10 Gulf of Alaska Rougheye rockfish (Executive Summary)

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10.1 Introduction

Rockfish have been moved to a biennial stock assessment schedule to coincide with new survey data. For Gulf of Alaska rockfish in alternate (even) years we will present an executive summary using the current year's key assessment parameters and projections for the next (odd) year. A discussion at the September 2006 Groundfish Plan Team meetings concluded the following two important points for updating information in off-year assessments:

1) Anytime the assessment model is re-run and presented in the SAFE Report, a full assessment document must be produced.
2) The single-species projection model may be re-run using new catch data without re-running the assessment model.

Therefore, as opposed to 2004, we will not be running the assessment model with updated catch data, but will run the projection model with updated catch data. This satisfies the above recommendations and accounts for changes in catch from last year's estimates. We present results from last year's projection with this year's projection for comparison. Both projections are based on the 2005 assessment model results. For further information about the assessment model, last year's full stock assessment is on the web (Shotwell et al. 2005, http://www.afsc.noaa.gov/refm/docs/2005/GOArougheye.pdf).

10.2 Updated catch and projection

New information for this year's projection is updated 2005 catch at 301 mt and the best estimate of the 2006 catch at 327 mt. Last year's estimates were 289 mt and 288 mt for 2005 and 2006, respectively. For the 2007 fishery, we recommend the maximum allowable ABC of 988 mt from the updated projection. This ABC is similar to last year's ABC of 983 mt. The corresponding reference values for rougheye rockfish are summarized in the following table, with the recommended values in bold. The stock is not overfished, nor is it approaching overfishing status.

	Last year's projection: Not Updated		This year's projection: Updated*	
	2006	2007	**2007**	2008
$B_{40\%}$ (mt)	8,399	--	--	--
Female Spawning Biomass (mt)	9,976	10,165	10,008	9,937
F_{ABC} (maximum allowable = $F_{40\%}$)	0.039	0.039	**0.039**	0.039
F_{OFL} ($F_{35\%}$)	0.047	0.047	**0.047**	0.047
$ABC_{F40\%}$ (mt yield at $F_{40\%}$=F_{max})	983	990	**988**	993
OFL (mt, yield at $F_{35\%}$)	1,180	1,188	**1,148**	1,197

*Estimated rougheye rockfish catch for 2006 is from the AK Regional Office website on 10/20/06. Estimated catch for 2007 is the same as 2006 catch, as recent catches have been much lower than maximum permissible ABC.

10.3 Area Apportionment

The apportionment percentages are identical to last year, because there is no new survey information. The following table shows the recommended apportionment for 2007.

	Western	Central	Eastern	Total
Area Apportionment	14%	62%	24%	100%
Area ABC (mt)	**136**	**611**	**241**	**988**
OFL (mt)				1,148

10.4 Responses to Council, SSC, and Plan Team Comments

The SSC December 2005 minutes included the following comments concerning rougheye rockfish:

The SSC requests that the authors provide a sensitivity analyses on the relative weighting between surveys to explore model fit to the data. This may provide some insight into the model trade offs of incorporating both surveys.

At this point the rougheye model is based on only three years of age data; therefore, estimates currently rely heavily on the two survey indices. We have run some preliminary sensitivity trials on the relative weighting between the trawl and longline surveys (see Appendix 10A), and determined that the biomass trajectory was similar between trials and the range in magnitude was moderate. We plan to incorporate a more extensive sensitivity analysis in next year's full assessment and also consider the relative influence of the length and age compositions from both surveys to model fit.

The SSC also requests that the authors provide additional analysis and consideration of the Type 1 and 2 genotypes, including their geographic separation and the potential for distinct population assessments and catch accounting.

Please see Appendix 10B for response.

10.5 Research Priorities

This year a rockfish modeling workshop was held at the Auke Bay Laboratory (ABL) that included participants from the Alaska Fisheries Science Center (AFSC), Alaska Regional Office, and the Alaska Department of Fish and Game. Additionally, a Center for Independent Experts (CIE) review of rockfish assessment occurred at the AFSC in June. A workshop summary and formal CIE review report are available online on the AFSC website (http://www.afsc.noaa.gov/Quarterly/amj2006/divrptsABL1.htm, and http://www.afsc.noaa.gov/refm/docs/2006/rf_CIE.pdf, respectively). Our priorities for next year's full assessment are to consider incorporating many of the useful recommendations produced by both the workshop and the review. Additionally, several more years of age samples have been recently completed for rougheye and will be incorporated into next year's assessment model.

