16. Assessment of the "Other Rockfish" Stock Complex in the Gulf of Alaska

by
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EXECUTIVE SUMMARY

Summary of Changes

A planned change for the 2012 fishing year is that yellowtail and widow rockfish will be added to the 15 species that were part of the former "other slope rockfish" group to form a new management category in the Gulf of Alaska, "other rockfish". Previously, yellowtail and widow rockfish were part of the "pelagic shelf rockfish" group in the Gulf of Alaska, which will no longer exist in 2012. Also, for the first time, this year's assessment of "other slope rockfish"/ "other rockfish" is presented in its own separate SAFE chapter. In previous assessments since 2005, the assessment for "other slope rockfish" was combined with for shortraker rockfish in a joint chapter, although each was a separate management entity. Separating these into two chapters was a recommendation by the Gulf of Alaska Plan Team and the NPFMC Scientific and Statistical Committee.

Assessment methodology in this report is identical to that used in the last full assessment for "other slope rockfish" in 2009. Changes in assessment inputs include new biomass estimates from the 2011 Gulf of Alaska trawl survey and a new estimate of natural mortality for harlequin rockfish. The new biomass estimates indicate a very large increase for silvergray rockfish, and this species now dominates the group. Biomass for harlequin rockfish remained quite low for the third survey in a row. A new natural mortality estimate of 0.09 was computed for harlequin rockfish; previously, a proxy estimate of 0.06 was used for this species in the computations of ABC and OFL.

Summary of Results

Current exploitable biomass for "other rockfish" is determined based on the group's average biomass in the three most recent trawl surveys, which are now 2007, 2009, and 2011. This yields an exploitable biomass for "other rockfish" of 85,774 mt. Species in the "other rockfish" group have always been classified into tier 5 in the NPFMC's ABC and OFL definitions, with the exception of sharpchin rockfish which is tier 4. The tier 5 definitions state that $F_{ABC} \leq 0.75M$, and the tier 4 definitions say $F_{ABC} \leq F_{40\%}$. Using various *M's* for the tier 5 species and an $F_{40\%}$ of 0.053 for sharpchin and applying these definitions to the exploitable biomass of "other rockfish" results in a recommended Gulfwide ABC of 4,045 mt for the group in 2012. As in the past, geographic apportionment of the ABC 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 (2007, 2009, and 2011). In these computations, each successive survey is given a progressively heavier weighting using factors of 4, 6, and 9, respectively. The new apportionment values for "other rockfish" are: Western area, 1.08%; Central area, 14.98%; and Eastern area, 83.94%. Applying these percentages to the recommended ABC of 4,045 mt yields the following apportionments for the Gulf in 2012: Western area, 44 mt; Central area, 606 mt; and Eastern area, 3,395 mt. The Eastern area for "other 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 calculation (a 4:6:9 weighted average percent biomass of the three most recent trawl surveys), the Eastern

area apportionment is subdivided as follows: West Yakutat, 6.78%; and East Yakutat/Southeast Outside, 93.22%. This translates into an ABC of 230 mt for West Yakutat and 3,165 mt for East Yakutat/Southeast Outside in 2012.

Overfishing for tier 5 species is defined to occur at a harvest rate of $F_{OFL}=M$, and for tier 4 species at a rate of $F_{OFL} = F_{35\%}$ Using various *M's* for the tier 5 species and an $F_{35\%}$ of 0.064 for sharpchin and applying these definitions to the current exploitable biomass (85,772) yields an overfishing catch limit of 5,305 mt for the group in 2012.

Summary of ABCs and Overfishing Levels for 2012 (mt)

"Other rockfish" ABC: Gulfwide, 4.045; Western Area, 44; Central Area; 606; West Yakutat,230; East Yakutat/ Southeast Outside, 3,165.

"Other rockfish" overfishing level: Gulfwide, 5,305.

Summary Table of Results for "Other Rockfish" in the Gulf of Alaska

	As estimated or *specified last* year for:		As estimated or *recommended this* year for:	
Quantity	2011	2012	2012	2013
M (natural mortality	0.05-0.10[a]	0.05-0.10[a]	0.05-0.10[a]	0.05-0.10[a]
Tier	5 or 4[b]	5 or 4[b]	5 or 4[b]	5 or 4[b]
Biomass (t)	76,867[c]	76,867[c]	85,774	85,774
F_{OFL}	0.05-0.10[d]	0.05-0.10[d]	0.05-0.10[d]	0.05-0.10[d]
$maxF_{ABC}$	0.0375-0.0750[e]	0.0375-0.0750[e]	0.0375-0.0750[e]	0.0375-0.0750[e]
F_{ABC}	0.0375-0.0750[f]	0.0375-0.0750[f]	0.0375-0.0750[f]	0.0375-0.0750[f]
OFL (t)	4,881	4,881	5,305	5,305
maxABC (t)	3,749	3,749	4,045	4,045
ABC (t)	3,749	3,749	4,405	4,405
	As determined *last* year for:		As determined *this* year for:	
Status	2009	2010	2010	2011
Overfishing	No	n/a	No	n/a

[a]Varies among species; this is the range of the M's.
[b]All species are tier 5 except sharpchin rockfish is tier 4.
[c]Does not include yellowtail and widow rockfish, which were part of pelagic shelf rockfish last year.
[d]Varies among species; this is the range of F_{OFL}.
[e]Varies among species; this is the range of $maxF_{ABC}$.
[f]Varies among species; this is the range of F_{ABC}.

Summaries for Plan Team

All values are in metric tons.

Stock Assemblage	Year	Biomass	OFL	ABC	TAC	*Catch*[1]
Other Rockfish[2]	2010	76,867	4,881	3,749	1,192	942
	2011		4,881	3,749	1,192	*849*
	2012	85,774	5,305	4,045		
	2013		*5,305*	*4,045*		

Stock Assemblage	Area	2011 OFL	2011 ABC	2011 TAC	2011 Catch[1]	2012 OFL	2012 ABC	2013 OFL	2013 *ABC*
Other Rockfish[2]	W		212	212	299		44		44
	C		507	507	344		606		606
	WYak		273	273	186		230		230
	EYak/SEO		2,757	200	20		3,165		3,165
	Total	*4,881*	*3,749*	*1,192*	*849*	*5,305*	*4,045*	*5,305*	*4,045*

[1]Current as of October 3, 2011 (National Marine Fisheries Service, Alaska Region, Sustainable Fisheries Division, P.O. Box 21668, Juneau, AK 99802.)
[2]"Other Rockfish" were called "Other Slope Rockfish" before 2012 and did not include yellowtail and widow rockfish.
Note: all values include northern rockfish in the eastern Gulf of Alaska.

Responses to SSC Comments

The SSC made the following comments in their Dec. 2009 minutes to shortraker/other slope rockfish assessment authors:

1) The SSC requests that the authors review the time trends for silvergray rockfish to assess whether recent declines are a conservation concern. The age data for silvergray rockfish ends in 1999. The SSC encourages the authors to request age determinations for silvergray rockfish collected in recent years to assess whether declines are due to recruitment failure or shifting spatial distributions.

2) The SSC requests that the author reviews the current harvest of harlequin rockfish to determine whether the current harvest strategy is sustainable for this species.

Response:

1) This request is now moot due to the very large biomass of silvergray rockfish found in the 2011 Gulf of Alaska trawl survey. Because of this large biomass and its relatively low coefficient of variance, there is no longer any conservation concern for this species. The assessment authors made requests to age silvergray rockfish samples from the 2005, 2007, and 2009 Gulf of Alaska trawl surveys, but due to the lower aging priority assigned to this species, aging was only completed for the 2005 sample. The 2005 age results are included in this report.

2) A section has been added to the report entitled "Conservation Concern for Harlequin Rockfish" that discusses this problem.

The SSC made the following comment in their Dec. 2010 minutes to shortraker/other slope rockfish assessment authors:

The SSC agrees with the Plan Team that the author should explore an option for breaking shortraker out of the other slope species chapter and adding yellowtail and widow rockfish to the remaining "other slope" species.

Response:

Assessment of shortraker rockfish in the Gulf of Alaska is now covered in a separate chapter. Yellowtail and widow rockfish have been moved from the pelagic shelf rockfish group to what was formerly called "other slope rockfish", and the group name has been changed to "other rockfish". A new chapter entitled "Other Rockfish" is now part of this year's SAFE report.

INTRODUCTION

The North Pacific Fishery Management Council (NPFMC) established a separate management category for "other slope rockfish" in the Gulf of Alaska (GOA) in 1991. The group initially included northern rockfish and 15 other diverse species, but northern rockfish was removed in 1993 to become its own separate management category. In 2010, the GOA Groundfish Plan Team and the NPFMC Scientific and Statistical Committee both recommended that yellowtail rockfish and widow rockfish be added to GOA "other slope rockfish". Previously, the two species were part of the GOA pelagic shelf rockfish management group. It was also recommended that the official name of "other slope rockfish" be changed to "other rockfish" because yellowtail and widow rockfish inhabit mainly the continental shelf rather than the slope. This SAFE chapter responds to these recommendations by renaming the management group and changing the title to "other rockfish". It also includes yellowtail and widow rockfish in the assessment procedure and computations for the 2012 fishing year.

From 2005 to 2010, the assessment for "other slope rockfish" in the GOA was combined with that for shortraker rockfish. Although "other slope rockfish" and shortraker rockfish were distinct management entities, their assessments were presented in a single SAFE chapter because each was assessed using a similar methodology based on the NPFMC's "Tier 5" definition of overfishing. However, in 2010 the GOA Groundfish Plan Team and the NPFMC Scientific and Statistical Committee recommended that future assessments for shortraker rockfish and "other slope rockfish" be presented in separate SAFE chapters. Thus, in the present SAFE report, "other slope rockfish" (renamed "other rockfish") and shortraker rockfish each have their own chapter.

