19. Assessment of the sculpin complex in the Gulf of Alaska

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Executive Summary

Summary of Changes in Assessment Inputs

This document summarizes the current information and status of sculpins in the Gulf of Alaska (GOA). Since 2010, when the North Pacific Fishery Management Council passed amendment 87 to the GOA Fishery Management Plan, which separated the Other Species complex into its constituent species groups, GOA sculpins have been managed as an independent complex with its own harvest specifications.

Changes in the Input Data

1. Sculpin catch and retention data from the GOA fisheries from 2003-2010 have been updated and partial 2011 data (as of September 22, 2011) has been added.

2. Biomass estimates and length compositions from the 2011 Gulf of Alaska survey have been added.

Summary of Results

	last year		**this year**	
Quantity/Status	2011	2012	**2012**	2013
sculpin complex average mortality rate (M)*	0.22	0.22	**0.22**	0.22
specified/recommended Tier	5	5	**5**	5
Biomass	33,307	33,307	**34,732**	34,732
F_{OFL} (*F=complex mortality rate*)	0.22	0.22	**0.220**	0.220
max F_{ABC} (maximum allowable = 0.75 *x* F_{OFL})	0.17	0.17	**0.165**	0.165
specified/recommended F_{ABC}	0.17	0.17	**0.165**	0.165
specified/recommended OFL (t)	7,328	7,328	**7,641**	7,641
specified/recommended ABC (t)	5,496	5,496	**5,731**	5,731
Is the stock being subjected to overfishing?	no		**No**	
(for Tier 5 stocks, data are not available to determine whether the stock is in an overfished condition)				

* *The sculpin complex mortality rate is a biomass-weighted average of the instantaneous natural mortality rates for the four most abundant sculpins in the GOA: bigmouth (Hemitripterus bolini), great (Myoxocephalus polyacanthocephalus), plain (Myoxocephalus jaok), and yellow Irish lord (Hemilepidotus jordani). The complex mortality rate may change as new survey data become available. See "results" section for more detail.*

Responses to SSC Comments

On page 21 of the Dec. 2010 SSC minutes, the SSC recommended that natural mortality estimates for sculpins be derived from GOA specific studies. This will be a priority for future research.

Introduction

Sculpins are a group of benthic-dwelling predatory teleost fishes that include 48 species in waters off the coast of Alaska. Sculpins have been identified to species in the AFSC surveys since 2001. Forty-six species of sculpins have been listed as occurring in the Gulf of Alaska (Table 1), and 39 of these have been identified on NMFS GOA research surveys. Sculpin diversity is high in the GOA, with many species also found in the Bering Sea (Table 19.1). Sculpins are broadly distributed throughout the shelf and slope regions of the Gulf of Alaska occupying all benthic habitats and depths. In this assessment, we mainly focus on large sculpin species from the genera *Myoxocephalus*, *Hemitripterus*, and *Hemilepidotus* which observers from the North Pacific Groundfish Observer Program currently identify to genus in commercial catches.

Historically, sculpins have been managed as part of the GOA Other Species complex, which also included sharks, skates, octopus and squid, and a single TAC was specified for the entire Other Species complex. In response to the requirements for Annual Catch Limits (ACLs) contained within the reauthorization of the Magnuson Stevens Fishery Conservation and Management Act, the NPFMC reviewed the management of other species in the GOA. The NPFMC passed Amendment 87 to the GOA FMP that requires that sculpins be managed as separate complex and that ACLs would be established annually by the SSC starting in 2011. Sculpins are currently a non-target species complex in the GOA, so sculpin catch depends solely on the TAC and spatial temporal limitations placed on target fisheries. Vulnerability analyses indicate that the individual species in the sculpin complex have a wide range of vulnerabilities to overfishing (largely as a result of differences in life history and thus productivity), which may suggest that two or more separate sculpin complexes could be considered.

Recent studies on the reproductive biology of the five most abundant sculpin species in the Eastern Bering Sea Shelf area have provided new information on sculpin life history in Alaska. Prior to those studies much of the reproductive biology information comes from studies in the western North Pacific. Most, if not all sculpins lay adhesive eggs in nests, and many exhibit parental care for eggs (Eschemeyer et al, 1983). Markevich (2000) observed the sea raven, *Hemitripterus villosus*, releasing eggs into crevices of boulders and stones in shallow waters in Peter the Great Bay, Sea of Japan. This type of reproductive strategy may make sculpin populations more sensitive to changes in benthic habitats than other groundfish species such as pollock, which are broadcast spawners with pelagic eggs. In the western Pacific, great sculpins *Myoxocephalus polyacanthocephalus* are reported to have late ages at maturity (5-8 years, Tokranov, 1985) despite being relatively short-lived (13-15 years), which suggests a limited reproductive portion of the lifespan relative to other groundfish species. Fecundity for the great sculpin off East Kamchatka waters ranged from 48,000 to 415,000 eggs (Tokranov, 1985). In contrast, preliminary information on reproduction for bigmouth sculpin (*Hemitripterus bolini*) in the Gulf of Alaska shows fecundity averaged 2283 eggs per female (Morgan Busby, AFSC, personal comm.). The diversity of sculpin species in the Gulf of Alaska suggests that each sculpin population might respond differently to environmental changes (whether natural or fishing induced). Within each sculpin species, observed spatial differences in fecundity, egg size, and other life history characteristics suggest local population structure (Tokranov, 1985).

Information such as depth range, distribution, and maximum length has been collected for several years for many species during research surveys. There is no GOA-specific age-and-growth or maturity data for sculpins identified in this management region. Known life history characteristics for selected sculpin species in the GOA are presented in Table 19.2. With the exception of data for bigmouth sculpins, all fecundity and maturity data in Table 2 are from outside GOA region.

