Section 16

SUMMARY OF CHANGES IN THE BERING SEA-ALEUTIAN ISLANDS SQUID AND OTHER SPECIES ASSESSMENT

by
Sarah Gaichas

Relative to the November 2002 SAFE report, the following changes have been made in the current draft of the squid and other species chapter:

1) Catch and survey biomass data are updated.

2) Squid and other species catches in aggregate were higher at 39,000 t in 2002 than in any other year between 1997-2001. The 2002 catch of squid was 1,748 t and like the 2001 estimated catch of squid, 1,810 t, was the higher than in the past four years and is much closer to the ABC of 1,970 t than any estimated catch since the 1980's. Catch within the BSAI other species complex also increased in 2002 relative to recent years, with higher observed catches of skates, all three shark species, and (to a lesser extent) sculpins. Octopus catch remained at similar levels.

3) The recommended ABC for squid in the year 2004 is calculated as 0.75 times the average catch from 1978-1995, or **1,970 mt**; the recommended overfishing level for squid in the year 2004 is calculated as the average catch from 1978-1995, or **2,624 mt**. The rationale for a Tier 6-based ABC recommendation is that there is no reliable biomass estimate for squid.

4) If there is no possibility of applying and managing species-group specific ABCs and OFLs (see below), then the recommended ABC for the other species complex in the year 2004 is calculated as 0.75 times the average catch from 1978-1995, or **19,320 mt**; the recommended overfishing level for the other species complex in the year 2004 is calculated as the average catch from 1978-1995, or **25,760 mt**. The rationale for a Tier 6-based ABC recommendation is that there is no reliable estimate of natural mortality, M, for a species complex containing animals with such extremely diverse life histories as sharks, skates, sculpins, and octopi.

5) The stock assessment author recommends using the following group specific ABCs and OFLs (based on the 10 year average EBS shelf survey biomass by group plus the 10 year average EBS slope survey biomass by group plus the 10 year average AI survey by group, all times the natural mortality rates below times 0.75 for ABC and 1 for OFL), and dispensing with the Other species complex level ABC, OFL, and TAC:

	Sharks	Skates	Sculpins	Octopi
Avg Biomass	29,337	483,791	211,874	4,977
M	0.09	0.10	0.15	0.30
BSAI ABC	**1,980**	**36,284**	**23,836**	**1,120**
BSAI OFL	**2,640**	**48,379**	**31,781**	**1,493**

These ABCs and OFLs would permit the levels of bycatch historically observed while increasing protection for the species groups should target fisheries develop before the assessment improves.

Squid and Other Species in the Bering Sea and Aleutian Islands

by
Sarah Gaichas

Response to SSC Comments

From the June, 1999 SSC minutes regarding shark and skate management: *During the SSC's discussion of this amendment, it was suggested that the Plan Team review the "other species" category generally to determine if adequate protection is provided for individual species to ensure their conservation.*

In Appendix D of the November 1999 SAFE, separate ABC estimates for each species group in the GOA were proposed, both to illustrate how Other species could be restructured to afford better protection to each species group, and so that the SSC may evaluate the extent to which removing sharks and skates would affect allowable catch for the rest of the category. Similar species group management for the BSAI other species complex is illustrated in this assessment.

From the October, 2001 SSC minutes: *The SSC received a discussion paper from Jane DiCosimo and Sarah Gaichas on progress towards management of the 'other species' categories for the BS/AI and GOA regions. The SSC is concerned that management based on gross taxonomic groupings will lead to a weakest link problem, where management will be expected to demonstrate "no harm" to species present in low and declining numbers. The development of ABCs and TAC for gross taxonomic groupings has the problem that species are grouped together that are neither ecologically connected, nor similar in their rates of productivity. This is a NMFS-wide problem that may need to be approached at a national level. The SSC recommends continuation of the current approach while a search is conducted for an alternative method.*

The ABC and OFL recommendations in this assessment are based on Tier 6 criteria for both squid and the other species complex. It is difficult to demonstrate "no harm" to individual species when using management measures that are applied to gross taxonomic (or non-taxonomic) groupings. Because there is no control over catches by individual species or even gross taxonomic group under current management of the other species complex, the use of Tier 6 criteria (which result in the lowest possible other species complex ABC and OFL allowed under the current approach) is an attempt to minimize any potential harm to individual species within the complex. No ABC or OFL based on the "step up" approach applied by the SSC in 2000 and 2001 is presented here. The primary objective of the Tier 6 based recommendation is to ensure maximum protection to individual species within the complex while working within the constraints of the current tier system and the directive not to split the complex into smaller groups. I recognize that other objectives may be prioritized by other components of the management system, including the SSC, which may result in different TAC setting methods.

For many of the other species, biological and catch information is of questionable quality due to limited sampling, imprecise species identification and other factors. We don't expect significant improvement in our knowledge in the immediate future. Rather than using typical quota setting measures for conservation of other species, other devices, such as restricted area management, should be explored. Survey and observer catch data should be examined to determine if such an approach has promise.

See the minutes of the ad hoc working group on nontarget species and species complexes for a summary of progress to date in this area.