Rationale for Moving Yellowtail and Widow Rockfish into the "Other Rockfish" Group

There are several good reasons for transferring yellowtail and widow rockfish from "pelagic shelf rockfish" to "other rockfish", which are discussed in detail in Clausen et al. 2011[1]. Briefly, the pelagic shelf group no longer appears justifiable as a rockfish assemblage in the GOA. The group consists of just three species, dusky, yellowtail, and widow rockfish, of which dusky rockfish greatly dominates in both abundance and commercial catch. Dusky rockfish generally do not inhabit the same geographic area in the GOA as yellowtail and widow rockfish and seldom co-occur with the latter two species. Moreover, present assessment methods in the GOA for dusky versus yellowtail and widow rockfish are very different. Dusky rockfish is now assessed with an age-structured model, while yellowtail and dusky rockfish are assessed using a relatively simple methodology based on the NPFMC's "tier 5" definition of overfishing. In many aspects, yellowtail and widow rockfish actually appear to share more attributes with species in the former "other slope rockfish" group than they do with dusky rockfish. For example, yellowtail and widow rockfish are "minor" rockfish species in Alaska that are mainly found in southeast Alaska, as are most of the "other slope rockfish" species. Also, all "other slope rockfish", with the exception of one species, are assessed with a "tier 5" methodology, the same as yellowtail and widow rockfish.

[1] Clausen, D., T. Pearson, and C. Lunsford. 2011. Management reorganization of species in the Gulf of Alaska pelagic shelf rockfish and "other slope rockfish" assemblages. Unpubl. discussion paper submitted to the NPFMC Gulf of Alaska Groundfish Plan Team, Sept. 2011. 12 p. Available from North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage AK 99501.

Distribution and Life History of GOA "Other Rockfish"

The common and scientific names for the 17 species that comprise the planned "other rockfish" management group are listed in Table 16-1. (Note: in addition to the 17 species, northern rockfish is also listed as a member of "other rockfish". However, this is a special circumstance that applies only to the eastern Gulf of Alaska and will be discussed later in this section.) Nearly all these species in the GOA are at the northern edge of their ranges; the center of abundance for most is farther south off British Columbia or the U.S. west coast. One exception is harlequin rockfish, which is predominantly an Alaskan species widely distributed across the GOA. Also, the center of abundance for silvergray rockfish based on recent trawl surveys now appears to be southeast Alaska and British Columbia. Within the GOA, "other rockfish" are most abundant in the eastern Gulf, particularly in southeast Alaska, and become increasingly scarce in areas farther west.

Information on life history, biology, and habitat of the "other rockfish" species is very sparse. An exception is silvergray rockfish, for which a study of biological characteristics has been done in British Columbia waters (Stanley and Kronlund 2005). This study found that during the summer, silvergray rockfish were most abundant on the outer continental shelf at depths 100-200 m, whereas in late winter they were concentrated deeper at depths 180-280 m. The study also indicated that the fish are almost never caught in mid-water and that anecdotal reports suggest they are found on relatively hard bottom. Parturition was in May-July, which is similar to the parturition dates of May-June reported for this species based on a small number of samples in southeast Alaska (O'Connell 1987). Anecdotal observations of fishermen and research scientists in Alaska for three of the most abundant "other slope rockfish" species, sharpchin, redstripe, and harlequin rockfish, suggest that they also are frequently found on relatively hard bottom, in contrast to species such as Pacific ocean perch that are usually found on softer substrate.

In contrast to most of the "other rockfish" species, yellowtail and widow rockfish are often distributed considerably off-bottom (Love et al. 2002). Consequently, off the U.S. west coast, yellowtail rockfish are harvested with both midwater and bottom trawls (Wallace and Lai 2005), and the fishery for widow rockfish in this region first developed around 1980 when large pelagic concentrations of the fish were discovered and taken with midwater trawls (Williams et al. 2000). Yellowtail rockfish are most abundant in depths 90-180 m (Love et al. 2002), and in British Columbia they often co-occur in hauls on the outer continental shelf with silvergray rockfish (Stanley and Kronlund 2005).

In practice, the NPFMC has apportioned the ABCs and TACs for "other slope rockfish" in the GOA into three geographic management areas: the Western, Central, and Eastern Gulf of Alaska. Since 1999, trawling has been prohibited in the Eastern area east of 140° W. long. Because most species of "other slope rockfish" are caught exclusively with trawl gear, this closure could have concentrated the catch of these fish in the Eastern area in the relatively small area between 140° and 147° W. long. 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° W. long.) and East Yakutat/Southeast Outside (area east of 140° W. long.). Separate ABCs and TACs have been assigned to each of these smaller areas for "other slope rockfish" and this will continue for the new "other rockfish" group.

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 was reassigned to the "other slope rockfish" category for this area only. Therefore, northern rockfish is listed as an "other slope rockfish" species in Table 16.1, but only for the Eastern area.

FISHERY

Catch History and Description of the Fishery

Since the mid-1990s, directed fishing has not been allowed for "other slope rockfish" in the GOA, and the fish can only be retained as "incidentally-caught" species. With the exception of 1993, Gulfwide catches of "other slope rockfish" have always been <1,700 mt (Table 16-2) and since 1998 have usually been ~600-900 mt. Annual catch since 1993 has always been much 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 1999, when trawling was prohibited east of 140° W. long. Yellowtail and widow rockfish are not included in Table 16-2, but have only been caught in very small amounts since 1995 (Lunsford et al. 2009). For example, in 2009 only 5.4 mt. of the two species are estimated to have been harvested[2].

In most years, trawling has accounted for a substantial majority of the "other slope rockfish" catch, as indicated in the following table that shows the percent caught in trawls vs. longlines for years 1993-2011 (updated through 3 October 2011):

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

Gear	2005	2006	2007	2008	2009	2010	2011
Trawl	84.7	78.6	74.5	80.5	83.3	79.1	80.5
Longline	15.3	21.4	25.5	19.5	16.7	20.9	19.5

The predominance of trawl catches is not surprising, as many of the 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, when directed fishing was still allowed for "other slope rockfish", it appears some targeting by trawlers occurred in the eastern Gulf of Alaska for silvergray and yellowmouth rockfish, two larger sized species that can be caught in bottom trawls; and 2) in 2004 and 2005, a small experimental fishery was permitted in southeast Alaska that used modified trolling gear to catch silvergray rockfish (Alaska Longline Fishermen's Association 2005).

[2] Clausen, D., T. Pearson, and C. Lunsford. 2011. Management reorganization of species in the Gulf of Alaska pelagic shelf rockfish and "other slope rockfish" assemblages. Unpubl. discussion paper submitted to the NPFMC Gulf of Alaska Groundfish Plan Team, Sept. 2011. 12 p. Available from North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage AK 99501.

Discards

Gulfwide discard rates[3] (% of the total catch discarded within management categories) of "other slope rockfish" are listed as follows for the years 1993-2011:

Year	Other slope rockfish
1993	48.9%
1994	65.6%
1995	72.5%
1996	75.6%
1997	52.1%
1998	66.3%
1999	68.7%
2000	52.8%
2001	47.9%
2002	58.0%
2003	56.7%
2004	62.1%
2005	32.6%
2006	61.9%
2007	41.2%
2008	54.1%
2009	55.2%
2010	59.9%
2011	52.7%

The above table indicates that annual discard rates of "other slope rockfish" have been relatively high and are usually greater than 50%. 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 low economic value. Consequently, fishermen likely have less incentive to retain these fish.

Non-commercial (research and sport) catches of "other slope rockfish" and incidental catch in the Pacific halibut longline fishery are discussed in Appendix 16A.

[3] Source: 1993-2008 : 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 3 October, 2009. 2009-2011: National Marine Fisheries Service, Alaska Region, Catch Accounting System, accessed via the Alaska Fishery Information Network (AKFIN). Updated through October 3, 2011.

Species Composition of the "Other Slope Rockfish Catch"

Species composition data for the commercial catch of "other slope rockfish" in the 1992-2010 commercial fishery can be estimated from information collected by the domestic observer program (Table 16-3). These estimates were computed by first totaling the catch weight of each "other slope rockfish" species by year and Gulf of Alaska management area (Western, Central, and Eastern) for all observed hauls. Next, a percentage value for each species was calculated relative to the total observed weight of all "other slope rockfish" within each area/year combination. Finally, these species percentages were applied to the official "other slope rockfish" catches in Table 16-2 for each area/year combination and then summed over areas to yield the Gulfwide estimated values for each year in Table 16-3. One caveat is that the species 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. Also, observer coverage in the central GOA has increased due to requirements of the Central Gulf of Alaska Rockfish Pilot Program, a five-year rationalization program initiated in 2007 that established cooperatives among trawl vessels (for details, see North Pacific Fishery Management Council 2008).

These data indicate that for the "other slope rockfish" category, harlequin and sharpchin rockfish have always been the predominant species caught, and that redstripe, silvergray and yellowmouth rockfish have also sometimes been taken in relatively large amounts. Since 2003, harlequin rockfish has especially dominated and has generally comprised about two thirds of the "other slope rockfish" catch.

Management Measures

A timeline of management measures that have affected "other slope rockfish" in the GOA is listed in the following table.

Year	Management Measures
1988	The NPFMC implements the slope rockfish assemblage, which includes the species that will become "other slope rockfish", together with Pacific ocean perch, northern rockfish, shortraker rockfish and rougheye rockfish. Previously, *Sebastes* in Alaska were managed as the "Pacific ocean perch complex" or "other rockfish".
1988	Apportionment of ABC among management areas in the Gulf (Western, Central, and Eastern) for slope rockfish assemblage is determined based on average percent biomass in previous NMFS trawl surveys.
1991	Slope rockfish assemblage is split into three management subgroups with separate ABCs and TACs: Pacific ocean perch, shortraker/rougheye rockfish, and "other slope rockfish".
1993	Northern rockfish is split as a separate management entity from "other slope rockfish".
1997	Area apportionment procedure for "other slope rockfish" is changed. Apportionment is now based on 4:6:9 weighting of biomass in the most recent three NMFS trawl surveys.
1999	Trawling is prohibited in the Eastern Gulf east of 140° W. long. Eastern Gulf trawl closure becomes permanent with the implementation of FMP Amendments 41 and 58 in 2000 and 2001, respectively.
1999	Northern rockfish in the Eastern Gulf is reassigned to "other slope rockfish".
1999	Eastern Gulf is divided into West Yakutat and East Yakutat/Southeast Outside, and separate ABCs and TACs are assigned for "other slope rockfish" in these areas.
2007	Amendment 68 creates the Central Gulf Rockfish Pilot Program, which affects trawl catches of rockfish in this area.
2012	(Planned) Yellowtail and widow rockfish are assigned to the "other slope rockfish" group, and group name is changed to "other rockfish".