Fishery

There are no directed fisheries for sculpin species in the GOA at this time. In 2011, sculpins constituted about 49% of the total GOA Other Species complex catch. Prior to 2005, when skates were still included in the complex, they comprised 7-19% of the Other Species catch (Table 3). Retained catch of sculpin species in the GOA has increased recently from 7% in 2003 to 18% in 2010 and 12% in 2011 (Table

19.3). Sculpins are caught incidentally by a wide variety of fisheries and several gear types (Table 19.4a). Based on data from the NMFS NMFS Alaska Regional Office (AKRO) the main gear type that catch sculpins is the non-pelagic trawl (Table 19.4a), and the main fisheries that catch sculpins are flatfish, Pacific cod, and IFQ halibut (Table 19.4b). It is unclear which sculpin species were commonly taken in GOA groundfish fisheries prior to 2004, because observers did not regularly identify animals in these groups to species. After increasing catches from 583 t in 2006 to 1,943 t in 2008, the total sculpin catch declined to 911 t in 2010. The 2011 catch as of September 22 is 820 t. These patterns are largely the result of variability in the catch of sculpins by the shallow-water flatfish target fisheries (Table 19.4b).

In 2002-2003, the observer program of AFSC initiated a species identification project to address the need to gather basic population data for groups in the Other Species complex. Beginning in January 2004, sculpin catch was identified to genus for the larger sculpin species: *Hemilepidotus, Myoxocephalus, and Hemitripterus.* Several species of *Hemilepidotus* and *Myoxocephalus* have been identified from surveys. In Alaskan waters, *Hemitripterus* probably represents only one species, the bigmouth sculpin (Stevenson 2004). Another member of this genus, the sea raven (*H. villosus*), has never been identified in any of the GOA trawl surveys conducted by AFSC. Therefore, it is reasonable to assume that all sculpins identified by observers as *Hemitripterus* sculpins were bigmouth sculpins. According to total catch figures for 2007 through 2010 from the NMFS AKRO, the aforementioned large sculpin genera contributed the vast majority of all sculpin catch in the GOA region (Table 19.5).

The observer catch composition data in Table 19.5 show that from 2007-2010, *Hemilepidotus* spp. (the Irish lords) made up between 63.1% and 78.6% of the sculpin total observed catch. *Hemitripterus* spp. (bigmouth sculpin) constituted between 7.8%-18% of the total sculpin observed catch. In 2008, the first year observers identified the top 5 most abundant species of sculpins, *Hemilepidotus jordani* (yellow Irish lord) comprised 62% of all sculpin catch in the GOA, followed by Irish lord unidentified. In 2009 and 2010 the catch percentage of *H. jordani* was lower but still represented the largest fraction of sculpin catch. *Myoxocephalus* species make up only a small part of GOA sculpin catches (Table 19.5). These results indicate that the species composition of the incidental sculpin catch does not necessarily parallel the species composition of the sculpin population as estimated by the AFSC groundfish surveys: bigmouth sculpins were 7.7% of the 2009 survey sculpin biomass estimate, whereas they constituted 15.3% of the 2009 catch; *Myoxocephalus* spp. were 26.5% of the survey estimate compared to 8.8% of the catch; and miscellaneous sculpins were 3.9% and 12.8% of the survey estimate and catch, respectively. However, in 2011, the survey caught the same proportion of *H. bolini* as observer data and Irish lords are consistently represented approximately equal in the survey and in the catch.

Data

Aggregate sculpin biomass estimates are derived from the GOA bottom trawl surveys. In the GOA, these aggregate data show no clear temporal trend, and should not be used as an indicator of population status for a complex with so much species diversity (Table 19.6). Species-specific biomass estimates were available for only selected sculpin species for the period 1984-2000 due to difficulties with species identification and survey priorities. Species-specific biomass estimates are available for the 2001-2011 surveys. Approximately 95% of the sculpin biomass is comprised of the larger sculpin species in the GOA. Mean proportions in the survey from 2003-2011 indicate that Yellow Irish lord is the most abundant (~50% of the sculpin biomass), followed by great sculpin at 22%, bigmouth sculpin at 13%, and plain sculpin at 9% (Table 19.7 and Figure 19.1).

Biomass trends show that the bigmouth sculpin declined between 2003 and 2007, but has remained relatively stable since then, while the other species are fairly consistent (Figure 19.1). The coefficients of variation (CVs) for the survey biomass estimates of 7 out of 10 sculpin species are at or below 0.35, suggesting that the GOA survey is doing an adequate job assessing the biomass of the more abundant species (Table 19.7).

Length measurements (fork length, FL in mm) have been collected for a variety of sculpin species during AFSC surveys. The four most abundant species from the GOA survey have been measured on every biennial survey since 2003: yellow Irish lord, plain sculpin, great sculpin and bigmouth sculpin (Figure 19.3). These length compositions have remained fairly stable during this period. One interesting observation is that the surveys tend to catch bigmouth sculpins on the larger end of the length range, similar to the length observations of bigmouth from the eastern Bering Sea (EBS) shelf survey. Little information is known about bigmouth sculpin life history; this may suggest that the younger or smaller bigmouth sculpins occur in areas not sampled well by the surveys.