It is critically important to the assessment of rockfish species that the GOA trawl surveys extend into deeper waters (>200m) in order to cover the range of primary habitat for rockfish.

10.6 Summaries for Plan Team

Species	Year	Biomass[1]	OFL	ABC	TAC	Catch
Rougheye rockfish	2005	40,281	1,531	1,007	1,007	301
	2006	37,449	1,180	983	983	331[2]
	2007		1,148	988		
	2008		1,197	993		

[1]Total biomass from the age-structured model

Stock/ Assemblage	Area	2006 OFL	2006 ABC	2006 TAC	2006 Catch[2]	2007 OFL	2007 ABC	2008 OFL	2008 ABC
Rougheye rockfish	W		136	136	57		136		137
	C		608	608	129		611		614
	E		239	239	145		241		242
	Total	1,180	983	983	331	1,148	988	1,197	993

[2]Current as of November 4, 2006 (http://www.fakr.noaa.gov/2006/car110_goa.pdf)

Appendix 10A Sensitivity of Trawl and Longline Surveys

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10A.1 Analytical Approach

We considered a range of error assumptions on the trawl and longline survey abundance indices within the rougheye model format. Parameter estimates were identical to the 2005 GOA Rougheye recommended model estimates.

10A.2 Preliminary Results

The sampling precision for the two surveys is approximately CV = 0.20. In general, artificially increasing the precision of the trawl survey results in overall higher biomass and a steadily decreasing trajectory with a slight increase in the last year while reducing precision results in overall lower biomass and an emphasized step in the early 1990s when the longline survey began. Conversely, increasing precision on the longline survey produces a similar result to decreasing precision on the trawl survey while reducing precision results in minimal change to the estimates. The length and age composition fits changed only slightly across all runs, with the best fit coming from the trial with the trawl survey at CV = 0.10 and the longline survey at a CV = 0.20. In this preliminary analysis we only looked at the precision assumed for the survey abundance indices, not length and age compositions. For our full assessment in 2007, we will conduct a more thorough analysis that tests the sensitivity of the length and age compositions from each data source to determine the optimal error assumptions about the data.