DATA

Fishery Data

Catch

Detailed catch information for "other slope rockfish" is listed in Tables 16-2.

Size and Age Composition

The numbers of lengths sampled by observers for "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.

Survey Data

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, 2005, 2007, 2009, and 2011. The surveys provide much information on "other slope rockfish", including estimates of absolute abundance (biomass) and population length compositions. The trawl surveys have 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. To compensate for this lack of sampling in 2001, substitute values of biomass were computed for this area in 2001 by averaging the eastern Gulf biomass estimates in the three previous trawl surveys (for details, see Heifetz et al. 2001). Also, the 1984 and 1987 survey results should be treated with some caution. A different, non-standard 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.

For the planned "other rockfish" group, the biomass estimates indicate that six species have comprised most of the biomass: sharpchin, redstripe, harlequin, silvergray, redbanded rockfish, and yellowtail rockfish (Table 16-4). Geographically, most of the biomass for these species is found in the eastern Gulf of Alaska, especially the Southeastern statistical area (Table 16-5). Harlequin rockfish is the one exception, as its highest biomass has often occurred in other areas west of Southeastern. Broad confidence intervals are associated with most of these biomass estimates, and the CVs for the estimates are generally higher than for many other rockfish in the GOA. For example, CVs for redstripe rockfish range from 36% to 87%, compared to a range of only 17% to 33% for shortraker rockfish and 11% to 23% for rougheye/blackspotted rockfish (see shortraker and rougheye/blackspotted rockfish chapters in this SAFE report).

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 2,625 mt in 1984 to 72,405 mt in 1987, and then decreased to 17,664 mt in 1990 (Table 16-5). Again, its biomass estimate increased nearly ten-fold from 2003 to 2005, followed by large declines in 2007 and 2009 to nearly the 1984 level. Such wide fluctuations in biomass do not seem reasonable given the slow growth and low natural mortality rates of all *Sebastes* species. 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, an extremely large catch of 5 mt of silvergray rockfish in one haul was mostly responsible for the very large biomass of that species in the Southeastern area, and it likely was a major cause for the high Gulfwide coefficient of variation that year of 73.4%. 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.

Especially notable results were seen for silvergray rockfish in the 2011 survey. Silvergray rockfish had shown a substantial and progressive decrease in Gulfwide biomass from ~52,000 mt in 2003 to only ~10,000 mt in 2009 (Table 16-5; Clausen 2009), and there was concern that a significant decline in population might be occurring. However, the 2011 biomass for this species increased ten-fold to over 100,000 mt. This is by far the most biomass ever recorded for silvergray rockfish in the GOA, and is also the largest single biomass for any species of "other rockfish" in all the GOA trawl surveys. According to the 2011 survey, silvergray rockfish now ranks third in biomass among all rockfish species in the GOA, surpassed only by Pacific ocean perch and northern rockfish. To investigate this large increase in 2011, we examined the survey's geographic catches of silvergray rockfish in individual hauls (Figure 16-1). Unlike the 2003 survey, when much of the large biomass of silvergray rockfish that year was attributable to one very large catch, several large catches contributed to the high biomass in 2011. One large catch is seen in the Chirikof area in the central GOA, and three large catches occurred in close proximity in the southeastern Alaska. Several moderate-sized catches were also seen in the latter area. Thus, the large biomass of silvergray rockfish in the 2011 survey does not appear to be caused by the chance encounter of one or two large aggregations, and this is reflected by the biomass' relatively low coefficient of variation of 34.5% (Table 16-5).

Also noteworthy is the small biomass of harlequin rockfish in 2011 (Table 16-4). In some of the previous trawl surveys, harlequin rockfish had been one of the most abundant of the "other rockfish" species (e.g., 1987, 1996, and 2005), but 2011 is the third consecutive survey when the biomass has been only ~3,000-4,000 mt. As discussed previously, harlequin rockfish is a species whose biomass has shown unreasonably wide fluctuations in the GOA surveys, so it appears to be poorly sampled by the survey's gear and/or methodology. Hence, whether these three low biomass estimates truly indicate a decline in abundance is uncertain.

Trawl Survey Size Compositions

To help interpret changes in biomass of silvergray rockfish in the GOA trawl survey, population size compositions for this fish are shown in Figure 16-2 for surveys since 1990. None of the size compositions show a significant influx of small fish <40 cm that would help explain the large increase in biomass of silvergray rockfish seen in 2011. Because so few fish <40 cm have been caught, it appears these younger fish may live in a different habitat than what is sampled by the survey. Mean length increased from 47.5 cm in 1990 to 51.7 cm in 2003, and then decreased in following years. In most years the size composition were unimodal, but the large biomass in 2011 showed two modes, one at 44 cm and the other at approximately 49 cm.

Survey Age Compositions

For the "other slope rockfish" species, age compositions are available for sharpchin, redstripe, harlequin, and silvergray rockfish in the GOA (Figures 16-3 and 16-4). The ages are all based on the break-and-burn technique of aging otoliths. No age validation has been done for any of these species, so the results should be considered preliminary. However, aging of the sharpchin, redstripe, and harlequin rockfish was reported to be relatively easy[4] when compared with other rockfish species such as Pacific ocean perch or

[4] B. Goetz, National Marine Fisheries Service, Alaska Fisheries Science Center, REFM Division, 7600 Sand Point Way NE, Seattle WA 98115. Pers. commun. Jul. 2003.

rougheye rockfish. In contrast, silvergray rockfish were relatively difficult to age[5]. The age compositions for sharpchin, redstripe, and harlequin were for the 1996 trawl survey only. Sharpchin ages ranged from 2 to 44, redstripe from 4 to 36, and harlequin from 3 to 47. Mean population age was highest for redstripe (14.4), followed by sharpchin (13.4) and then harlequin (12.0). The 1986 year class appeared to be strong for both sharpchin and harlequin, whereas 1982 or 1983 were strong for sharpchin and redstripe.

Age compositions for silvergray rockfish are available for four GOA trawl surveys: 1993, 1996, 1999, and 2005. Unfortunately, the 2005 age compositions are based on a small sample size of only 82 fish, so they provide limited information. Mean population age increased from 17.0 in 1993 to 19.2 in 1996, and then decreased to 18.2 in 1999. Much of the increase in 1996 appears to be due to the passage of a large 1981/1982 year-class through the population. The existence of a large 1981 year-class is also supported by data from northern British Columbia, where an extremely large 1981 year-class was observed[6]. The 1981 year class is no longer especially prominent in the 1999 age composition, perhaps because age determination of older fish may be less precise. However, a strong 1987 year-class is apparent in the 1999 sample. The large increase in biomass for silvergray rockfish seen in the 1990s and early 2000s may be partially attributable to strong 1981 and 1987 year classes. A large age sample of 444 silvergray rockfish was collected in the 2011 survey, and when these are aged much information will be available concerning the age structure of that year's exceptionally high biomass.

ASSESSMENT PARAMETERS

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

Estimates of mortality, maximum age, and female age- and size-at-50% maturity are shown in Table 16-6 for eight species of "other rockfish". The mortality rates are based on a variety of methods. Those that were calculated using the catch curve method are actually estimates of the total instantaneous mortality (Z) and should be considered as upper bounds for the natural mortality rate (*M*). Mortality rate estimates range from as low as 0.01 for silvergray rockfish to a high of 0.157 for harlequin rockfish, and maximum age ranges up to 82 years for silvergray rockfish and 99 years for yellowmouth rockfish.

As previously discussed in the 2009 SAFE report (Clausen 2009), the estimated mortality range of 0.127-0.157 for harlequin rockfish (Malecha et al. 2007) is probably an overestimate because it was based on a small sample size of just 100 fish in which the oldest fish was only 34. Other aging results for harlequin rockfish based on larger sample sizes showed maximum ages of 43 and 47 (Table 16-6) for harlequin rockfish, which indicates the mortality rate should be considerably lower. For this assessment, we calculated alternative estimates of mortality for harlequin rockfish based on the large age sample of 641 fish from the 1996 GOA trawl survey (Figure 16-3). We used procedures identical to those of Malecha et al. (2007) in which four estimates of natural mortality were calculated, two variations of the Alverson and Carney method (1975) and two variations of the Hoenig (1983) method. We then averaged these four estimates to yield a single estimate of mortality. Both the Alverson and Carney and the Hoenig method are very sensitive to maximum age of the fish, and when we examined the 1996 age data we found the oldest age, 47, was for just a single fish that exceeded the next oldest by six years. Because the sample size of ages (641 fish) was so large, and the maximum age was for only one fish that was much older than the others, we decided that a maximum age of 47 was an outlier that should not be used in the estimations of natural mortality. We instead used the next oldest fish, age 41, as the maximum age in the computations to yield the following estimates of mortality: 0.053, 0.131, 0.112, and 0.073. These four

[5] K. Munk, Alaska Dept. Fish and Game, P. O. Box 25526, Juneau AK 99802. Pers. commun. Oct. 2007.

[6] R. Stanley, Fisheries and Oceans Canada, Pacific Biological Station, Nanaimo, British Columbia, Canada V9T 6N7. Pers. commun. Jan. 2006.

estimates correspond to what Malecha et al. (2007) call "Alverson-Carney$_{(0.38)}$", "Alverson-Carney$_{(0.25)}$", "Hoenig$_{(0.01)}$", and "Hoenig$_{(0.05)}$", respectively. The average of the four values, 0.092, is our new recommendation as the best estimate of natural mortality for harlequin rockfish in the GOA.

The only information on age-of-recruitment for any of the "other slope rockfish species" is for female silvergray rockfish in British Columbia, which are about 50% recruited at age 14, and >90% recruited at age 20 (Stanley and Kronlund 2005). It appears that nearly all the females are mature when they recruit to the British Columbia fishery.

Length- and Weight-at-Age

Length-weight coefficients and von Bertalanffy parameters for several species of "other rockfish" are listed in Tables 16-7 and 16-8. The length-weight coefficients are based on data collected in the 1996 GOA survey and are newly calculated for this report. The von Bertalanffy parameters are all based on age results that have not been validated, so they should be used with caution. The von Bertalannfy parameters for harlequin rockfish are based on age data from the 1996 GOA trawl survey and are newly calculated for this report.