Sample sizes for length frequency analysis for GOA:

Species	**2003**	**2005**	**2007**	**2009**	**2011**
yellow Irish lord	917	1034	1044	2573	1391
plain sculpin	81	126	176	153	171
great sculpin	208	201	209	304	179
bigmouth sculpin	81	61	51	64	50

Analytic Approach

In the past, harvest recommendations for GOA sculpins were made using an estimate of natural mortality (M) based on data from the western Bering Sea (Rikhter and Efanov, 1976). In 2008, life history studies of sculpins in the eastern Bering Sea and Aleutian Islands were completed and the results of those studies are now used to make harvest recommendations for sculpins in the BSAI. In 2009, the BSAI Plan Team recommended that M values based on age-based catch-curve analysis be used wherever possible. In addition, separate ABC and OFL calculations were made for each species for which recent estimates of M were available, and the individual values were aggregated to create sculpin complex harvest recommendations. In effect, this means that for the BSAI, a weighted average of species-specific M's is applied to the aggregate sculpin biomass, with the proportional average biomass of each species providing the weights. Sculpins in the GOA are managed under Tier 5, where OFL = M * average survey biomass and ABC = 0.75 * M * average survey biomass. Average biomass was calculated as the average of the last 4 GOA trawl survey estimates, and the proportion of each species is based on the average proportion from the last 4 surveys (Figure 19.1 and Table 19.6).

We recommend that harvest recommendations for sculpins in the GOA be made using the values of M now in use for the BSAI sculpin complex. Those M estimates are more recent and closer in geographical distance than the M values used previously. We also recommend that GOA harvest recommendations be based on the application of a biomass-weighted average M to the total sculpin complex biomass.

Results

Recent estimates of M are available for four of the sculpin species in the GOA sculpin complex: yellow Irish lord, great sculpin, bigmouth sculpin, and plain sculpin (Table 19.8). Together, these 4 species comprise 97% of the estimated GOA sculpin biomass in 2011 (Figure 19.1). A biomass-weighted average M was calculated according to the following table:

Species	Average biomass from 2005, 2007, 2009 and 20011 surveys	Proportion	Natural mortality
yellow Irish lord	18,163	55%	0.17
great sculpin	7,719	23%	0.28
bigmouth sculpin	3,853	12%	0.21
plain sculpin	3,523	11%	0.40
		Overall	0.22

The weighted average M of 0.22 was used to make the following harvest recommendations. The recommended F_{ABC} was calculated as 0.75*0.22=0.165.

2011-2012 harvest recommendations for the GOA sculpin complex	
sculpin complex biomass	34,732
complex *M*	0.22
F_{OFL}	0.22
maximum permissible F_{ABC}	0.165
recommended F_{ABC}	0.165
OFL	7,641
maximum permissible ABC	5,731
recommended ABC	5,731

Ecosystem Considerations

Ecosystem Effects on the Stock

Little is known about sculpin food habits in the GOA, especially during fall and winter months. Limited information indicates that in the GOA, the larger sculpin species prey on shrimp and other benthic invertebrates, as well as some juvenile walleye pollock (Figure 19.4). In the GOA the main predator of large sculpins are Pacific halibut, pinnipeds, small demersal fish and sablefish (Figure 19.4). Other sculpins in the GOA feed mainly on shrimp and benthic crustaceans (Figure 19.5). Other sculpins are mainly preyed upon by Pacific cod which is the main source of mortality (Figure 19.5). The source of above information is from Aydin et al. (2007).

Fishery Effects on the Ecosystem

The analyses of ecosystem considerations for those fisheries that affect the species within this complex (see Table 19.4) are given in the respective target fisheies SAFE chapters. The GOA sculpin complex is not a targeted fishery, therefore reference to the effects of the fishery on the ecosystem will be described in those chapters of the target fisheries that catch sculpins incidentally.

Ecosystem effects on *Sculpin complex*			
Indicator	Observation	Interpretation	Evaluation
Prey availability or abundance trends			
Zooplankton	Stomach contents, ichthyoplankton surveys, changes mean wt-at-age	No affect	Probably no concern
a. Predator population trends			
Marine mammals	Fur seals declining, Steller sea lions increasing slightly	No affect	Probably no concern
Birds	Stable, some increasing some decreasing	No affect	Probably no concern
Fish (Pollock, Pacific cod, halibut)	Stable to increasing	Affects not known	Probably no concern
b. Changes in habitat quality			
Temperature regime	None	Affects not known	Unknown
Winter-spring environmental conditions	None	Probably a number of factors	Unknown
Production	Fairly stable nutrient flow from upwelled BS Basin	Inter-annual variability low	No concern
***Targeted fisheries* effects on ecosystem (see relative chapters)**			

Data Gaps and Research Priorities

Data gaps exist in sculpin species life history characteristics, spatial distribution and abundance in Alaskan waters. Most importantly no data on maximum age exists for the four main sculpin species in the GOA. Therefore, collections for age data on yellow Irish lord, great sculpin, bigmouth sculpin and plain sculpin are needed from the GOA. It is essential that we continue to improve species identifications as well as collecting life history information from the fisheries. Over 90% of all sculpins caught in the fisheries of the GOA in 2004 were from the genera *Myoxocephalus*, *Hemitripterus*, and *Hemilepidotus*. Collecting seasonal food habits data (with additional summer collections) would help to clarify the role of both large and small sculpin species within the GOA ecosystem. In addition, there is a need for GOA specific research on natural mortality of sculpin species. These data are necessary to improve management strategies for non-target species.

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Table 19.1. Sculpin species listed for the Gulf of Alaska.