From the December 2002 SSC minutes: *The SSC has previously expressed its concern with the estimation of ABC for squid and other species. The multiplicity of species within the complexes and the variety of life*

histories they represent complicate the task of assuring responsible conservative harvest recommendations. Compounding this difficulty is the paucity of data, and the lack of precision in available estimates of stock condition. Nevertheless, the Council is obligated to stipulate allowable catches for these species. To do so we utilize a mix of survey biomass estimates and historic catch data following Tier 5 and 6 ABC estimation algorithms. Squid: There are no reliable biomass estimates for squid. ***The SSC concurs with the Plan Team recommendation to follow Tier 6 ABC estimation procedures for squid using mean catch for the period 1978 to 1995.*** *Under this procedure OFL is set at the level of average catch and ABC is 75% of the average catch. The estimated ABC and OFL is 1,970 mt and 2,620 mt respectively. Other Species: The Plan Team believes that the biomass estimates for sharks and octopi are unreliable. They suggest and the SSC agrees that ABCs for these species be estimated using Tier 6 procedures. Tier 6 stipulates that catch should be averaged for the period 1978 to 1995 or some other appropriate period as recommended by the SSC. Reliable catch data for these complexes is only available since the 1990s.* ***The SSC concurs with the Plan Team recommendation to base the average catch on 1992-2001 data.*** *Sculpin and skate ABCs are estimated using Tier 5.*
In 1998 the SSC recommended using Tier 5 procedures for estimation of Other Species ABC. To do so, exploitation rates based on natural mortality values were assigned to each of the Other Species component complexes (sculpins, skates, sharks and octopi) and multiplied against the estimated bottom trawl survey biomass. The ABCs for each complex were summed to produce the total ABC. At the time, the application of this methodology suggested nearly a 4-fold increase in the maximum allowable ABC. The SSC was uncomfortable adopting such a large increment in allowable catch and implemented a 10-year stair step to move gradually into the ABC. We still have the same concern. Thus we are in the 5th year of the stair-step process. The SSC stair-step procedure computes the proportion (nth year of the stair-step divided by 10) of the difference between the 1997 Other Species ABC (25,800 mt) and the current estimate of maximum ABC (60,896 mt) then adds that amount to the 1997 ABC. ***Thus the SSC recommended Other Species ABC, after rounding, is 43,300 mt*** *(25,800 + (5/10)*(60,896-25,800)). OFL is the sum of the Tier 5 and 6 estimated OFL values for each complex within the Other Species category or 81, 100 mt.*

The stock assessment author shares the SSCs discomfort with the large increment in allowable catch that results from summing the individual species components, and is downright horrified with the enormous OFL that results from the same process (and which apparently has no “step up” applied). That is why the stock assessment author continues to recommend separate species group specific ABC and OFL be estimated for each of the four species groups, using the methodology the SSC agreed to above and the Plan Team supports. Summing the individual ABCs and OFLs does absolutely nothing to ensure that the appropriate levels of catch recommended by the stock assessment author and agreed to by the Plan Team and the SSC are actually achieved in real time. Given that a target fishery has developed for a component of the Other species complex in the GOA this year (see GOA SAFE), it is especially important to ensure that these species have the minimal group level protection afforded by the species group specific ABCs and OFLs.

The SSC notes that sharks and skates share many of the same life history characteristics of the rockfishes (e.g. late maturity, low productivity, long life spans, low reproductive rates), and warrant particular concern. These life history characteristics make these species especially vulnerable to overfishing and their continued aggregation is not recommended as a long-term management strategy. The SSC strongly recommends that a methodology for ensuring adequate conservation of these species be developed as quickly as possible.

One method for ensuring adequate conservation is setting group specific OFLs. It is available now.

INTRODUCTION

Other species are considered ecologically important and may have future economic potential; therefore an aggregate annual quota limits their catch. Directed fishing on one component of the Other species category, skates, began this year in the Gulf of Alaska. While there may be interest in targeting skates in elsewhere, the catches within the other species category in the Bering Sea / Aleutian Islands (BSAI) region were apparently still bycatch in 2002-2003. In the BSAI, squid is considered separately from the "other species" management group, which includes sculpins, skates, sharks, and octopus. Smelts were removed from the "other species" group and moved to the forage fish group beginning in 1999 as a result of fishery management plan (FMP) amendments 36 and 39 to the Bering Sea and Aleutian Islands and Gulf of Alaska groundfish FMPs.

Individual other species known or suspected to occur in the Bering Sea and Aleutian Islands are listed in Table 16- 1. The species list was compiled from AFSC survey and fishery observer catch records, and is considered more comprehensive and up-to-date for the region than the general literature (Hart, 1973; Eschmeyer et al., 1983; Allen and Smith, 1988). However, this list may contain errors because species identification is difficult within this category, and taxonomy for certain groups is not fully resolved.

There is some information indicating which species in this large category are most likely caught in BSAI groundfish fisheries. The predominant species of squid in commercial catches in the EBS is believed to be the red squid, *Berryteuthis magister*, while *Onychoteuthis borealijaponicus*, the boreal clubhook squid, is likely the principal species encountered in the Aleutian Islands region. Sharks are the only group in the complex which is consistently identified to species in catches by fishery observers. The three shark species most often encountered in Alaska fisheries are the Pacific sleeper shark, *Somniosus pacificus*, the piked or spiny dogfish, *Squalus acanthias*, and the salmon shark, *Lamna ditropis*.

Skate species are not identified in catches at present (This began to change in 2003, results will be reported next year). During cooperative U.S.-Japan surveys from 1979-85, 15 species of skates were identified but inadequate taxonomic keys for this family may have resulted in more species being identified than actually exist (Bakkala et al. 1985; Ronholt et al. 1985; Bakkala 1993). In recent AFSC surveys, taxonomic keys have been significantly improved, so that we are now confident of most survey identifications. The most common skate species on the EBS shelf is the Alaska skate, *Bathyraja parmifera*. This species accounts for about 91% of the aggregate skate biomass estimated in 1999. The Bering or sandpaper skate *(Bathyraja interrupta*) was the next most common species in the EBS shelf survey, making up about 6% of aggregate skate biomass. The other six skate species identified on the shelf survey made up less than 3% of the aggregate skate complex biomass. Skate species diversity increases on the outer continental shelf and slope, where numerous species were identified in 2000, including the Bering or sandpaper skate *Bathyraja interrupta*, the Aleutian skate *B. aleutica*, and several deeper dwelling skates including the whitebrow skate *B. minispinosa*, the mud skate *B. taranetzi* (=*Rhinoraja longii*), the whiteblotched skate *B. maculata*, and the commander skate *B. lindbergi*. The skate community in the AI appears to be different from that described for the EBS. In the AI, the most abundant species on the 1997 survey was the whiteblotched skate, *Bathyraja maculata* (45% of aggregate biomass). Alaska and Aleutian skates were also common, composing about 30% and 15% of aggregate biomass, respectively. The mud skate, *Bathyraja tanaretzi*, was relatively common but represented a lower proportion of total biomass (~3%) because it is a smaller skate. All seven other skate species identified on the 1997 AI survey made up about 7% of aggregate skate complex biomass.