ANALYTIC APPROACH AND ABC/OFL RECOMMENDATIONS

Due to the lack of biological information for "other slope rockfish" (especially an absence of validated age data), past assessments for this group have all used a biomass-based approach based on trawl survey data to calculate ABCs. We continue to use this approach in the present assessment for "other rockfish".

Determination of Current Exploitable Biomass

In all the past SAFE reports, exploitable biomass for "other slope rockfish" in the Gulf of Alaska has been determined based on the average Gulfwide biomass for the three most recent trawl surveys. Before the 2007 assessment (Clausen 2007), exploitable biomass computations did not include the biomass in the 1-100 m depth stratum. This was a holdover from a period in the late 1980s when "other slope rockfish" were part of a much larger management group that included all slope rockfish, such as Pacific ocean perch and northern rockfish. Pacific ocean perch in the 1-100 m stratum were thought to be mostly small juveniles and therefore not exploitable. However, in the 2007 assessment for shortraker rockfish and "other slope rockfish", an analysis indicated that excluding the 1-100 m stratum in the exploitable biomass calculations was unnecessary because catches of shortraker rockfish and "other slope rockfish" in this stratum are negligible in the surveys (Clausen 2007). Since 2007, the exploitable biomass determinations for "other slope rockfish" have included all the strata covered by the trawl surveys.

Therefore, for "other rockfish", current exploitable biomass is calculated based on the average Gulfwide biomass estimates (including the 1-100 m stratum) for the three most recent trawl surveys in 2007, 2009, and 2011 (Table 16-9). These biomasses are 74,518, 37,532, and 145,273 mt, which yield an average of 85,772 mt. Hence, current exploitable biomass for "other rockfish" in the GOA is 85,774 mt. It should be noted that the exploitable biomass for "other slope rockfish" is based on the values in Table 16-9, instead of those in Table 16-4, because Table 16-9 includes northern rockfish in the Eastern area, where northern rockfish is a member of this management group.

ABC Recommendations

In past SAFE reports, "other slope rockfish" species have all been classified as "tier 5" species, with the exception of sharpchin rockfish which has been tier 4 for a number of years. Yellowtail rockfish and widow rockfish have also been classified as tier 5 in the past "pelagic shelf rockfish" assessments. "Tier 5" is a classification from the NPFMC definitions for ABC and Overfishing Level (OFL) based on Amendment 56 to the Gulf of Alaska FMP. The population dynamics information available for tier 5 species consists of reliable estimates of biomass and natural mortality *M*, and the definitions state that for these species, the fishing rate that determines ABC (i.e., F_{ABC}) is $\leq 0.75M$. Values of *M* used in the computations for ABC of "other rockfish" in this report are based on the mortality rates listed in Table 16-6 and are the same as those in the 2009 assessments for "other slope rockfish" and pelagic shelf rockfish (Clausen 2009; Lunsford et al. 2009), with the exception of harlequin rockfish. Estimates of *M* for redstripe rockfish and yellowtail rockfish can be obtained directly from the table and are 0.10 and 0.07, respectively. For silvergray rockfish, an *M* of 0.05 is used for the computations, which is the approximate midpoint of the 0.041-0.057 range shown in Table 16-6 for this species in the Gulf of Alaska. In all previous assessments, a proxy estimate of *M* of 0.06 was used for harlequin and redbanded rockfish and the minor species, based on the average *M* for northern, sharpchin, redstripe, and silvergray rockfish. However, as discussed previously in the "Mortality, Maximum Age, Female Age- and Size-at-50% Maturity, and Age-of-Recruitment" section, we recently computed a new natural mortality estimate of 0.092 for harlequin rockfish that we now recommend using in the tier 5 calculations. For simplicity and to be consistent with the *M* values for the other species, we recommend rounding *M* for harlequin rockfish to 0.09. Based on all these recommended values of *M* and on the NPFMC definitions for tier 4 and tier 5, calculations of ABC for "other rockfish" are summarized in the following table:

Species	Tier	current exploit. biomass	*M*	$F_{40\%}$	F_{ABC} definition	F_{ABC} recommended	ABC (mt) (F_{ABC} x exploit. bio.)
Sharpchin	4	13,190	0.05	0.053	$F_{ABC} \leq F_{40\%}$	$F_{ABC} = F_{40\%}$	699
Redstripe	5	10,612	0.10	-	$F_{ABC} \leq 0.75 \times M$	$F_{ABC} = 0.75 \times M$	796
Harlequin	5	3,493	0.09	-	$F_{ABC} \leq 0.75 \times M$	$F_{ABC} = 0.75 \times M$	236
Silvergray	5	46,566	0.05	-	$F_{ABC} \leq 0.75 \times M$	$F_{ABC} = 0.75 \times M$	1,746
Redbanded	5	6,227	0.06	-	$F_{ABC} \leq 0.75 \times M$	$F_{ABC} = 0.75 \times M$	280
Yellowtail	5	4,230	0.07	-	$F_{ABC} \leq 0.75 \times M$	$F_{ABC} = 0.75 \times M$	222
minor species[a]	5	1,456	0.06	-	$F_{ABC} \leq 0.75 \times M$	$F_{ABC} = 0.75 \times M$	66
All species		85,774					4,045

[a]Includes northern rockfish in the eastern GOA

Therefore, the recommended combined ABC for "other rockfish" in the GOA in 2012 is 4,045 mt. This is an increase of about 8% compared to the 2010 and 2011 ABCs for "other slope rockfish" of 3,749 mt. The increased ABC is mostly due to the addition of yellowtail rockfish to the group in 2012 and the large biomass of silvergray rockfish in the 2011 trawl survey. The increase would have been even higher but was offset by lower exploitable biomass for sharpchin, redstripe, and harlequin rockfish.

Area Allocation of ABC

Since 1991, the Gulfwide ABC for "other slope rockfish" has been allocated amongst the Western, Central, and Eastern GOA regulatory areas based on the geographic distribution of the species' exploitable biomass in the trawl surveys. Beginning with 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 GOA 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 "other slope rockfish". The Plan Team's scheme was adopted for the 1997 fishery, and the scheme has continued to be used in the years since. Therefore, based on a 4:6:9 weighting of the 2007, 2009, and 2011 trawl surveys, the percent distribution of exploitable biomass for "other slope rockfish" biomass in the GOA is: Western area,1.08%; Central area, 14.98%, and Eastern area, 83.94% (Table 16-10). Applying these percentages to the recommended Gulfwide ABC of 4,045 mt yields the following apportionments for the GOA in 2012: Western area, 44 mt; Central area, 606 mt; and Eastern area, 3,395 mt.

Because the Eastern area is divided into two management areas for "other rockfish", i.e., the West Yakutat area and the East Yakutat/Southeast Outside area, the ABC for "other 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 percent biomass estimates in the last three trawl surveys, i.e., 2007, 2009, and 2011. The weighted average of the "other rockfish" biomass in these three surveys for West Yakutat is 6.78%, and that for East Yakutat/Southeast Outside is 93.22%. This translates into an ABC of 230 mt for West Yakutat and 3,165 mt for East Yakutat/Southeast Outside in 2010. The West Yakutat ABC includes a very small amount of northern rockfish (~2 mt) that was allocated to this area because all the northern rockfish biomass in the Eastern area occurs in West Yakutat.

Overfishing Level

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 rockfish", all of which are in tier 5, overfishing is defined to occur at the *F=M* rate. Applying these *Fs* results in an overfishing catch limit of 5,305 mt for the GOA "other slope rockfish" group in 2012.

Summary

A summary of tiers, current exploitable biomass, values of *F*, and recommended ABCs and OFLs for "other rockfish" is in Table 16-11.

OTHER CONSIDERATIONS

Conservation Concern for Harlequin Rockfish

When the species composition of the commercial catch estimates for "other slope rockfish" (Table 16-3) is compared with the species composition of the trawl survey biomass estimates for this group (Table 16-4), it is apparent that harlequin rockfish have a history of disproportionate harvest in the GOA. For example, during the years 2001-2010, harlequin rockfish comprised an estimated 69% of the "other slope rockfish" catch, while they were only 14% of the biomass estimates for the group in trawl surveys conducted between 2001 and 2009. Although harlequin rockfish have been disproportionately harvested, in previous years their catch has always been less than their computed ABC within the "other slope rockfish" group. Thus, there has not been a particular overharvest concern for these fish. However, because of the low biomass estimates for harlequin rockfish in the last three trawl surveys, the computed ABC and OFL values for this species in 2012 (236 mt and 314 mt, respectively) are now considerably

less than their estimated catches in recent years. Technically, because harlequin rockfish are managed as part of a species group ("other rockfish"), their computed species ABCs and OFL are not officially binding, and if the commercial harvest exceeds the OFL, this would not trigger any management action. Action would only be required if the group ABCs and OFL were exceeded. However, the low biomass estimates for harlequin rockfish in the last three trawl surveys do raise a conservation concern for this species if the biomass estimates are truly reliable (see discussion about harlequin rockfish biomass in the section "Biomass Estimates from Bottom Trawl Surveys"). If catches of harlequin rockfish in 2012 are similar to those in past years, it is likely they will exceed the "unofficial" ABCs and OFL for this species.

ECOSYSTEM CONSIDERATIONS

In general, a determination of ecosystem considerations for "other 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 16-12.

Ecosystem Effects on the Stock

Prey availability/abundance trends: similar to other rockfish species, stock condition of "other 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 generally not possible, although genetic techniques allow identification to species level for larvae of many "other rockfish" species (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). Food habits data on "other rockfish" species in Alaska is very sparse, but adult sharpchin rockfish in the GOA apparently feed mostly on plankton such as calanoid copepods and euphausiids and also on pandalid shrimp (Yang et al. 2006). Redstripe rockfish in areas south of Alaska feed on euphausiids, shrimps, and small fish (Love et al. 2002). 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 by 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 an effect on prey item abundance and success of transition of rockfish from the 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 affect survival rates by altering available shelter, prey, or other functions. Associations of juvenile rockfish with biotic and abiotic

structure have been noted by Carlson and Straty (1981), Pearcy et al. (1989), Love et al. (1991), and Freese and Wing (2003). The Essential Fish Habitat Environmental Impact Statement (EFH EIS) for groundfish in Alaska (NMFS 2005) concluded that the effects of commercial fishing on the habitat of groundfish is minimal or temporary based largely on the criterion that stocks were above the Minimum Stock Size Threshold (MSST). However, a review of the EFH EIS suggested that this criterion was inadequate to make such a conclusion (Drinkwater 2004).