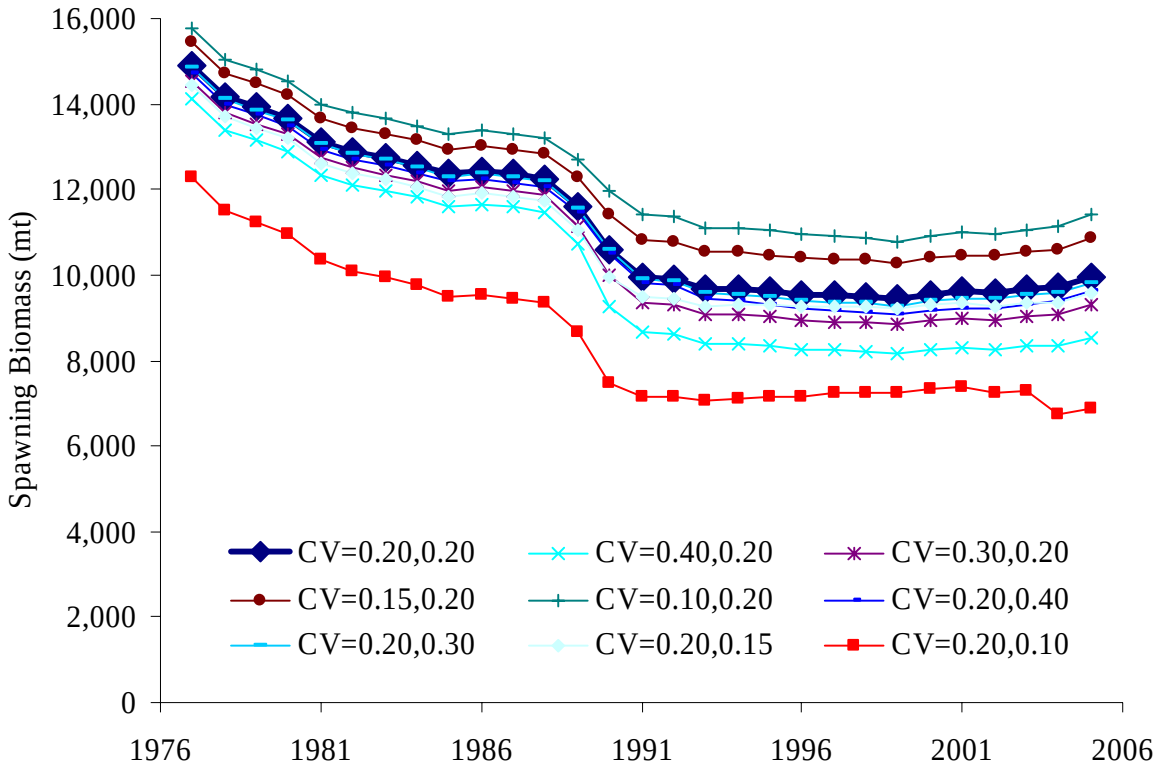

Figure 10A.1. Trajectories of spawning biomass for each paired CV of the two survey abundance indices. The first number is the CV of the trawl survey and the second number is the CV of the longline survey. CVs tested ranged from 10-40%. Trial (CV=0.2, 0.2) is the base model from 2005 (bold blue diamond).

Appendix 10B Separate Species of Rougheye rockfish

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10B.1 Genotypic Differences

Recent studies on the genetic differences between the observed types of rougheye rockfish indicate two distinct species (Gharrett et al. 2005, Hawkins et al. 2005). The proposed speciation was initiated by Tsuyuki and Westrheim (1970) after electrophoretic studies of hemoglobin resolved three distinct banding patterns in what were later described as rougheye (Type A and B) and shortraker (Type C) rockfish. In this study, the two rougheye blood types detected in samples (n = 313) taken off the coast of Vancouver Island, British Columbia were predominant with a relatively rare presumed hybrid. However, they were unable to distinguish any patterns in meristics or morphometrics between the two types. Seeb (1986) again proposed two species of rougheye in an allozyme-based phylogenetic survey where clear isolation occurred between samples of rougheye (n = 47) into two types. The "aleutianus" type was represented by pink/red coloration with suborbital spines (n = 24), whereas the "aleutianus unknown" type had considerable blackness around the mouth and jaw with suborbital spines often lacking (n = 23). In 1997, Hawkins et al. initiated another allozyme-based study analyzing a large sample (n=750) of rougheye rockfish collected by bottom trawl and longline in the Gulf of Alaska and Bering Sea using starch gel electrophoresis. They describe two types that were separated out by five distinguishable loci, an Aleutian type and a Southeast type. Distributions of each type were somewhat distinct; although, several areas of overlap existed. The Aleutian type was completely dominant in the western Aleutian Islands. In 2005, the published extension of this study (Hawkins et al. 2005) included more samples of rougheye (n=1027) and again demonstrated the two genetically distinct types of rougheye as Sebastes aleutianus and S. sp. cf. aleutianus. Both types are found in the Gulf of Alaska and occur in sympatry (overlapping distribution without interbreeding), although samples with depth information demonstrated a significantly deeper depth for S. sp. cf. aleutianus. Deep samples taken near Washington State indicate that the S. sp. cf. aleutianus type may diminish in the southern ranges while the S. aleutianus does not extend past the western Aleutian Islands. Limited length sampling in southeast Alaska where both types were caught in a single trawl haul suggested that S. aleutianus were much larger than S. sp. cf. aleutianus. Finally, Gharrett et al. (2005) analyzed the variation in mitochondrial DNA and eight microsatellite loci in samples (n = 698) taken at 84 sites from Oregon to the western edge of the Aleutian Islands. They also determined two distinct types of rougheye, I and II, with a nearly fixed difference at one microsatellite loci and relatively little hybridization. The fixed difference is reflective of advanced lineage sorting and arguably results from speciation. Based on calculations of divergence time for lineage sorting, the authors suggest that divergence likely took place between several hundred thousand and one million years ago, making speciation an unlikely result of the last two glaciations. Samples in the Aleutian Islands and Bering Sea were predominantly Type I and many hauls throughout the sampling area were typically one type or the other. Additionally, for some genetically analyzed samples in which coloration was noted, dark morphs were predominant in the western Gulf of Alaska while samples in the eastern Gulf near Yakutat consisted of light, dark, and sometimes intermediate.