During the cooperative U.S.-Japan surveys, 41 species of sculpins were identified in the EBS and 22 species in the Aleutian Islands region. Sculpin diversity remains high in recent surveys of both areas. It is likely that the larger sculpin species (Irish lords, *Hemilepidotus* spp., great sculpin and plain sculpins, *Myoxocephalus* spp., and bigmouth sculpin *Hemitripterus bolini*) which contribute to the majority of sculpin biomass on surveys are the ones commonly encountered as bycatch. However, it is unclear which sculpin and skate species are commonly taken in BSAI groundfish fisheries up to 2002, because observers did not regularly identify animals in these groups to species. (Limited data should be available for 2003, and most observers will be identifying skates to species in 2004.) It is also unknown which octopus species are caught in BSAI fisheries, although it is assumed that the majority of the catch is of the giant Pacific octopus, *Octopus dolfleni* (recently renamed *Enteroctopus dolfleni*, Hochberg 1998 as referenced in http://marine.alaskapacific.edu/octopus/factsheet.html).

Information on distribution, stock structure, and life history characteristics is limited for other species in the Bering Sea and Aleutian Islands. Some life history information is available for the same or similar species in other geographic areas. Given the wide diversity of species represented in this management category, we feel it is important to attempt to describe general life history characteristics at least at the species group level in order to evaluate the potential effects of fishing on other species. Therefore, we summarize the available life history information by group below, with the caveat that this should not substitute for future investigations specific to Bering Sea and Aleutian Islands stocks.

Sharks

Sharks are long-lived species with slow growth to maturity and large maximum size; therefore the productivity of shark stocks is very low relative to most commercially exploited bony fishes (Compagno, 1990; Hoenig and Gruber, 1990). Shark reproductive strategies are characterized by long (6 months - 2 years) gestation periods, with small numbers of large, well-developed offspring (Pratt and Casey, 1990). Many large-scale directed fisheries for sharks have collapsed, even where management was attempted (Anderson, 1990). The three shark species most likely to be encountered in Alaska fisheries are the Pacific sleeper shark, *Somniosus pacificus*, the piked or spiny dogfish, *Squalus acanthias*, and the salmon shark, *Lamna ditropis*. We review life history information for each species below.

Little biological information is available for Pacific sleeper sharks, although they are considered common in boreal and temperate regions of shelf and slope waters of the north Pacific. Sleeper sharks are found in relatively shallow waters at higher latitudes, and in deeper habitats in temperate waters. Pregnant females have not been found, so reproductive mode is unknown, although ovoviviparity is suspected. One individual mature female sleeper shark had 300 eggs. Sleeper sharks grow to large sizes; individuals have been measured to 4.3 m, and lengths to 7 m have been observed under water (Compagno, 1984). Large concentrations of sleeper sharks were found during the 2000 pilot Bering Sea slope survey, while almost none have been encountered in the EBS shelf survey.

Spiny dogfish are demersal, occupying shelf and upper slope waters from the Bering Sea to the Baja Peninsula in the north Pacific, and worldwide in non-tropical waters. They are considered more common off the U.S. west coast and British Columbia than in Alaska (Hart, 1973). This species is commercially fished worldwide, and may be the most abundant living shark. Complex population structure characterizes spiny dogfish stocks in other areas; tagging shows separate migratory stocks that mix seasonally on feeding grounds in the UK, and separate stocks in BC and Washington state, both local and migratory, that don't mix (Compagno, 1984). Dogfish form large feeding aggregations, with schools often segregated by size, sex, and maturity stage. Male dogfish are generally found in shallower water than females, except for pregnant females which enter shallow bays to pup. This species is ovoviviparous with small litters of 1-20, and gestation periods of 18-24 months. While all parameters may vary by population, British Columbia female spiny dogfish are reported to mature at 23 years, and males at 14. Maximum age estimates range from 25-30 up to 100 years. Eastern north Pacific spiny dogfish stocks grow to a relatively large maximum size of 1.6 m (Compagno, 1984). Directed fisheries for spiny dogfish are often selective on larger individuals (mature females), resulting in significant impacts on recruitment (Hart 1973; Sosebee 1998).

Salmon sharks range in the north Pacific from Japan through the Bering Sea and Gulf of Alaska to southern California and Baja. They are considered common in coastal littoral and epipelagic waters, both inshore and offshore. Like other lamnid sharks, salmon sharks are active and highly mobile, maintaining body temperatures well above ambient water temperatures (Anderson and Goldman, 2001). Salmon sharks have been both considered a nuisance for eating salmon and damaging fishing gear (Macy et al., 1977; Compagno, 1984) and investigated as potential target species in the Gulf of Alaska (Paust and Smith, 1989), although little is known about their life history locally. In the western Pacific, females are estimated mature at 8-10 years and males at 5 years (Tanaka 1980). The reproductive mode for salmon sharks is ovoviviparous and with uterine cannibalism (Gilmore 1993), and litter size in the western North Pacific is up to 5 pups, with a ratio of male to female of 2.2 (Tanaka 1980). Maximum size has been reported at 3.0 m, but average size range seems to be between 2.0 and 2.5 m. This species lives at least 25 years in the western North Pacific (Tanaka 1980). An investigation is currently underway to determine demographics and population parameters for salmon sharks in the eastern North Pacific (K. Goldman, VIMS, personal communication).