Fishery Effects on the Ecosystem

Because there is no targeted fishing on "other rockfish" in the GOA, nearly all the catch of these species is taken incidentally in directed rockfish trawl fisheries for Pacific ocean perch, northern rockfish, and dusky rockfish and in longline fisheries for sablefish and Pacific halibut. Thus, the reader is referred to the discussions on "Fishery Effects" in the chapters for these species in this SAFE report.

Fishery-specific contribution to bycatch of HAPC biota: Refer to chapters in this SAFE report on Pacific ocean perch, northern rockfish, dusky rockfish, and sablefish. Directed fisheries on these four species take most of the "other rockfish" catch.

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: Discards of GOA "other slope rockfish" in 2009, 2010, and 2011 have totaled 494 mt, 564 mt, and 443 mt, respectively[7].

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 rockfish fishery can move around rocks and boulders on the bottom.

Data Gaps and Research Priorities

All the species of "other rockfish" in the GOA suffer from a general lack of information. Probably due to their low economic value and, for some species, their relatively low abundance, there has been almost no directed research on these fish in Alaska. The most important research priority for assessment would be to improve the biomass estimates for "other rockfish". Biomass estimates for most of the major species of "other rockfish" have often shown unreasonably wide fluctuations in biomass from survey to survey, and their coefficients of variation are usually high relative to other groundfish. To improve the reliability and decrease the variance of the biomass estimates, revised and innovative survey methodologies are likely necessary. Another priority for assessment is age validation for the GOA sharpchin, redstripe, harlequin, and silvergray rockfish that have been aged. To move these species beyond their present tier 5 or tier 4 assessments, age-structured models are needed, and age validation will be required. Life history information on these species is virtually nil. Habitat requirements for larval, post-larval, and early juvenile stages are mostly unknown, while those for later stage juvenile and adult fish are anecdotal or conjectural. Research needs to be done to determine the habitat preference of all these life stages.

[7] National Marine Fisheries Service, Alaska Region, Catch Accounting System, accessed via the Alaska Fishery Information Network (AKFIN). Updated through October 3, 2011.

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Table 16-1.--Species comprising the "other rockfish" management category in the Gulf of Alaska.

Common name	Scientific name	Former (pre-2012) management category
Sharpchin rockfish	*Sebastes zacentrus*	Other slope rockfish
Redstripe rockfish	*S. proriger*	Other slope rockfish
Harlequin rockfish	*S. variegatus*	Other slope rockfish
Silvergray 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. elongatus*	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. goodei*	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
Yellowtail rockfish	*S. flavidus*	Pelagic shelf rockfish
Widow rockfish	*S. entomelas*	Pelagic shelf rockfish

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

Table 16-2.--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), 1991-2011. (Note: catches do not include yellowtail and widow rockfish, which were part of the "pelagic shelf rockfish" management group in these years). Updated through October 3, 2011.

	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	92	514	109	715	3,900	670
2006	244	541	146	931	4,152	1,480
2007	252	338	100	690	4,154	1,482
2008	300	435	74	809	4,297	1,730
2009	403	396	95	895	4,297	1,730
2010	364	417	161	942	3,749	1,192
2011	299	344	206	849	3,749	1,192

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: 1991-2007, Clausen (2007); 2008 and 2009, North Pacific Fishery Management Council website (http://www.fakr.noaa.gov/npfmc/Council0910specs.pdf).

Table 16-3.--Estimated commercial catch (mt) for species in the "other slope rockfish" management category in the Gulf of Alaska, 1992-2010. See text for an explanation of how these catches were estimated. Catch estimates do not include yellowtail and widow rockfish, which were members of the "pelagic shelf rockfish" management group during these years. Because of rounding, numbers may not add exactly to totals.

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Sharpchin rockfish	434	1,345	330	342	278	316	319	169	274	162
Redstripe rockfish	261	1,222	207	198	134	291	51	107	51	44
Harlequin rockfish	745	1,864	789	667	403	492	443	438	186	281
Silvergray rockfish	130	487	219	123	8	34	8	19	19	18
Yellowmouth rockfish	102	498	40	15	6	63	1	2	13	8
Redbanded rockfish	-	-	23	22	30	15	20	21	25	36
Minor "other slope rockfish" species	2	16	4	31	23	6	21	32	10	11
Total, all species	1,674	5,433	1,613	1,397	881	1,217	861	788	577	559

Note: Data are not available for redbanded rockfish in 1992 and 1993.

	2002	2003	2004	2005	2006	2007	2008	2009	2010
Sharpchin rockfish	276	226	119	69	89	102	129	94	185
Redstripe rockfish	13	42	38	20	56	51	46	51	37
Harlequin rockfish	365	732	674	601	716	450	555	641	657
Silvergray rockfish	52	20	17	4	8	40	17	28	20
Yellowmouth rockfish	15	10	5	0	0	0	0	0	0
Redbanded rockfish	35	38	31	21	34	40	55	33	37
Minor "other slope rockfish" species	17	9	trace	1	28	6	6	47	6
Total, all species	774	1,078	885	715	931	690	809	895	942

Table 16-4.--Comparison of Gulfwide biomass estimates (mt) for species in the "other rockfish" management category in the Gulf of Alaska, based on bottom trawl surveys conducted between 1984 and 2011.

Species	1984	1987	1990	1993	1996	1999	2001[a]	2003	2005	2007	2009	2011
Sharpchin rockfish	6,612	80,439	38,334	23,676	64,570	20,841	34,169	7,094	21,193	19,037	12,493	8,041
Redstripe rockfish	5,364	26,519	27,064	29,619	14,964	8,226	17,564	8,025	21,691	11,501	1,592	18,745
Harlequin rockfish	2,625	72,405	17,664	9,281	20,026	9,877	14,480	3,545	33,125	4,057	2,686	3,735
Silvergray rockfish	4,817	5,426	14,149	18,979	24,127	37,641	24,032	51,916	39,837	29,798	9,851	100,049
Redbanded rockfish	1,430	1,822	3,285	3,675	4,594	10,941	6,409	3,441	5,667	7,198	6,442	5,042
Darkblotched rockfish	7	37	174	291	121	272	227	91	232	161	1,121	71
Splitnose rockfish	0	3	3	0	0	7	2	5	42	6	20	0
Greenstriped rockfish	14	65	174	268	352	467	362	423	392	676	356	331
Vermilion rockfish	0	0	0	20	0	0	7	0	0	0	0	0
Bocaccio	505	36	173	106	137	0	81	132	0	104	0	0
Pygmy rockfish	0	406	88	3	283	187	141	127	137	137	266	32
Yellowmouth rockfish	497	260	1,876	3,563	923	5,570	3,346	387	0	475	43	0
Yellowtail rockfish	478	0	0	0	85	12,671	4,245	705	1,121	1,096	2,481	9,112
Widow rockfish	0	166	298	0	929	184	345	32	128	236	110	88
Total, "other rockfish"	22,349	187,584	103,282	89,481	131,111	106,884	105,410	75,923	123,565	74,482	37,461	145,246

[a]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.

Note: because these are Gulfwide estimates, they do not include the biomass for northern rockfish, which is a member of the "other slope rockfish" management group only in the Eastern Gulf of Alaska.

Table 16-5.--Detailed biomass estimates (mt) for major species of "other slope rockfish" (sharpchin, redstripe, harlequin, silvergray, redbanded, and yellowtail rockfish) in the Gulf of Alaska, by statistical area, based on bottom trawl surveys conducted between 1984 and 2011. Gulfwide 95% confidence bounds, variance, and coefficient of variation (CV) are also shown for each year.

	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
2007	53	68	3,979	3,826	11,111	19,037	5,792	32,282	42,070,721	34.1
2009	15	12	643	2,763	9,061	12,493	3,006	21,979	19,558,735	35.4
2011	0	176	363	5,461	2,042	8,041	0	19,965	25,421,741	62.7
					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
2007	15	4	651	0	10,830	11,051	0	26,535	49,124,778	60.9
2009	1	26	22	0	1,542	1,592	47	3,136	535,783	46.0
2011	0	0	499	506	17,740	18,745	0	54,603	265,425,067	86.9
					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
2007	834	1,814	89	307	1,014	4,057	384	7,730	3,373,252	45.3
2009	44	74	766	716	1,086	2,686	274	5,099	1,328,629	42.9
2011	2,238	880	202	400	15	3,735	0	8,409	5,241,255	61.3

(Table continued on next page).

Table 16-5.--(Continued)

	Statistical areas						Gulfwide			
							95% Conf. bounds			
Year	Shumagin	Chirikof	Kodiak	Yakutat	South-eastern	Gulfwide Total	Lower	Upper	Biomass variance	Biomass CV (%)
					Silvergray 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
2007	0	86	273	8,754	20,685	29,798	13,588	46,007	60,382,205	26.1
2009	0	8	86	4,229	5,528	9,851	939	18,763	17,671,366	42.7
2011	0	20,218	3,892	3,879	72,061	100,049	29,458	170,641	1,191,566,283	34.5
					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
2007	52	294	870	2,772	3,211	7,198	3,315	11,081	3,277,015	25.1
2009	34	643	1,377	1,249	3,139	6,442	4,215	8,669	1,214,410	17.1
2011	12	270	1,034	876	2,850	5,042	2,655	7,428	1,342,036	23.0
					Yellowtail Rockfish					
1984	0	0	0	9	469	478	3	953	53,149	48.2
1987	0	0	0	0	0	0	0	0	0	-
1990	0	0	0	0	0	0	0	0	0	-
1993	0	0	0	0	0	0	0	0	0	-
1996	0	0	20	0	65	85	0	191	2,803	62.2
1999	0	0	0	162	12,509	12,671	0	37,470	133,664,228	91.2
2001*	0	0	0	54	4,192	4,245	n.a.	n.a.	n.a.	n.a.
2003	0	0	0	71	635	705	0	1,730	233,768	68.5
2005	0	0	0	0	1,121	1,121	0	2,859	724,518	75.9
2007	0	17	0	0	1,079	1,096	0	2,268	268,322	47.3
2009	0	0	30	33	2,419	2,481	0	5,713	2,300,710	61.1
2011	0	1,136	0	0	7,976	9,112	0	26,230	64,530,639	88.2

*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 CVs listed in this table, but confidence bounds and variance are not available (n.a.) for yellowtail rockfish in 2001.