10B.2 Phenotypic Differences

In a 2006 study on phenotypic differences, Gharrett et al. compared meristic characters and morphometric dimensions (35 reported) to genetically determined species. Samples were analyzed from eight of the 84 locations described in Gharrett et al. (2005) where coloration was recorded. Distributions of all the phenotypic parameters overlapped; however, Type II rougheye had slightly fewer and shorter gill rakers and deeper bodies. Upon examination of coloration, Type II were predominantly light colored, while Type I fish were either light or dark and the proportion of either color varied geographically. Orr and

Hawkins (2006) discuss preliminary results of a fairly extensive study on the recognition, identification, and nomenclature of the two types of rougheye rockfish. They recognized the two species as Sebastes aleutianus (originally described by Jordon and Evermann 1898) and Sebastes melanostictus (described previously by Matsubara 1934). They defined S. aleutianus or rougheye rockfish as the southern species, ranging from California to the southern Bering Sea and eastern Aleutian Islands and S. melanostictus or the blackspotted rockfish as the northern species, ranging from the western Aleutian Islands and Bering Sea to Washington State. The blackspotted rockfish was distinguished primarily by a darker body color, discrete spotting on the dorsal fin and body, longer fin spines, longer gill rakers, and a narrower body depth at the anal-fin origin; although the morphometric differences were slight. Additionally, the blackspotted rockfish tend to be caught at deeper depths than rougheye in locations were both species were caught. However, both species were abundant at similar depths (200-350 m) and their distributions overlap extensively (Gulf of Alaska, southern Bering Sea, and eastern Aleutians).

10B.3 Conclusion

In summary, the southern species of rougheye rockfish now proposed as S. aleutianus or rougheye rockfish proposed by Orr and Hawkins (2006) is likely similar to the Type II proposed by Gharrett et al. (2005 and 2006), the S. aleutianus proposed by Hawkins et al. (2005), the Southeast type proposed by Hawkins et al. (1997), the “aleutianus” proposed by Seeb (1986), and the B blood type proposed by Tsuyuki and Westrheim (1970). This species is typically lighter in coloration with spots absent from the spinous dorsal fin and possibly has mottling on the body. The northern species of rougheye rockfish now proposed as S. melanostictus or blackspotted rockfish by Orr and Hawkins (2006) is likely similar to the Type I proposed by Gharrett et al. (2005 and 2006), the S. sp. cf. aleutianus proposed by Hawkins et al. 2005, the Aleutian type proposed by Hawkins et al. (1997), the “aleutianus unknown” proposed by Seeb (1986), and the A blood type proposed by Tsuyuki and Westrheim (1970). This species is often darker in body coloration with distinct spots present on the dorsal fin and body. The two species occur in sympatric distribution with rougheye extending farther south along the Pacific Rim and blackspotted extending into the western Aleutian Islands. The overlap is quite extensive; however a potential difference in depth distribution may occur.

In 2005 and 2006 the sablefish longline survey conducted two-day sampling experiments in the eastern Gulf near Yakutat Bay to collect detailed depth information associated with the longline catch of rougheye and blackspotted rockfish. New GPS and sonar technology on board combined with numerous time-depth recorders along the groundline were used to determine accurate depth and GPS coordinates of the groundline as it fished. Approximately 250 rougheye and blackspotted rockfish were collected across a depth range of 200-400 m with associated photos of 150 fish and observer identification based on the features in a pamphlet distributed by J. Orr. Genetic analysis of these samples is in progress. Preliminary discussions with researchers from this experiment suggest that identification of each species was difficult due to the range of coloration and spotting between individuals.

At present there appears to be difficulty in accurate field identification between the two species. Methods should be developed and tested that would enable rapid and accurate field identification of the two species by observers and scientists so that population estimates and catch accounting can occur. In addition studies should be undertaken that assess whether the two species have significantly different life history traits (i.e. age of maturity and growth). Until such information and studies occur it will be difficult to undertake distinct population assessments. Ongoing research in this area may determine particular habitat preference that might be useful for separating the species, and phenotypic research may determine a distinct combination of characters for onboard identification.

10B.4 Literature Cited

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