Skates

Skate species are distributed throughout the north Pacific and are common from shallow inshore waters to very deep benthic habitats. Skate life cycles are similar to sharks, with relatively low fecundity, slow growth, and large body sizes. All skate species are oviparous, with one to seven embryos per egg case in locally occurring Raja species (Eschmeyer et al., 1983). The big skate, *Raja binoculata*, is the largest skate in Alaska, but it is more common in the Gulf of Alaska than in the BSAI. In California, female big skates mature at 12 years (1.3-1.4m), and males mature at 7-8 years (1-1.1 m). Maximum size is 2.4 m, with 1.8m and 90 kg common (Martin and Zorzi, 1993). The longnose skate, *Raja rhina*, achieves a smaller maximum length of about 1.4 m in California, and matures between ages 6 (males) and 9 (females). Maximum age reported for the longnose skate was 13 years, although there are many difficulties with ageing skates (Zeiner and Wolf, 1993). Little information is available on reproductive frequency in skate species, or on any *Bathyraja* species life history, but Table 16- 2 lists our best information on life history for all species in Alaska. Although little specific life history information exists for most skate species, they are generally thought to have limited reproductive capacity, and thus be vulnerable to overfishing (Sosebee, 1998). Large skate species with late maturation (11+ years) are most vulnerable to heavy fishing pressure, with cases of near-extinction reported in the North Atlantic for the common skate *Raja batis* and the barndoor skate *Raja laevis* (Brander, 1981; Casey and Myers, 1998). In the North Atlantic, declines in barndoor skate abundance were concurrent with an increase in the biomass of skates as a group (Sosebee 1998). NMFS surveys identified at least 11 species of skates in the FMP areas. Although it is not determined if any individual skate species have declined in the North Pacific over the course of federal fisheries management, there is adequate evidence that fisheries can affect skate populations and that stable or rising aggregate skate biomass does not necessarily indicate that no impact is occurring at the species level.

Sculpins

Sculpins (Cottidae) are relatively small, benthic-dwelling predators, with many species in the North Pacific. Despite their abundance and diversity, sculpin life histories are not well known in Alaska. In terms of life history, sculpins are different from many target groundfish species in that they lay adhesive eggs in nests, and many exhibit parental care for eggs (Eschemeyer et al, 1983). For example, bigmouth sculpins lay eggs in vase sponges–it is unknown whether they are completely dependent on finding a particular type of sponge to reproduce. This type of reproductive strategy may make sculpin populations more sensitive to changes in benthic habitats than other groundfish species such as cod and pollock, which are broadcast spawners with pelagic eggs. Some larger sculpin species such as the great sculpin, *Myoxocephalus polyacanthocephalus*, reach sizes of 70 cm and 8 kg in the western North Pacific. There, great sculpins are reported to have relatively 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. Mean fecundities for great sculpin were 60,000 to 88,000 eggs per gram body weight (Tokranov, 1985). In addition, the diversity of sculpin species in the FMP areas suggests that each sculpin population might react to similar environmental changes (whether natural or fishing influenced) in different ways. Within each sculpin species, the spatial effects of fishing may still be important, because observed differences in fecundity, egg size, and other life history characteristics suggest local population structure (Tokranov, 1985) which is not generally observed in target groundfish stocks. All of these characteristics indicate that sculpins as a group might be managed differently than other groundfish stocks, perhaps most efficiently within a spatial context rather than with a global annual aggregate TAC.

Octopi

In general, short lifespans of 1 to 5 years with a single reproductive period are reported for octopod species (Boyle, 1983). The North Pacific giant octopus, *Enteroctopus dofleini*, is the largest of all octopods. It ranges from northern California to Japan in nearshore waters from low tide line to 200 m deep. In Japan, where octopus support directed fisheries, its life history has been extensively studied. Seasonal inshore-offshore migrations are reported, with mating occurring during autumn inshore in less than 100 m depth. Male octopus migrate back offshore and die, while females remain inshore, spawning 18,000 to 74,000 eggs in shallow water nests (< 50 m) on rocky or sandy bottom between May and July. Eggs are brooded for 6-7 months; female octopus do not feed during this period, and die soon after the eggs hatch. Hatchlings are about 10 mm long, and are planktonic until growing to 20 - 50 mm, settling out to benthos in about March of the year following hatching (Roper et al., 1984). Life history in the eastern North Pacific is not as well known, but spawning may be more common in winter months (Hartwick, 1983). It is thought that giant octopus require 3 years to grow to an adult (mature female) size of 10kg, and that they live 3-5 years. We found no specific information about the life history of the flapjack devilfish, *Opisthoteuthis californiana*, or the smoothskin octopus, *Octopus leioderma*. Because at least some octopus species migrate seasonally inshore and offshore, the sexes are often found in separate habitats. Therefore, the timing and location of fishery interactions with octopus populations may have differential effects on the sexes. More information is necessary to develop appropriate management for octopus species in Alaska, but the fact that they already have the highest estimated retention rates of any group in the other species complex suggests that management at the group level may be necessary in the near future.

Squids

Like octopods, squid species have a single reproductive period; however, most squid lifespans are thought to be 1-2 years. Unlike octopods, squid are generally migratory pelagic schooling species. Squid have been described as "the marine equivalent of weeds," displaying rapid growth, patchy distribution and highly variable recruitment (O'Dor, 1998). Many squid populations are composed of spatially segregated schools of similarly sized (and possibly related) individuals, which may migrate, forage, and spawn at different times of year (Lipinski, 1998). Most information on squids refers to *Illex* and *Loligo* species which support commercial fisheries in temperate and tropical waters. Of North Pacific squids, life history is best described for western Pacific stocks (Arkhipkin et al., 1995; Osako and Murata, 1983). The most commercially important squid in the north Pacific is the magistrate armhook squid, *Berryteuthis magister*. *B. magister* from the western Bering Sea are described as slow growing (for squid) and relatively long lived (up to 2 years). Males grew more slowly to earlier maturation than females. *B. magister* were dispersed during summer months in the western Bering sea, but formed large, dense schools over the continental slope between September and October. Stock structure in this species is complex, with three seasonal cohorts identified in the region. Growth, maturation, and mortality rates varied between seasonal cohorts (Arkhipkin et al., 1995). Timing and location of fishery interactions with squid spawning aggregations may affect both the squid population and availability of squid as prey for other animals (Caddy 1983, O'Dor 1998). The essential position of squid within North Pacific pelagic ecosystems, combined with the limited knowledge of the abundance, distribution, and biology of many squid species in the FMP areas, make squid a good candidate for management distinct from that applied to other species (as is already done in the BSAI). Because fishery interactions with squid happen in predictable locations (see below), squid may be a good candidate for management by spatial restriction rather than by quota.