Table 16-6.-- Mortality rates, maximum age, and female age and size at 50% maturity for some species of "other rockfish". Size is fork length in cm. Area indicates location of study: British Columbia (BC) or Gulf of Alaska (GOA).

Species	Mortality rate[a]	Mortality rate method	Maximum age	Age at Maturity	Size at Maturity	Area	References
Sharpchin	0.05	CC	46	-	-	BC	1
	0.056-0.059	A&C - H	58	10	26.5	GOA	5,3
Yellowmouth	0.06	CC	71	-	-	BC	1,2
	-	-	99	-	-	BC	6
Darkblotched	0.07	CC	48	-	-	BC	1
Harlequin	-	-	43	-	-	BC	2
	0.127-0.157	A&C - H	34	-	-	GOA	5
	0.092	A&C - H	47	-	-	GOA	7
Redstripe	0.10	CC	41	-	-	BC	1,2
	-	-	55	-	-	BC	6
	-	-	36	-	-	GOA	7
Silvergray	0.01-0.07	CC	80	-	-	BC	1,2
	0.041-0.057	A&C - H	75	-	-	GOA	5
	-	-	82	9	-	BC	8
	0.06	H	-	-	-	BC	9
Yellowtail	0.07		53			BC	4
Widow	0.05	CC	59			BC	2

[a]Mortality rates determined by the catch curve method are rates of total instantaneous mortality (*Z*), and those determined by other methods are rates of instantaneous natural mortality (*M*).

Mortality rate methods:
CC: catch curve analysis to compute total mortality rate *Z*; A&C - H: combination of Alverson and Carney (1975) method and Hoenig (1983) method (see Malecha et al. 2007); H: Hoenig (1983) method.

References:
1) Archibald et al. 1981; 2) Chilton and Beamish 1982; 3) Heifetz et al. 1997; 4) Leaman and Nagtegaal 1987; 5) Malecha et al. 2007; 6) Munk 2001; 7) this report; 8 Stanley and Kronlund 2005; 9 Stanley and Kronlund 2000.

Table 16-7.-- Length-weight coefficients for sharpchin, harlequin, redstripe, and silvergray 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 collected in the 1996 GOA trawl survey).

Species	Sex	a	b
Sharpchin	combined	1.13×10^{-5}	3.07
	males	8.89×10^{-6}	3.15
	females	1.19×10^{-5}	3.06
Harlequin	combined	6.11×10^{-6}	3.24
	males	8.96×10^{-6}	3.13
	females	5.96×10^{-6}	3.24
Redstripe	combined	1.00×10^{-5}	3.07
	males	1.07×10^{-5}	3.07
	females	9.97×10^{-6}	3.07
Silvergray	combined	7.26×10^{-6}	3.15
	males	7.34×10^{-6}	3.14
	females	9.97×10^{-6}	3.07

Table 16-8.--Von Bertalanffy parameters for sharpchin, silvergray, and harlequin rockfish, by area and sex. (BC = British Columbia; GOA = Gulf of Alaska).

Species	Area	Sex	t_0	k	L_{inf} (cm)	Reference
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	-1.70	0.141	30.66	3
	GOA	male	-1.27	0.164	29.02	3
	GOA	female	-1.58	0.137	31.53	3

1) Archibald et al. 1981; 2) Malecha et al. 2007; 3) this report.

[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 16-9.--Biomass estimates (mt) for "other rockfish" in the Gulf of Alaska, by NPFMC regulatory areas, in the 2007, 2009, and 2011 trawl surveys.

	Area			
Species	Western	Central	Eastern	Total
		2007		
Sharpchin rockfish	53	4,048	14,937	19,037
Redstripe rockfish	15	656	10,830	11,501
Harlequin rockfish	834	1,902	1,321	4,057
Silvergray rockfish	0	359	29,439	29,798
Redbanded rockfish	52	1,164	5,982	7,198
Yellowtail rockfish	0	17	1,079	1,096
Minor species[a]	4	31	1,797	1,832
Total, "other rockfish"	957	8,177	65,384	74,518
		2009		
Sharpchin rockfish	15	655	11,823	12,493
Redstripe rockfish	1	48	1,542	1,592
Harlequin rockfish	44	840	1,802	2,686
Silvergray rockfish	0	94	9,757	9,851
Redbanded rockfish	34	2,020	4,388	6,442
Yellowtail rockfish	0	30	2,452	2,482
Minor species[a]	0	252	1,734	1,986
Total, "other rockfish"	94	3,939	33,499	37,532
		2011		
Sharpchin rockfish	0	538	7,503	8,041
Redstripe rockfish	0	499	18,246	18,745
Harlequin rockfish	2,238	1,082	415	3,735
Silvergray rockfish	0	24,110	75,939	100,049
Redbanded rockfish	12	1,304	3,726	5,042
Yellowtail rockfish	0	1,136	7,976	9,112
Minor species[a]	0	16	535	551
Total, "other rockfish"	2,250	28,684	114,339	145,273

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

Table 16-10.-- Percentage of biomass by area for "other rockfish" based on the biomass estimates shown in Table 16-9 for Gulf of Alaska trawl surveys in 2007, 2009, and 2011. Weighted averages use weights of 4:6:9 for the 2007, 2009, and 2011 surveys, respectively.

Area		
Western	Central	Eastern[a]
	2007	
1.28%	10.97%	87.74%
	2009	
0.25%	10.50%	89.25%
	2011	
1.55%	19.74%	78.71%
	4:6:9 weighted average	
1.08%	14.98%	83.94%

[a] Includes northern rockfish in the Eastern area.

Table 16-11.--Summary of computations of ABCs and overfishing levels for "other rockfish" in the Gulf of Alaska for 2012. Biomass and yields are in mt. Since actual ABCs and overfishing levels for "other rockfish" are based on the overall management category, individual species are shown only for illustrative purposes. (Because of rounding, numbers may not add exactly to totals.)

		Exploit.	ABC		Overfishing	
Species	Tier	biomass	*F*	Yield	*F*	Yield
Sharpchin rockfish	4	13,190	$F_{40\%} = 0.0530$	699	$F_{35\%} = 0.064$	844
Redstripe rockfish	5	10,612	$F = 0.75M = 0.0750$	796	$F = M = 0.100$	1,061
Harlequin rockfish	5	3,493	$F = 0.75M = 0.0675$	236	$F = M = 0.090$	314
Silvergray rockfish	5	46,566	$F = 0.75M = 0.0375$	1,746	$F = M = 0.050$	2,328
Redbanded rockfish	5	6,227	$F = 0.75M = 0.0450$	280	$F = M = 0.060$	374
Yellowtail rockfish	5	4,230	$F = 0.75M = 0.0525$	222	$F = M = 0.070$	296
Minor species[a]	5	1,456	$F = 0.75M = 0.0450$	66	$F = M = 0.060$	87
Total, other slope rockfish		85,774		4,045		5,305

[a]Minor species include northern rockfish in the eastern Gulf of Alaska.

Table 16-12.-- Analysis of ecosystem considerations for "other 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		
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 ecosys-tem 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		
Fishery contribution to discards and offal production	"other rockfish"discard rates are moderate to high	some unnatural input of food into the ecosystem	some concern
Fishery effects on age-at-maturity and fecundity	unknown		

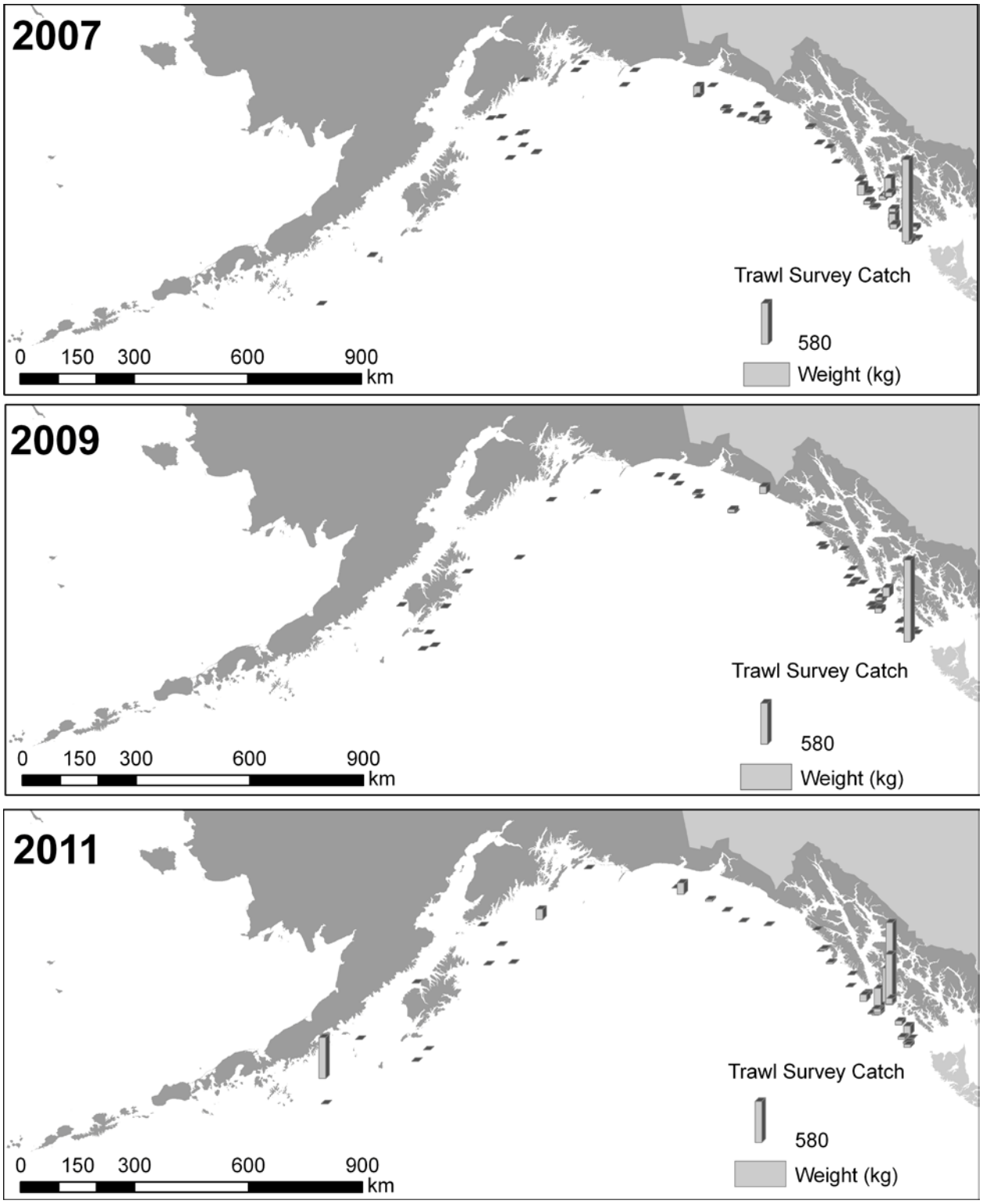

Figure16-1.--Spatial distribution of silvergray rockfish in the Gulf of Alaska during the 2007, 2009, and 2011 NMFS bottom trawl surveys.

