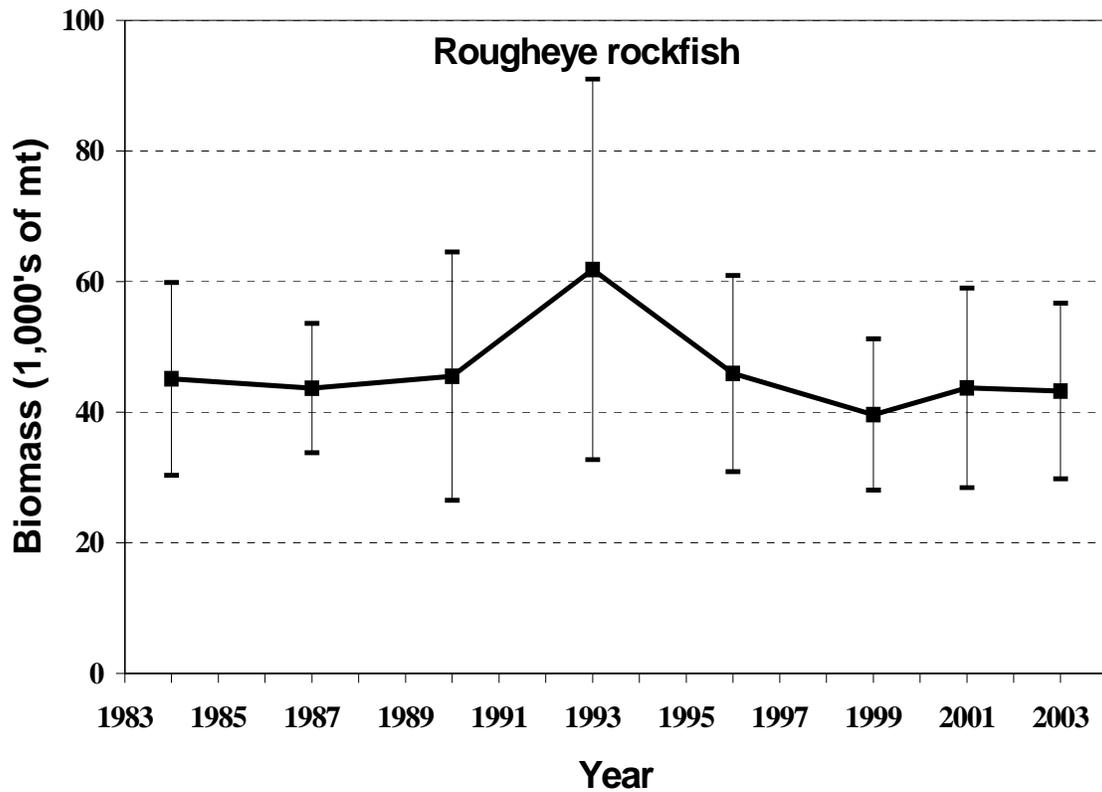


Figure 9-1.--Estimated biomass of rougeye rockfish in the Gulf of Alaska based on results of bottom trawl surveys from 1984 through 2003. The vertical bars show the 95% confidence limits associated with each estimate. The eastern Gulf of Alaska was not sampled in the 2001 survey, but substitute estimates of biomass and variance for this region in 2001 were calculated and included in the above graph.