FISHERY INFORMATION

There is currently little directed fishing for species in this category in the BSAI as far as we know. Squid and other species are taken incidentally in target fisheries for groundfish, and aggregate catches of squid species (Table 16- 3) and the other species complex (Table 16- 4) are tracked inseason by the Alaska Regional Office.

Catch estimates by species group

Because annual other species catches are reported in aggregate, catches by species group or individual species must be estimated using data reported by fishery observers. A new method (described below) has been used since 2000 to estimate species group catch within the other species complex in the BSAI. This method most closely matches the Regional Office blend catch estimation system, and is considered an improvement over past methods. However, the species group catch estimates presented here may not be identical to those presented in past assessments. Catches for all non-target species were estimated at the lowest practical taxonomic level for the recent domestic fishery, 1997 - 2002, by simulating the Regional Office's blend catch estimation system as follows. Target fisheries were assigned to each vessel / gear / management area / week combination based upon retained catch of allocated species, according to the same algorithm used by the Regional office. Observed catches of other species (as well as forage and non-specified species) were then summed for each year by target fishery, gear type, and management area. The ratio of observed other species group catch to observed target species catch was multiplied by the blend-estimated target species catch within that area, gear, and target fishery. Total annual catch by species group has been relatively stable between 1997-2000, although there were some changes in 2001-2002 (Table 16- 5). Estimated annual species group catches are reported by target, gear, and area in Tables 16- 6 through 16- 7 for 2000-2002 in the BSAI. Annual estimated total catches for identified shark species are reported within these same tables. Catch patterns for each species group are discussed below.

Estimation of individual species catches within the other species complex depends on the level of identification of those species in the catch. Within the complex, only sharks (especially spiny dogfish, Pacific sleeper, and salmon sharks) are identified to the species level by observers with any regularity. Skates are almost always recorded as "skate unidentified", with very few exceptions between 1990-2002. This will change in 2004 with the implementation of a skate identification special project initiated by Dr. Duane Stevenson within the Observer program. All observers will identify skates to species using the key beginning in 2004, a subset tested the key in 2003 in what was a very successful special project. At least 80% (by weight) of the observed sculpin catch in past years was recorded as "sculpin unidentified," with the remainder of catch identified to the genus level (*Hemilepidotus*, *Myoxocephalus*, *Gymnocanthus*, *Triglops*). Only small amounts (<2%) of sculpin catch in past years were identified to species. Likewise, octopus and squid are generally not identified to species in the NORPAC database--there is only one individual species code for squid, *Moroteuthis robusta*, and all other squid catch falls under the "squid unidentified" species code. Octopus can only be recorded as "octopus unidentified," or "pelagic octopus unidentified." Observers are presently instructed to devote resources to higher-priority target species and prohibited species data collection, so they have limited time to devote to other species identification. At present, fishery observers are not trained to identify squid, or octopus to species.

The accuracy of catch estimates for groups or species within the other species complex also depends on the level of observer coverage in a given fishery (no observers, no catch estimates). Observer coverage requirements are based upon vessel size. In general, larger vessels fish in the Bering Sea, such that observer coverage levels in some fisheries approach 100%. Our calculations for 1997-2001 suggest that the BSAI region has approximately 70-80% observer coverage overall. Therefore, in making these catch estimates, we are assuming that other species catch aboard observed vessels is representative of other species catch aboard unobserved vessels throughout Alaska. Because observer assignment to vessels in the 30% coverage class is not at random, there is a possibility that this assumption is incorrect.

Catch history for BSAI Squid and Other Species

Squid are generally taken incidentally in target fisheries for pollock but have been the target of Japanese and Republic of Korea trawl fisheries in the past. Reported catches since 1977 are shown in Table 16- 3. After reaching 9,000 mt in 1978, total squid catches have steadily declined to only a few hundred tons in 1987-95. Thus, squid stocks have been comparatively lightly exploited in recent years. Discard rates of squid (discards/total squid catch) by the BSAI groundfish fisheries have ranged between 40% and 85% in 1992-1998 (NMFS Regional Office, Juneau, AK). Note that the 2001 estimated catch of squid, 1,810 t (Table 16-5), was the highest in the past five years and is much closer to the ABC of 1,970 t than any estimated catch since the 1980's. The estimated catch for 2002 was not far behind.

Reported catches of "other species" increased during the 1960's and early 1970's and reached a peak of 133,000 mt in 1972, the year when total catches of all species of groundfish reached a maximum of 2.3 million mt. The "other species" catch in 1972 represented 6% of the total groundfish catch. In 1973-76 catches declined to a range of 33,000-70,000 mt annually as total catches of groundfish also declined. Catches of "other species" were relatively high from 1977-1981 (43,000-73,000 mt), but thereafter declined to a range of 5,000-13,000 mt in 1984-89 despite increased catches of total groundfish (Table 16- 4). Part of the reason may be incomplete reporting of domestic catches before 1990 which would cause those reported catches to be understimates of total catch. Since 1990, catches have ranged between 17,000 and 33,000 mt, and represented 2% or less of the total groundfish catches from the Bering Sea and Aleutian Islands. From 1992-1998, between 90% and 94% of the "other species" caught were discarded (NMFS Regional Office, Juneau, AK).