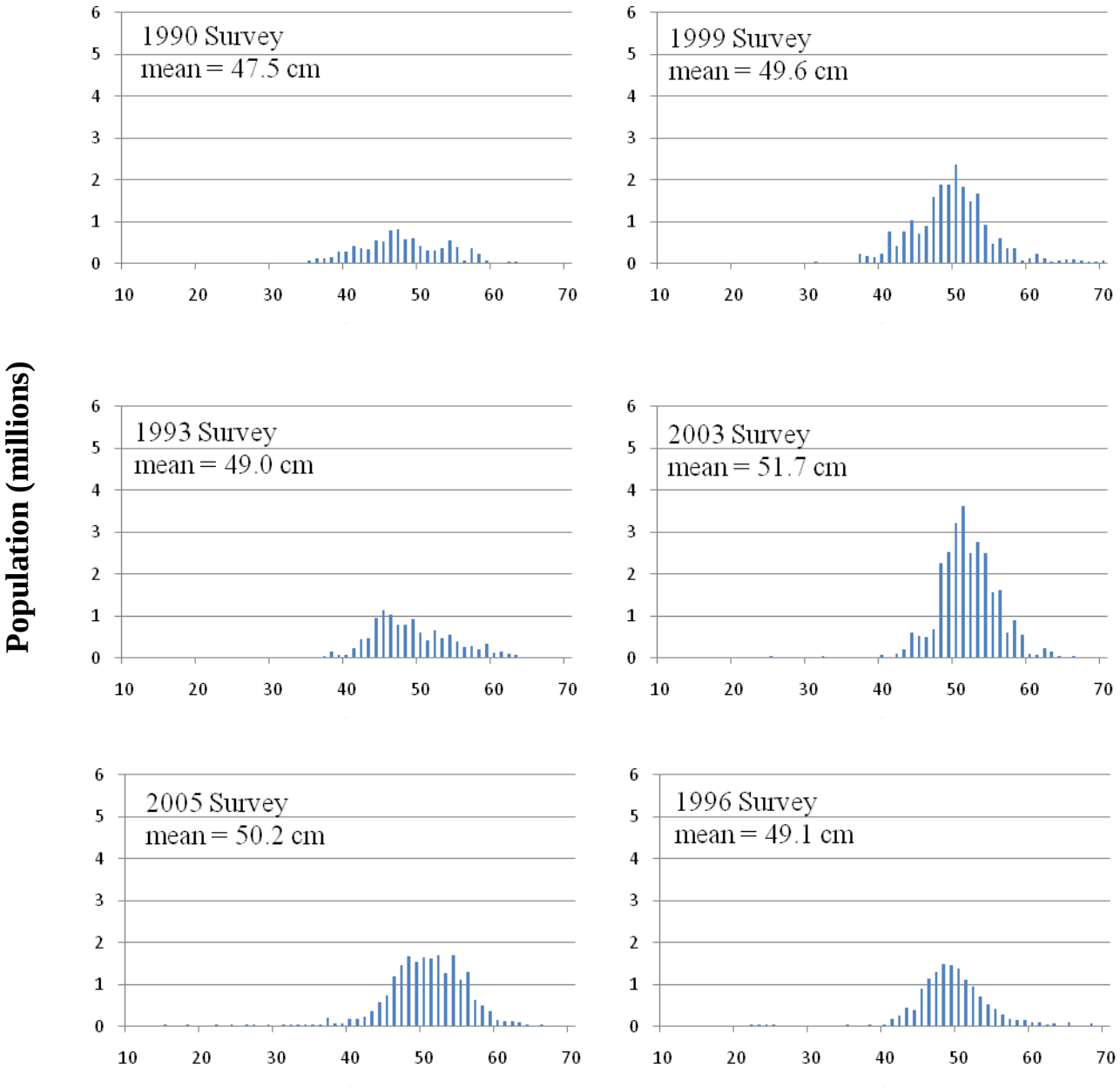

Figure 16-2. Size composition of the estimated population of silvergray rockfish in the 1990, 1993, 1996, 1999, 2003, 2005, 2007, 2009, and 2011 Gulf of Alaska trawl surveys. (Figure continued on next page.)