Family	Scientific name	Common name
Cottidae	*Artediellus pacificus*	Pacific hookear sculpin
	Artedius lateralis	Smoothhead sculpin
	Bolinia euryptera	Broadfin sculpin
	Enophyrs bison	Buffalo sculpin
	Enophrys diceraus	Antlered sculpin
	Gymnocanthus galeatus	Armorhead sculpin
	Gymnocanthus pistilliger	Threaded sculpin
	Hemilepidotus hemilepidotus	Red Irish Lord
	Hemilepidotus jordani	Yellow Irish Lord
	Hemilepidotus papilio	Butterfly sculpin
	Hemilepidotus spinosus	Brown Irish lord
	Hemilepidotus zapus	Longfin Irish lord
	Icelinus borealis	Northern sculpin
	Icelinus burchami	Dusky sculpin
	Icelinus filamentosus	Threadfin sculpin
	Icelinus tenuis	Spotfin sculpin
	Icelus spatula	Spatulate sculpin
	Icelus spiniger	Thorny sculpin
	Icelus uncinalis	Uncinate sculpin
	Jordania zonope	Longfin sculpin
	Leptocottus armatus	Pacific staghorn sculpin
	Microcottus sellaris	Brightbelly sculpin
	Myoxocephalus jaok	Plain sculpin
	Myoxocephalus polyacanthocephalus	Great sculpin
	Myoxocephalus verrucocus	Warty sculpin
	Paricelinus hopliticus	Thornback sculpin
	Radulinus asprellus	Slim sculpin
	Rastrinus scutiger	Roughskin sculpin
	Thecopterus aleuticus	Whitetail sculpin
	Thyriscus anoplus	Sponge sculpin
	Triglops forficatus	Scissortail sculpin
	Triglops macellus	Roughspine sculpin
	Triglops metopias	Crescent-tail sculpin
	Triglops pingelii	Ribbed sculpin
	Triglops septicus	Spectacled sculpin
Hemitripteridae	*Blepsias bilobus*	Crested sculpin
	Hemitripterus bolini	Bigmouth sculpin
	Nautichthys oculofasciatus	Sailfin sculpin
	Nautichthys pribilovius	Eyeshade sculpin
Psychrolutidae	*Dasycottus setiger*	Spinyhead sculpin
	Eurymen gyrinus	Smoothcheek sculpin
	Malacoccottus zonurus	Darkfin sculpin
	Malacocottus kincaidi	Blackfin sculpin
	Psychrolutes paradoxus	Tadpole sculpin
	Psychrolutes phrictus	Blob sculpin
Rhamphocottidae	*Rhamphocottus richardsoni*	Grunt sculpin

Table 19.2. Life history information available for selected GOA sculpin species. "O" designates data was obtained from individuals of that species outside the GOA region.

Species	common name	maximum length (cm)		maximum age		fecundity (x1000)	age at 50% maturity
		O	GOA	O	GOA		
Myoxocephalus joak	plain	75	59	15		25.4 - 147	5 - 8
M. polyacanthocephalus	great	82	72	13		48 - 415	6 - 8
M. verrucosus	warty	78				2.7	
Hemitripterus bolini	bigmouth	83	86			2.3	
Hemilepidotus jordani	yellow Irish lord	65	50	13		25 - 241	6 - 7
H. papilio	butterfly	38					
G. pistilliger	threaded	27		13		5 - 41	
G. galeatus	armorhead	46	28	13		12 - 48	
Dasycottus setiger	spinyhead	45	22	11			
Icelus spiniger	thorny	17					
Triglops pingeli	ribbed	20		6		1.8	
T. forficate	scissortail	30	28	6		1.7	
T. scepticus	spectacled	25		8		3.1	

References: AFSC; Panchenko 2002; Tokranov 1985; Andriyashev 1954; Tokranov 1988; Tokranov 1995; Tokranov and Orlov 2001; Busby, AFSC, personal comm.

Table 19.3. GOA total sculpin complex catch, retention rate, total Other Species catch (sculpin, sharks, skates, octopus and squid), and sculpin percentage of Other Species catch, 1997-2011*. *Source: Other species total catch: AKRO Catch Accounting System, retention rate: estimated from fishery observer data obtained from the AFSC Fishery Monitoring and Analysis program, Sculpin complex total catch: AKFIN data base.*

Year	Sculpin complex total catch	retention rate	Other species total catch	Percent of Other Species catch
1997	898		4,823	19%
1998	526		7,422	7%
1999	544		3,788	14%
2000	940		5,455	17%
2001	587		3,383	17%
2002	919		8,162	11%
2003	629	7%	6,266	10%
2004+	701	9%	1,705	41%
2005	626	16%	2,513	25%
2006	583	16%	3,881	15%
2007	960	19%	3,035	32%
2008	1,925	14%	2,967	65%
2009	1,374	18%	3,188	43%
2010	911	12%	1,866	49%
2011*	820	n/a	1,678	49%

+ Beginning in 2004, skates were removed from Other Species complex.
* 2011 data as of September 22, 2011. Retention rate not reported for 2011 due to incomplete data.

Table 19.4a. Total catch (t) of all sculpins by target fishery in the Gulf of Alaska, 2003-2011 by gear type (NPT: non-pelagic trawl, PTR: pelagic trawl, TRW: trawl, HAL: hook and line, POT: pot). *Source: AKFIN database. * 2011 catch data are incomplete; retrieved September 22, 2011.*

Aleutian Islands	**Gear Type**					
Target fishery	**NPT**	**PTR**	**TRW**	**HAL**	**POT**	**Total**
arrowtooth flounder	217	0	0	0	0	217
Atka mackerel	0	0	0	0	0	0
deep flatfish	0	0	0	0	0	0
flathead sole	47	0	0	0	0	47
IFQ halibut	0	0	0	578	0	578
other target	0	0	0	0	0	0
Pacific cod	548	2	0	1620	2112	4282
rex sole	124	0	0	0	0	124
rockfish	330	1	0	0	0	331
sablefish	3	0	0	58	0	61
shallow flatfish	2729	0	0	0	0	2729
walleye pollock	82	4	0	0	0	86
Total	**4080**	**7**	**0**	**2256**	**2112**	**8455**