Skates and sculpins constitute the bulk of the other species catches, accounting for between 66-96% of the estimated totals in 1992-1997. This trend has continued in 1997-2002 (Tables 16- 5 through 16- 7). While skates are caught in almost all fisheries and areas of the Bering Sea shelf, most of the skate bycatch is in the hook and line fishery for Pacific cod, with trawl fisheries for pollock, rock sole and yellowfin sole also catching significant amounts. Sculpins are also caught by a wide variety of fisheries, but trawl fisheries for yellowfin sole, Pacific cod, pollock, Atka mackerel and rock sole catch the most.

Most squid have been caught as bycatch in the midwater trawl pollock fishery primarily over the shelf break and slope or in deep waters of the Aleutian Basin (subareas 515, 517, 519, 521 and 522). Bottom trawl pollock and all three of the fisheries for Pacific cod (pots, longlines and trawls) catch almost all of the octopus bycatch. Octopus catches by groundfish fisheries in the BS/AI estimated using observer bycatch rates ranged between 139-1,017 mt in 1992-96. In addition, there is a small directed fishery for octopus in the Aleutian Islands and southwestern Bristol Bay regions. Directed octopus landings from 1988-95 have been less than 8 mt per year (Skip Gish, Alaska Department of Fish and Game, Dutch Harbor, pers. comm.).

Estimates of shark bycatch in the BS/AI groundfish fisheries from 1992-96 have ranged from 308-702 mt. Most of the shark bycatch occurs in the midwater trawl pollock fishery and in the hook and line fisheries for sablefish, Greenland turbot and Pacific cod along the outer continental shelf and slope of the Bering Sea (subareas 517, 515 and 521).

Grenadiers, while not part of the other species category, are a significant bycatch species in the sablefish and turbot longline fisheries on the outer shelf and continental slope regions of the Aleutian Islands and eastern Bering Sea. Total bycatch estimates from 1992-96 have ranged between 2,675 mt (in 1992) and 8,885 (in 1993).

SURVEY DATA

There is currently no reliable estimate of squid abundance in the eastern Bering Sea. Sobolevsky (1996) cites an estimate of 4 million tons for the entire Bering Sea made by squid biologists at TINRO (Shuntov et al. 1993), and an estimate of 2.3 million tons for the western and central Bering Sea (Radchenko 1992), but admits that squid stock abundance estimates have received little attention. It is clear that the AFSC bottom trawl surveys greatly underestimate squid abundance.

Data from AFSC surveys provide the only abundance estimates for the various groups and species comprising the "other species" category (Table 16- 8). Biomass estimates for the eastern Bering Sea are from a standard survey area of the continental shelf. The 1979, 1981, 1982, 1985, 1988 and 1991 data include estimates from continental slope waters (200-1,000 m in 1979, 1981, 1982, and 1985; 200-800 m in 1988 and 1991), but data from other years do not. Slope estimates were usually 5% or less of the shelf estimates, except for grenadiers. Stations as deep as 900 m were sampled in the 1980, 1983 and 1986 Aleutian Islands bottom trawl surveys, while surveys in 1991 and 1994 obtained samples only to a depth of 500 m. The actual catches made by research vessels are shown in Table 16- 9.

Biomass estimates from AFSC surveys illustrate that sculpins were the major component of the other species complex until 1986, after which the biomass of skates exceeded that of sculpins. The abundance of skates increased between 1985 and 1990 (when a high of 583,800 mt survey biomass was observed), but has since declined to 354,200 mt in 1998; the abundance of sculpins has remained relatively stable over that time period. Biomass estimates for the "other species" complex as a whole have fluctuated considerably since 1975, possibly because of changes in availability or vulnerability of the various species to the survey trawls, as well as the depths surveyed. This is particularly evident for smelts, sharks and octopus, which are poorly sampled by demersal trawls; abundance of these groups may be underestimated. Until the 2000 pilot slope survey of the EBS, it was thought that bottom trawl surveys did not adequately sample sharks. However, sleeper sharks were the third highest CPUE on this pilot survey, indicating that they can be sampled by bottom trawls. Substantial biomass of sleeper sharks was estimated on the slope by the 2002 EBS slope survey (Table 16-8). This recent information suggests that it is the location and timing of the EBS trawl survey on the shelf during the summer, and not the use of bottom trawls for sampling which results in the apparently low biomass estimates for sharks in the EBS shelf (Table 16- 8). Changes in distribution of particular species may also account for some of the biomass fluctuation of a group. For instance, a cold water sculpin species, the butterfly sculpin (*Hemilepidotus papilio*), has been found to intrude into the northern portion of the survey area to a greater extent in some years than others, and accounts for some of the fluctuations in biomass of the sculpin group.

This year (2003) a special project was completed at the end of the EBS shelf bottom trawl survey which was designed to evaluate escapement of selected Other species under the survey footrope. The information is still being analyzed and so is not available for this assessment. We expect results of this project to be very useful to the Other species assessment, especially with respect to estimating ABC and OFL based on Tier 5 criteria.

Catch relative to biomass based on survey estimates

Estimated skate and sculpin bycatch in the BSAI groundfish fisheries has ranged between 1-4% of their respective survey biomass (Table 16- 8) between 1990 and 1996. Harvest rates of octopus (defined as total removals divided by survey biomass) have ranged between 2-10% for each of the years from

1990-94. However, in 1995, removals of 977 mt of octopus from the eastern Bering Sea alone represented 35% of the octopus survey biomass of 2,779 mt. Octopus biomass in the eastern Bering Sea and Aleutian Islands regions is believed to be underestimated by the bottom trawl surveys due to undersampling in important nearshore, rocky habitats. Due to the lack of deep stations in eastern Bering Sea trawl surveys after 1985, the best biomass estimates of grenadiers may be from the early 1980s in both the eastern Bering Sea (1982) and Aleutian Islands (1983). If this is the case, current (1992-96) bycatch of grenadiers in the BSAI groundfish fisheries represents between 0.5 and 2% of the grenadier biomass in the BSAI region (Table 16- 8).