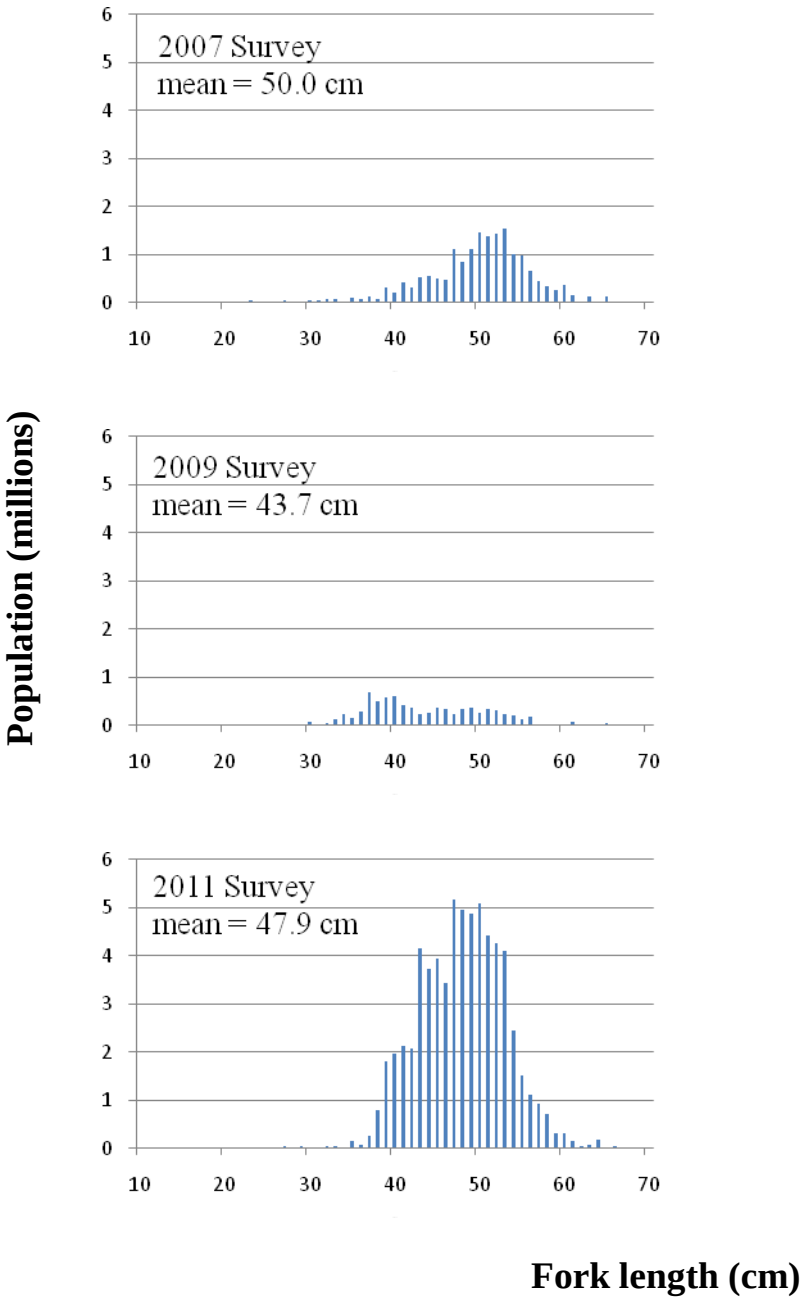

Figure 16-2. Continued

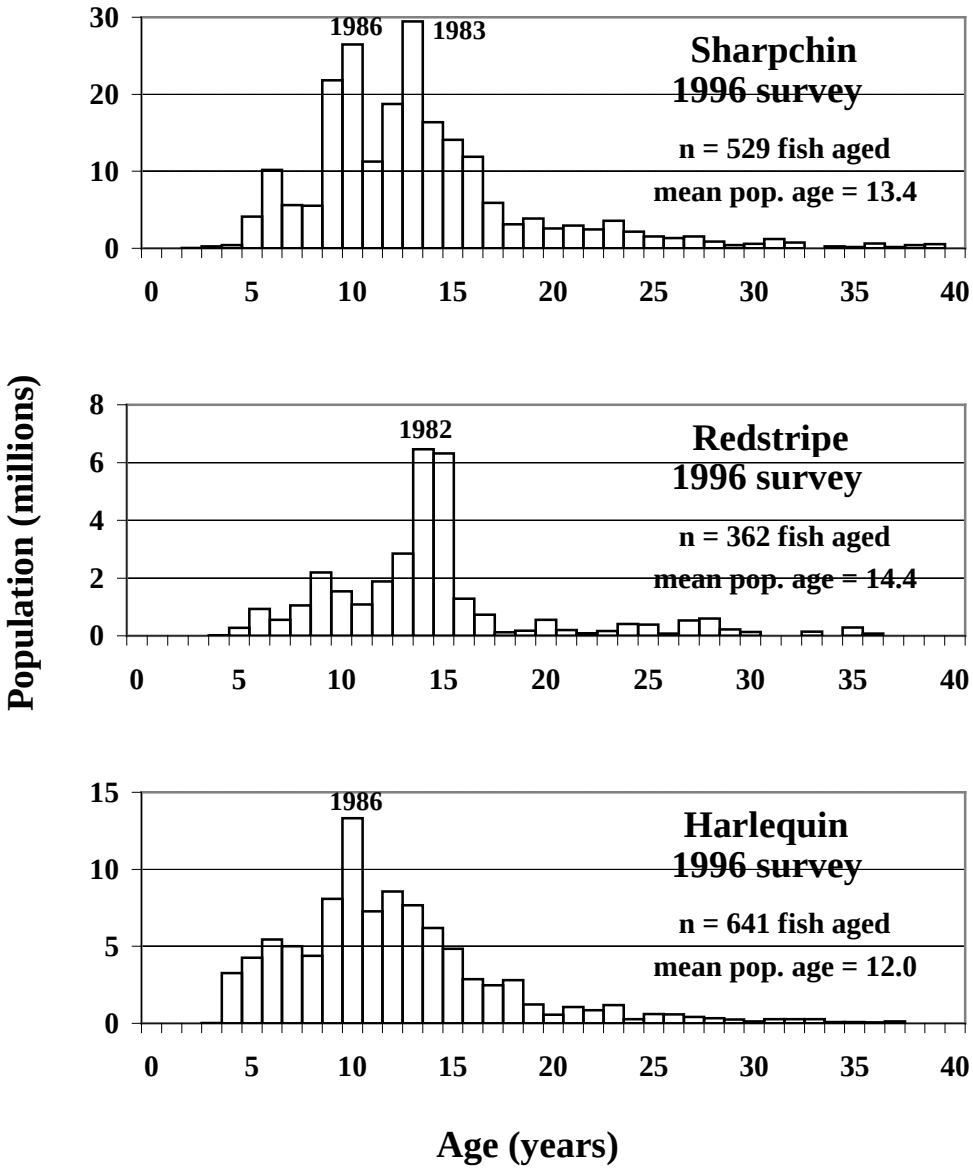

Figure 16-3.--Age compositions of the estimated population of sharpchin, redstripe, and harlequin rockfish in the 1996 Gulf of Alaska trawl survey. The numbers next to prominent bars identify apparently strong year classes.

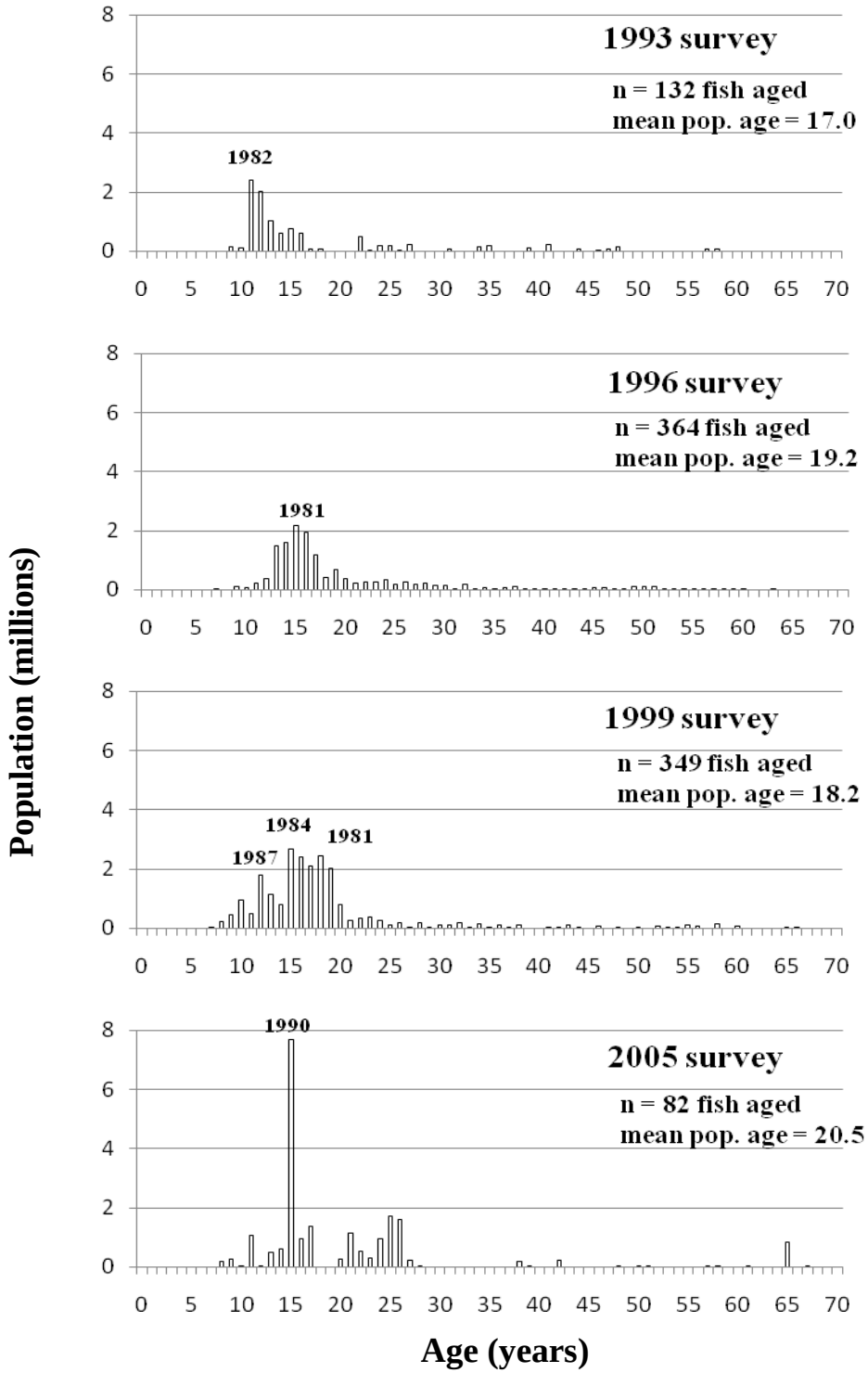

Figure16-4.--Age compositions of the estimated population of silvergray rockfish in the 1993, 1996, 1999, and 2005 Gulf of Alaska trawl surveys. The numbers next to prominent bars identify apparently strong year classes.

Appendix 16A – Supplemental Catch Data

Research catches of "other slope rockfish" in the GOA for the years 1977-2009 are listed in Table 16A-1. Although data are not available for a complete accounting of all research catches, the values in the table indicate that generally these catches have been modest. The one exception is 1999, when a total of almost 52 mt was taken, mostly by research trawling. However, because commercial catches for "other slope rockfish" that year were much below ABC (see Table 16-2 in the main document), this relatively large catch was not a conservation concern.

To comply with the Annual Catch Limit (ACL) requirements, two new datasets have been generated to help estimate total catch and removals from NMFS stocks in Alaska. The first dataset, non-commercial removals, estimates total removals that do not occur during directed groundfish fishing activities. This includes removals incurred during research, subsistence, personal use, recreational, and exempted fishing permit activities, but does not include removals taken in fisheries other than those managed under the groundfish FMP. These estimates represent additional sources of removals to the existing Catch Accounting System estimates and are only available for 2010. The second dataset, Halibut Fishery Incidental Catch Estimation (HFICE), is an estimate of the incidental catch of groundfish in the halibut IFQ longline fishery in Alaska, which at present is largely unobserved (Table 16A-2). To estimate removals in the halibut fishery, methods were developed by the HFICE working group and approved by the Gulf of Alaska and Bering Sea/Aleutian Islands Groundfish Plan Teams and the Scientific and Statistical Committee of the North Pacific Fishery Management Council. A detailed description of the methods is available in Tribuzio et al. (2011). The HFICE estimates should be considered preliminary estimates for what is caught in the IFQ halibut fishery. Improved estimates of groundfish catch in the halibut fishery may become available following restructuring of the Observer Program in 2013.

The non-commercial removals for "other slope rockfish" in 2010 showed that only a trace amount totaling 94 kg (<0.1 mt) was taken in the GOA[8].

Estimated catches of "other slope rockfish" in the Pacific halibut longline fishery have been much higher than research catches and other non-commercial removals and range from 81 mt in 2003 to 133 mt in 2004 (Table 16A-2). This level of unaccounted catch, although relatively high compared to the official catch (see Table 16-2 in main document), does not appear to have put stocks of "other rockfish" at risk because the annual catch of these species in the GOA has always been much less than ABC.

Reference:

Tribuzio, C. A, S. Gaichas, J. Gasper, H. Gilroy, T. Kong, O. Ormseth, J. Cahalan, J. DiCosimo, M. Furuness, H. Shen, and K. Green. 2011. Methods for the estimation of non-target species catch in the unobserved halibut IFQ fleet. August 2011 Groundfish Plan Team document. Presented to the Joint Groundfish Plan Teams of the North Pacific Fishery Management Council.

[8] Data provided by NMFS Alaska Regional Office (AK R.O.), October, 2011.

Table 16A-1.--Catch (mt) of "other slope rockfish" taken during NMFS research cruises in the Gulf of Alaska, 1977-2009. (Does not include catches in longline surveys; tr=trace).

Year	Other slope rockfish
1977	0.8
1978	9.5
1979	0.4
1980	0.4
1981	16.3
1982	2.9
1983	0.1
1984	3.4
1985	1.7
1986	0.0
1987	19.8
1988	0.7
1989	0.1
1990	11.8
1991	tr
1992	0.0
1993	11.3
1994	0.0
1995	0.0
1996	16.9
1997	0.0
1998	2.4
1999	51.6
2000	0.0
2001	0.7
2002	tr
2003	8.7
2004	tr
2005	11.0
2006	tr
2007	8.1
2008	tr
2009	4.2

Table 16A-2.--Estimated catch (mt) of "other slope rockfish" in the Gulf of Alaska halibut fishery, 2001-2010, from the Halibut Fishery Incidental Catch Estimation working group.

Year	Catch
2001	96
2002	89
2003	81
2004	133
2005	132
2006	126
2007	100
2008	100
2009	93
2010	85

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