Table 19.4b. Total catch (t) of all sculpins by target fishery in the Gulf of Alaska, 2003-2011. *Source: AKFIN database. * 2011 catch data are incomplete; retrieved September 22, 2011.*

	Gulf of Alaska								
Target fishery	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011***
arrowtooth flounder	16	7	19	36	38	16	16	27	41
Atka mackerel	0	0	0	0	0	0	0	0	0
deep flatfish	2	2	0	0	0	0	0	0	0
flathead sole	4	10	3	1	0	16	3	5	6
IFQ halibut	45	41	29	13	31	134	165	53	67
other target	6	0	0	0	0	0	11	0	0
Pacific cod	381	430	320	361	442	740	556	591	460
rex sole	27	19	11	7	8	4	31	11	6
rockfish	24	58	27	32	31	23	35	62	38
sablefish	1	2	16	4	7	2	20	1	9
shallow flatfish	113	129	200	125	376	959	515	155	158
walleye pollock	1	0	0	2	22	15	5	6	35
Total catch (mt)	**620**	**698**	**625**	**581**	**955**	**1909**	**1357**	**911**	**760**

Table 19.5. Estimated species composition of GOA incidental sculpin catches, 2007-2010, based on fishery observer data. *Source: NMFS AFSC Fishery Monitoring and Analysis Program*.

	proportion of catch (FMA)				proportion of catch (survey)	
	2007	**2008**	**2009**	**2010**	**2009**	**2011**
Hemitripterus* spp.*	**18.0%**	**7.8%**	**15.3%**	**11.4%**	**7.7%**	**11.3%**
H. bolini		7.8%	15.3%	11.4%	7.7%	11.3%
***Hemilepidotus* spp.**	**65.0%**	**78.6%**	**63.1%**	**77.3%**	**61.9%**	**49.7%**
Hemilepidotus unidentified		16.4%	24.8%	28.2%		
H. hemilepidotus		<1%	<1%	<1%		
H. jordani		61.7%	37.8%	49.0%	61.9%	49.7%
***Myoxocephalus* spp.**	**9.0%**	**11.5%**	**8.8%**	**9.0%**	**26.5%**	**36.4%**
Myoxocephalus unidentified		<1%	2.3%	<1%		
M. verrucosus		<1%	<1%	<1%	0%	0%
M. jaok		<1%	<1%	<1%	6.3%	10.0%
M. polyacanthocephalus		10.0%	6.2%	8.9%	20.2%	26.4%
miscellaneous sculpins§	**8.0%**	**3.4%**	**12.8%**	**2.3%**	**3.9%**	**2.6%**

** *Hemitripterus spp*. probably represents only one species (bigmouth sculpin).
§ Miscellaneous sculpins includes unidentified sculpins as well as darkfin, scissortail, and longfin Irish lord.

Table 19.6. Sculpin complex biomass estimates (t) based on NMFS bottom-trawl surveys, 1984-2011.

year	biomass (t)	CV
1984	44,236	8%
1987	31,811	11%
1990	26,859	17%
1993	25,583	12%
1996	31,727	26%
1999	30,879	11%
2001	30,590	28%
2003	26,562	9%
2005	33,840	9%
2007	32,636	11%
2009	40,726	11%
2011	31,728	9%

Table 19.7. GOA trawl survey biomass estimates (t) for individual sculpin species, 1990-2011, with 2011 CV.

Species	1990	1993	1996	1999	2001*	2003	2005	2007	2009	2011	**2011 CV**
yellow Irish lord	11,701	11,813	17,804	20,255	20,945	12,064	15,943	15,721	25,219	15,771	0.14
great sculpin	3,815	5,893	7,326	3,913	3,540	6,037	6,542	7,734	8,215	8,384	0.17
bigmouth sculpin	8,600	5,584	4,246	3,983	3,471	5,767	5,543	3,126	3,154	3,591	0.19
plain sculpin	433	461	1,015	1,692	932	1,220	3,913	4,456	2,562	3,160	0.35
darkfin sculpin	594	948	477	371	335	607	944	790	614	412	0.31
sculpin unident.	1,302	211	414	96	172	48	321	168	147	60	-
spinyhead sculpin	261	553	278	271	690	608	463	422	410	202	0.14
spectacled sculpin	30	52	90	233	12	39	105	97	68	104	0.41
scissortail sculpin	103	50	60	47	62	94	23	31	111	21	0.34
armorhead sculpin	1	17	13	15	61	78	28	59	216	17	0.48
warty sculpin	8.5				339.4			33.1			-
Pacific staghorn sculpin	1.7			1.1	2.3		14.2		8.2	6.8	1
threaded sculpin		0.5	3.1		21.1	0.3	1.9		2.0		-
crested sculpin	3.4	1.0			5.8						-
antlered sculpin					1.0						-
thorny sculpin	3.2	0.7	1.0		1.4	0.3	0.1	0.2	0.1		-
butterfly sculpin			0.3	1.4							-
Total	26,859	25,583	31,727	30,879	30,590	26,562	33,840	32,636	40,726	31,728	0.09

* The 2001 trawl survey did not cover the eastern GOA, so those numbers are not directly comparable.

Table 19.8. List of available natural mortality information for sculpins. Values are from Ormseth and Tenbrink 2009.