ANALYTIC APPROACH, MODEL EVALUATION, AND RESULTS

The available data do not support modeling for any component of the Other species complex in the BSAI.

PROJECTIONS AND HARVEST ALTERNATIVES

At the moment, other species are currently taken only as bycatch in directed target fisheries, so future catches of other species are more dependent on the distribution and limitations placed on target fisheries than on any harvest level established for this category. For example, changes in the allocation of quota by gear type in a major target fishery (i.e., Pacific cod longline vs. trawl) will result in different proportions and species composition of catches within the other species category. However, if target fisheries develop in the BSAI for components of the complex as they did in the GOA this year, this will no longer be true. With this in mind, no projections are presented, but options for other species "harvest alternatives" are outlined.

The first option is to continue with the status quo of setting other species ABC and OFL at the complex level, and squid ABC and OFL at the species group level. In this assessment, other species complex and squid ABC are set using Tier 6 criteria as 75% of the average catch of the complex between 1978-1995, and OFL as average catch over the same period:

> The average catch of the other species complex between 1978-1995 is 25,760 metric tons. Therefore, the Tier 6 ABC for the BSAI other species complex in the year 2004 is calculated as 0.75 times the average catch from 1978-1995, or **19,320 mt**; the Tier 6 overfishing level for the other species complex in the year 2004 is calculated as the average catch from 1978-1995, or **25,760 mt**. (This recommendation is unchanged from last year's assessment.)
>
> Using the same Tier 6 criteria, the recommended ABC for BSAI squid in the year 2004 is calculated as 0.75 times the average catch from 1978-1995, or **1,970 mt**; the recommended overfishing level for squid in the year 2004 is calculated as the average catch from 1978-1995, or **2,624 mt**. (This recommendation is unchanged from previous assessments.)

While this method results in the lowest possible ABC and OFL for the other species complex as a whole, it should be noted that this option does nothing to prevent the entire catch within the ABC or OFL from comprising a single species group or even a single species within the other species category. This may happen if a directed fishery were to develop. In such a situation it is possible that any OFL that might have been established for that single species (or species group) might be exceeded, especially for less productive stocks.

A second alternative is to attempt to estimate an ABC and OFL for each species group within the other species category, based on the information available. Although this option will afford better protection to less productive groups within other species (e.g. sharks and skates), it requires that other species catch be monitored at the species group level instead of the current aggregate level. In addition, application of the tier criteria from FMP amendment 56 is difficult for species groups within other species. Tier 6 criteria for establishing ABC and OFL require a reliable catch history from 1978 to 1995. Although a catch history exists for the other species group as a whole during this period, there are no reliable catch estimates by species group prior to 1990 at present. Therefore, we cannot estimate ABC or OFL based on Tier 6 criteria at the species group level unless the rules are amended by the Plan Team and or SSC.

Tier 5 criteria require reliable point estimates of biomass and natural mortality rate M. Relatively conservative estimates of M were developed for each species group based on literature values (Table 16-10). For certain groups within other species (cephalopods), our current lack of reliable biomass estimates makes ABC and OFL determination difficult using this method, and potentially results in severe underestimates of allowable catch. Several ABC and OFL options are available using the current tier 5 criteria for each species group within the other species category. Within tier 5, ABCs and OFLs are presented which are based on the average biomass from the past 10 years for each species group (see full description in Table 16- 11).

	Sharks	Skates	Sculpins	Octopi
Avg Biomass	29,337	483,791	211,874	4,977
M	0.09	0.10	0.15	0.30
BSAI ABC	**1,980**	**36,284**	**23,836**	**1,120**
BSAI OFL	**2,640**	**48,379**	**31,781**	**1,493**

These alternative ABCs and OFLs reflect our current understanding of the basic biology for each species group while protecting the less productive components of the category. In addition, they would allow similar levels of bycatch in target fisheries to those observed since 1990, assuming fishing patterns remain stable. We recognize that these taxonomic categories still contain many ecologically unrelated species with different levels of productivity, so that even within these smaller ABCs there is a possibility of overfishing the least productive individual species. However, we think species group ABCs which result in quota management at the species group level are an improvement over an aggregate TAC for this diverse category.

Alternative management for components of the Other species complex

Because TAC setting may not be equally effective for all “other species”, alternative management measures might be considered for some of these groups, depending upon the management objective. For instance, if the management objective is simply to reduce bycatch of a given “other species”, management tools such as gear restrictions or area management might be more efficient than TAC management. An example of area management to reduce squid bycatch in the EBS pollock fishery was included as an appendix to last year’s assessment. Bycatch of squid is reduced by limiting pelagic trawl fishing within relatively small areas of the shelf break; this has already been demonstrated through the indirect effects of closures related to Stellar sea lions. In 1999 and 2000, the pollock fishery was restricted or removed from one area of historically concentrated squid bycatch and squid catch was cut to less than half that observed in 1997-1998 (Table 16- 1). In 2001-2002, the pollock fishery moved back into the area and squid catch increased to levels approaching the ABC. Another option for bycatch reduction is the use of specialized gear. Excluder devices designed to reduce halibut bycatch have also been found to be effective in some configurations at releasing skates from trawl nets before they are captured (Craig Rose, NMFS AFSC, and John Gauvin, Groundfish Forum, personal communication). Other configurations may reduce shark bycatch in trawls. For sharks and skates caught on longlines, it is possible that changes in release methods (eg., not gaffing through the body or running them through the crucifier) would improve survival, as has also been shown for halibut.

For more sedentary species, there are also ways to combine catch information with survey information in applying area-specific TACs to achieve individual species management without individual species TACs. While there are several species within each sculpin genus in the EBS, there is reasonably good geographic separation of these species according to AFSC bottom trawl survey data. It is therefore possible to have only identification to genus in the catch, along with location, and determine which species were in the catch with a reasonable degree of certainty. A sculpin genus-level TAC (e.g. "Irish lords") applied within a given area where species do not overlap would then be species specific. This might result in fewer area-specific group TACs to manage as opposed to many area-wide species TACs to track. It may also be possible to apply this type of area-specific TAC at the assemblage level, and estimate which species are in the assemblage using survey data. These management measures may be incorporated into these plan amendments or developed in future amendments.