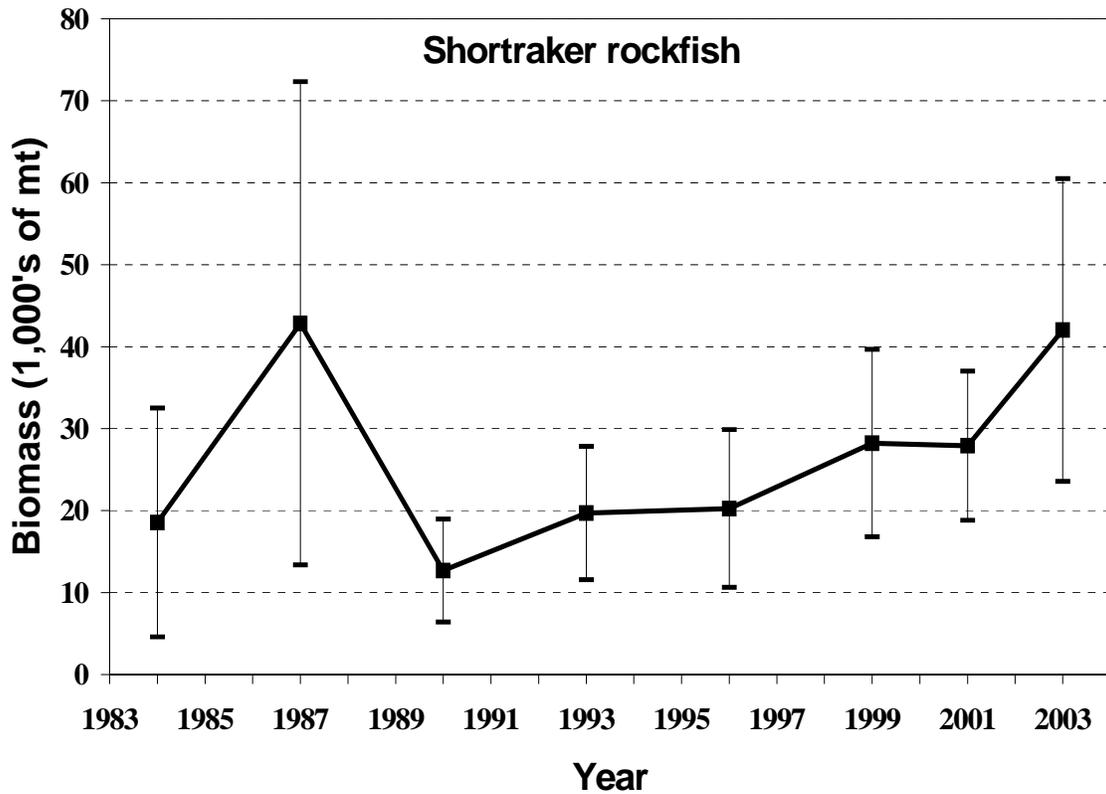


Figure 9-2.--Estimated biomass of shortraker rockfish in the Gulf of Alaska based on results of bottom trawl surveys from 1984 through 2003. The vertical bars show the 95% confidence limits associated with each estimate. The eastern Gulf of Alaska was not sampled in the 2001 survey, but substitute estimates of biomass and variance for this region in 2001 were calculated and included in the above graph.

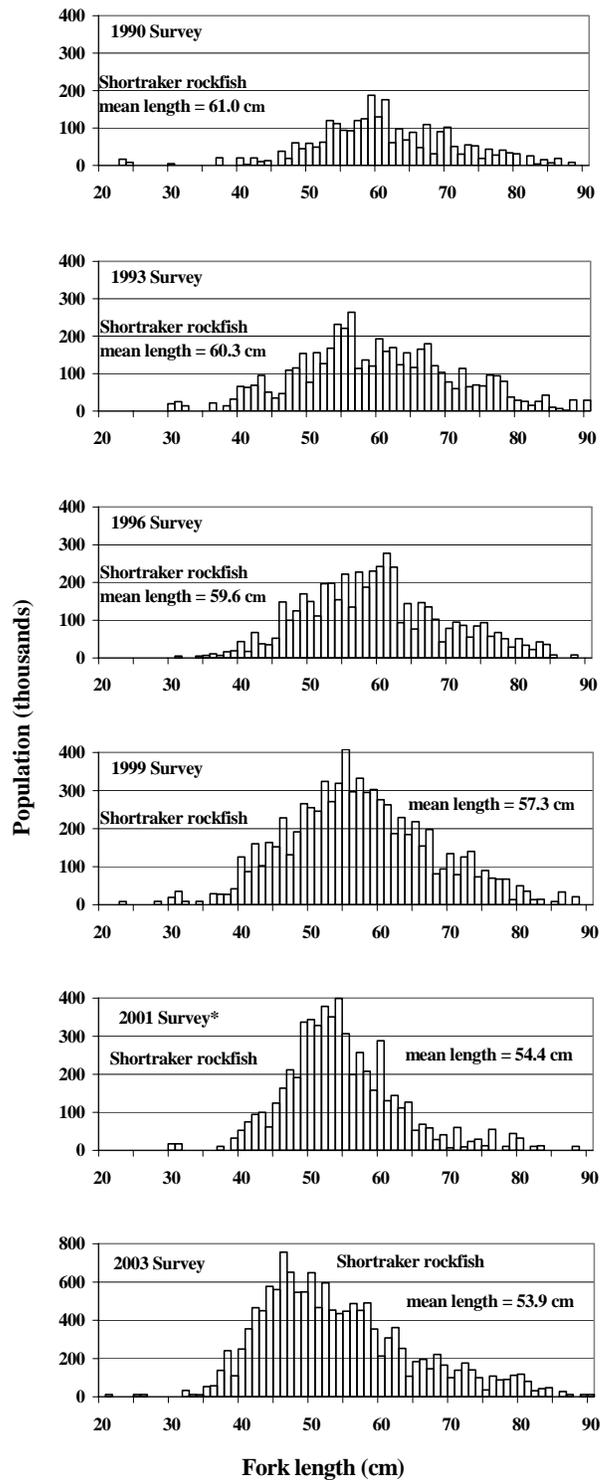


Figure 9-3.--Length frequency distribution of the estimated population of shortraker rockfish in the Gulf of Alaska, based on trawl surveys from 1990 through 2003. *2001 survey did not sample the eastern Gulf of Alaska.