Species	Area	Sex	Hoenig	Jensen	Charnov	catch curve	SAFE M
yellow Irish lord	EBS	M	0.17	0.41	0.45	0.17	0.17
	EBS	F	0.15	0.47	0.51	0.17	
	AI	M	0.21	0.23	0.27	0.17	
	AI	F	0.16	0.27	0.31	0.17	
great sculpin	EBS	M	0.28	0.39	0.43	0.25	0.28
	EBS	F	0.25	0.27	0.3	0.31	
bigmouth sculpin	EBS	both	0.21	0.21	0.24	n/a	0.21
plain sculpin	EBS	M	0.28	0.38	0.42	0.39	0.4
	EBS	F	0.26	0.27	0.55	0.41	

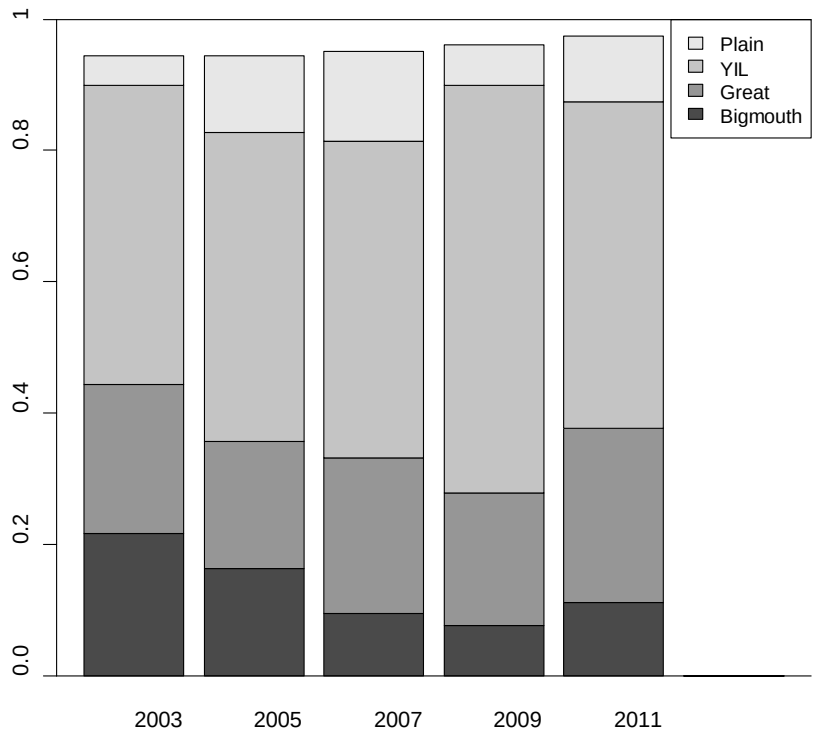

Figure 19.1. Species composition of the sculpin complex in the GOA. Data are from the 2003-2011 AFSC GOA bottom trawl surveys.

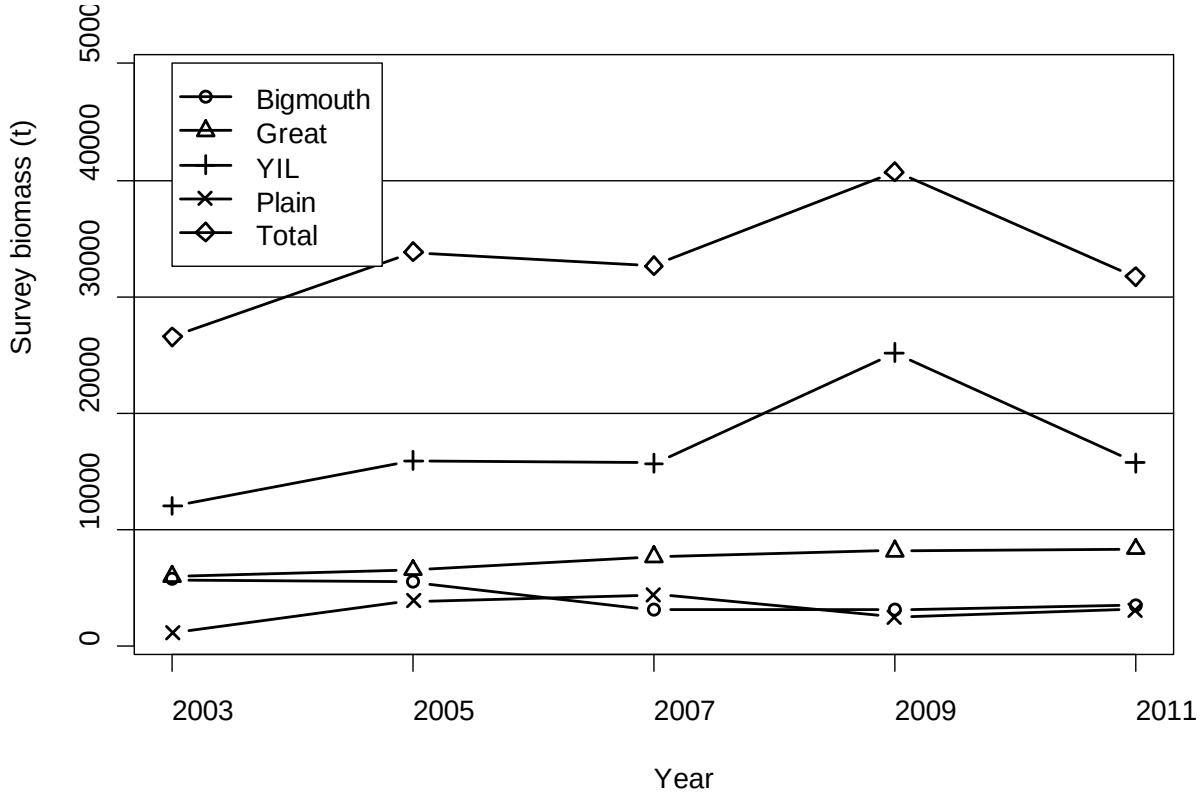

Figure 19.2. Time series of trawl survey biomass estimates for selected sculpin species and all sculpins combined in the GOA, 1984-2009.

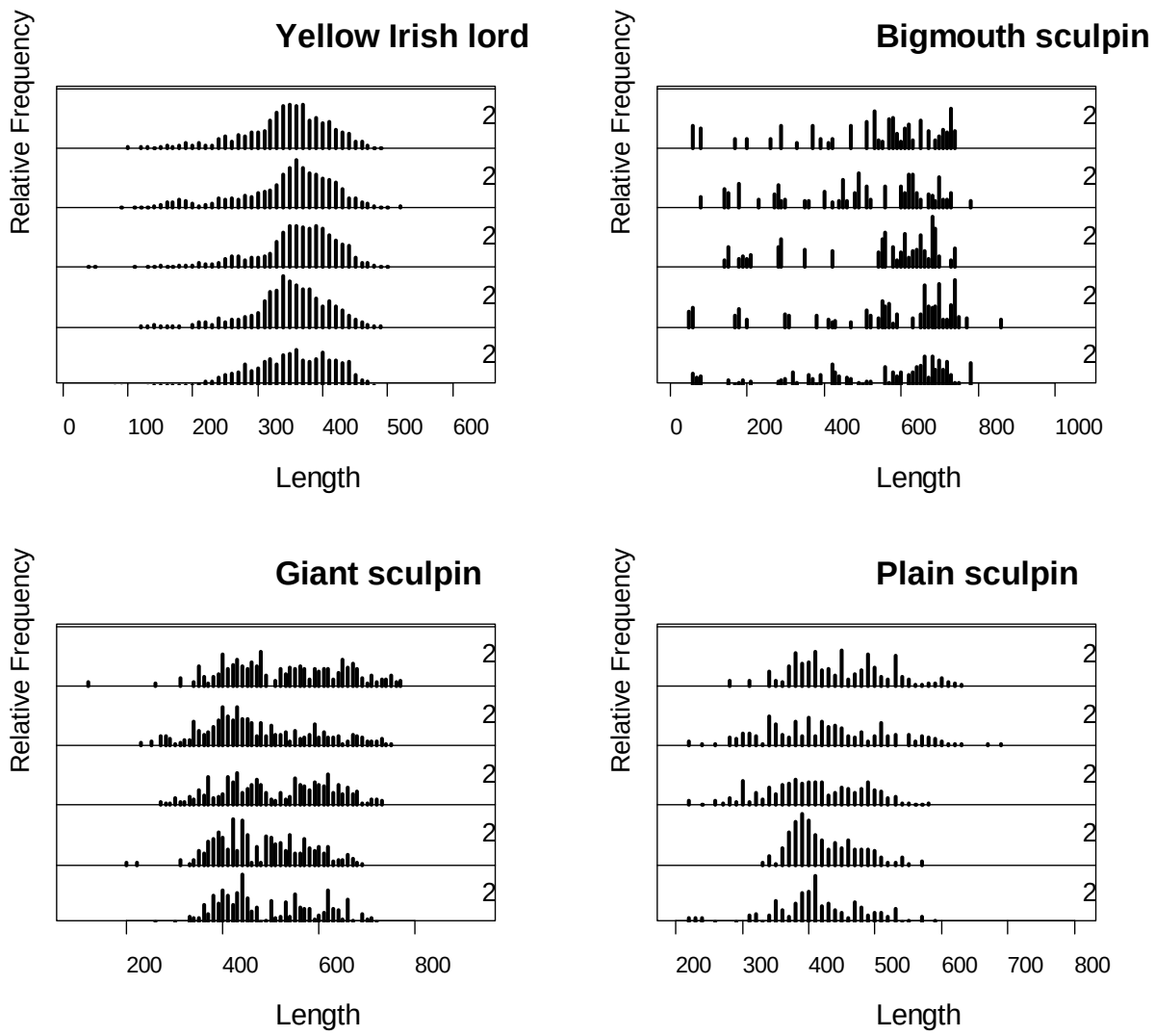

Figure 19.3. Length composition (fork length, FL in mm) from survey data for the 4 most abundant sculpin species in the GOA, 2003-2011.