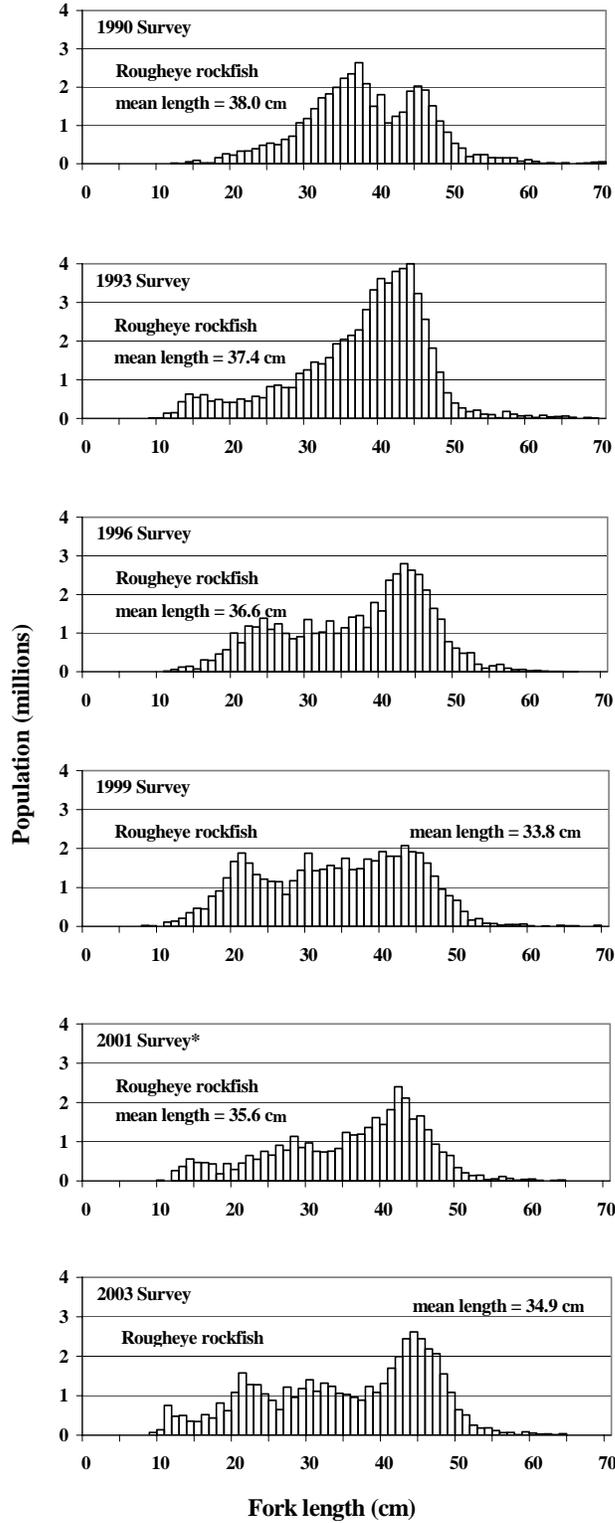


Figure 9-4.--Length frequency distribution of the estimated population of rougheye rockfish in the Gulf of Alaska, based on trawl surveys from 1990 through 2003. *2001 survey did not sample the eastern Gulf of Alaska.

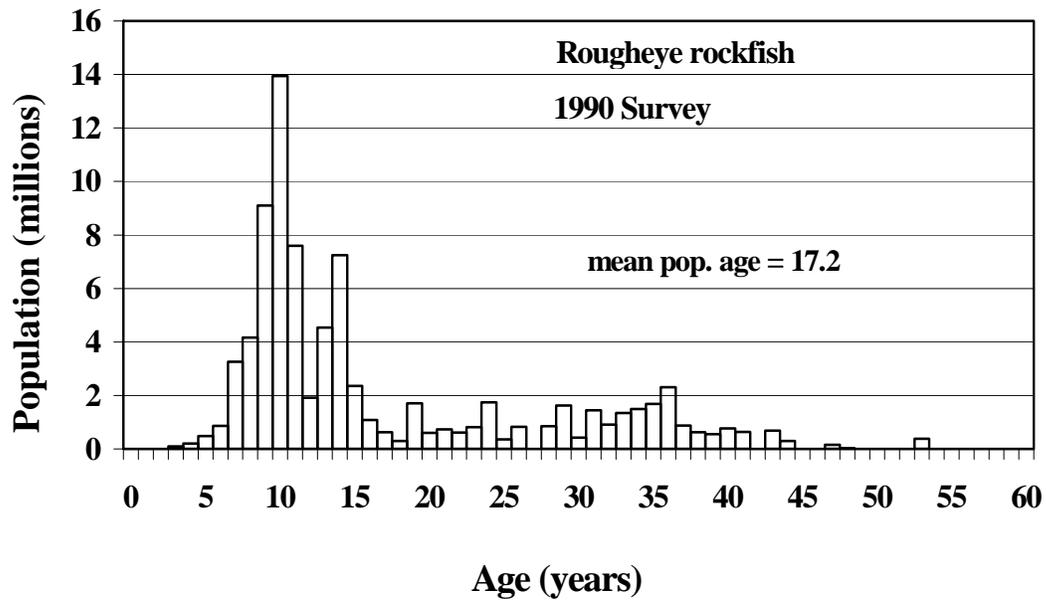


Figure 9-5.--Age composition of the estimated population of roughey rockfish in the 1990 Gulf of Alaska trawl survey.