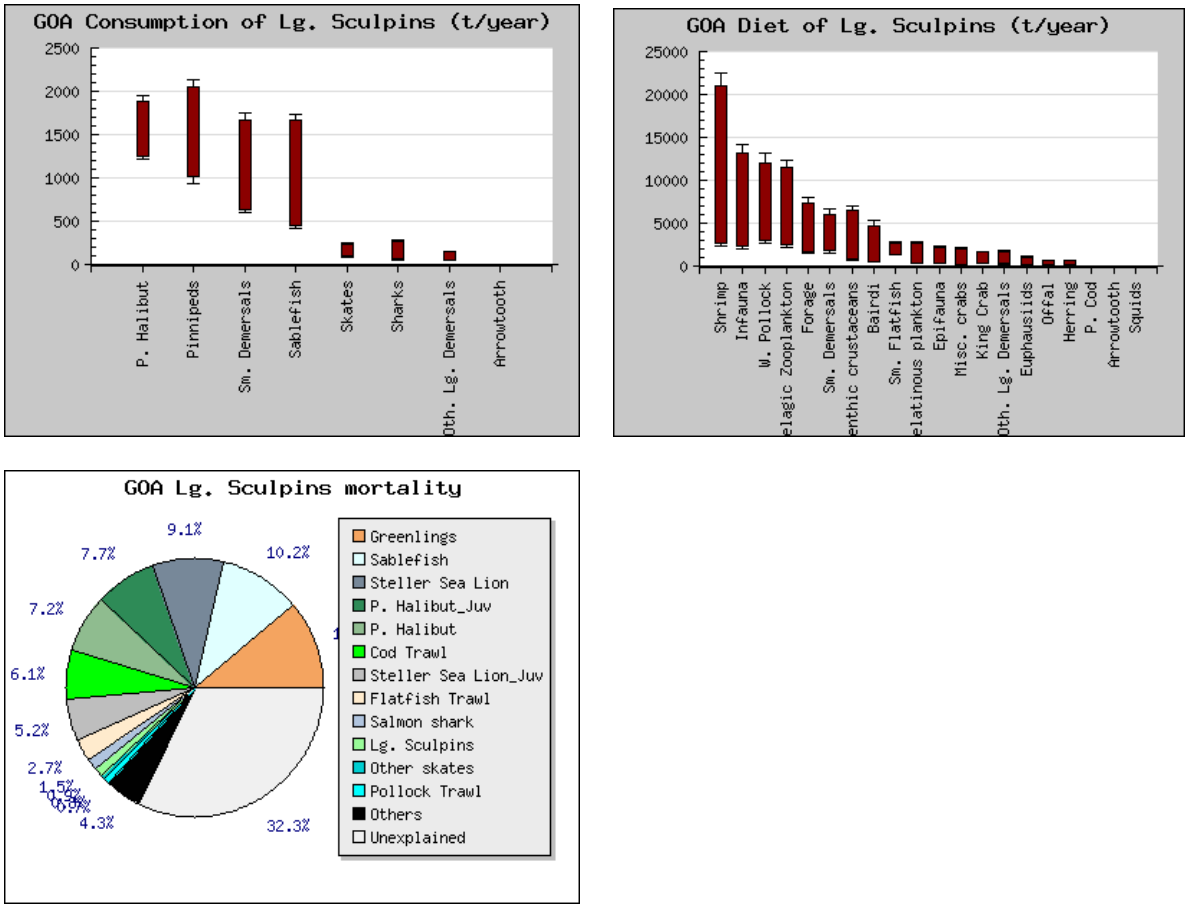

Figure 19.4. Diet, consumption and mortality information for large sculpins in the GOA.

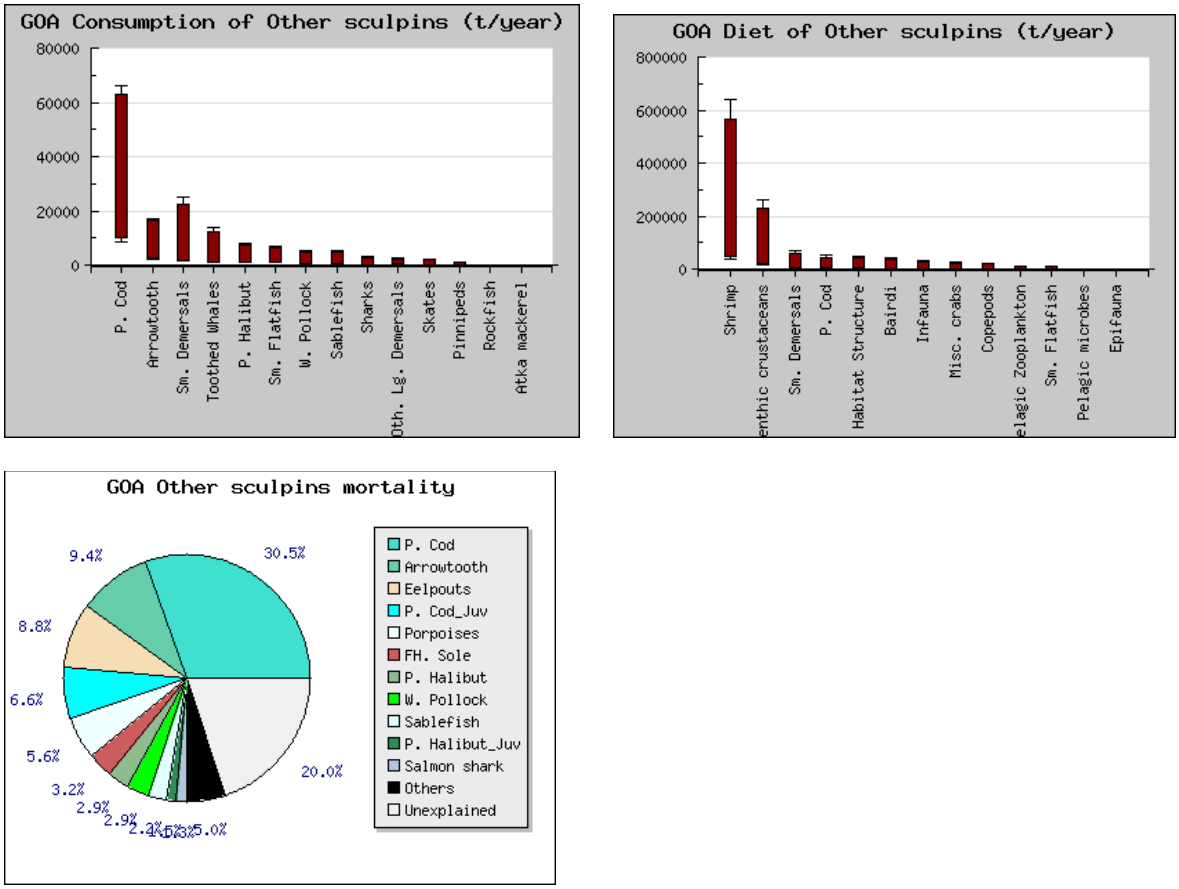

Figure 19.5. Diet, consumption and mortality information for other sculpins in the GOA.

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