ECOSYSTEM CONSIDERATIONS

Understanding other species population dynamics is fundamental to describing ecosystem structure and function in Alaska, because each group in other species plays an important ecological role. The species groups in this category occupy all marine habitats from pelagic to benthic, nearshore to open ocean, and shallow to slope waters. Sharks are top predators, so fluctuations in their populations may have significant effects on community structure. Squid and octopus are highly productive, voracious predators which are in turn important prey for commercially important groundfish, sharks, and marine mammals. Smelts and other forage fishes are essential components in the diets of marine mammals, seabirds, and commercially important groundfish. Sculpins and skates are important benthic predators, and sculpins serve as prey for many groundfish species. Grenadiers, while not included in the other species category, may be the dominant fish in deeper habitats. They are caught in sufficient numbers to warrant additional attention, especially because they may be very long lived species (Andrews et al., 1999).

Because there is no "Other species fishery" it does not make sense to evaluate what effect that fishery would have on the ecosystem. This entire assessment describes what effects target fisheries have on the ecosystem, and target species assessments each contain the appropriate section describing which Other species are impacted by directed fisheries. The ecological connections of Other species are better described in the Ecosystem Indicators and Assessment SAFE chapters, so the reader is directed there to avoid duplication.

SUMMARY

Catches of other species have been very small compared to those of target species in Alaska, but they appear to be increasing. There are data limitations in terms of life history for all creatures in the other species complex; we lack information on age and growth, reproductive biology, habitat requirements, and in some cases, species descriptions. Considerable further investigation is necessary to be sure that all components of other species are not adversely affected by groundfish fisheries. Furthermore, if target fisheries develop for any component of the other species group (as they have for skates in the Gulf of Alaska this year), effective management will be extremely difficult with the current limited information. Regardless of management decisions regarding TAC and the future structure for other species, it is essential that we continue to improve species identification, survey sampling, and biological data collection for the species in this group if we hope to ensure their continued conservation.

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This year the implementation of a special project within the Observer Program to identify skates to species was extremely successful, and for this I thank Duane Stevenson first and foremost for designing the project and the species identification key, along with Jay Orr and Jerry Hoff and other RACE division staff. I also thank the participating observers who brought back comments for improving the key as well as data. The improvement of species identification by observers is invaluable to this assessment and should provide much improved data in the future. The Observer Program as a whole has been very responsive this year to issues surrounding the developing skate fishery in the Gulf of Alaska and I appreciate their efforts, especially the midseason application of the skate key to as many observers as possible. I realize that this type of flexibility requires substantial effort, and that making a change midseason can be logistically difficult, especially for field staff. Thanks to you all for the extra hard work you put in!

In addition, new data are available from the EBS shelf survey this year, including length frequencies for several species of skates and sculpins. This data greatly improves knowledge of the current state of several major other species populations and is extremely useful to the assessment. I thank all participants in RACE trawl surveys who assisted in collecting this information, and especially Gary Walters, Mark Wilkins, Jerry Hoff, and Terry Sample for organizing these collections.

We gratefully acknowledge Gary Walters' timely and efficient work in estimating biomass and variance of biomass for each other species group from all Eastern Bering Sea trawl surveys back to 1975, including the historical slope surveys. Likewise, Mark Wilkins kindly provided species specific and group specific "biomass estimates" from the pilot Bering Sea slope survey conducted in 2000. Jerry Hoff provided references on sculpin species. Ken Goldman (VIMS) provided information and references on shark species. Jay Orr and Jerry Hoff edited species lists from racebase and provided insights into the difficulties of species identification. Sheryl Corey and Jennifer Ferdinand clarified past and current observer training procedures.

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TABLES

Table 16- 1. Other species and squids in the Bering Sea-Aleutian Islands, by scientific and common name; compiled from the AFSC survey database RACEBASE. This list should be considered preliminary.

BSAI Other Category	Scientific name	Common name
115 species codes		shark unident.
	Lamna ditropis	salmon shark
	Squalus acanthias	spiny dogfish
	Somniosus pacificus	Pacific sleeper shark
	Rajidae unident.	skate unident.
		skate egg case unident.
	Bathyraja sp. egg case	
	Raja sp.	
	Bathyraja sp.	
	Bathyraja spinosissima	white skate
	Bathyraja abyssicola	deepsea skate
	Raja binoculata	big skate
	Bathyraja interrupta	Bering skate
	Raja rhina	longnose skate
	Raja stellulata	starry skate
	Bathyraja taranetzi (=Rhinoraja longii)	mud skate
	Bathyraja trachura	black skate
	Bathyraja parmifera	Alaska skate
	Bathyraja aleutica	Aleutian skate
	Bathyraja lindbergi	commander skate
	Bathyraja maculata	whiteblotched skate
	Bathyraja minispinosa	whitebrow skate
	Bathyraja smirnovi	golden skate
	Bathyraja violacea	Okhotsk skate
	Cottidae	sculpin unident.
	Zesticelus profundorum	flabby sculpin
	Thyriscus anoplus	sponge sculpin
	Icelinus borealis	northern sculpin
	Icelinus tenuis	spotfin sculpin
	Gymnocanthus sp.	
	Gymnocanthus pistilliger	threaded sculpin
	Gymnocanthus tricuspis	Arctic staghorn sculpin
	Gymnocanthus galeatus	armorhead sculpin
	Radulinus asprellus	slim sculpin
	Clinocottus acuticeps	sharpnose sculpin
	Gymnocanthus detrisus	
	Artediellus sp.	
	Artediellus miacanthus	bride sculpin
	Artediellus pacificus	Pacific hookear sculpin
	Artediellus scaber	hamecon
	Artediellus uncinatus	Arctic hookear sculpin
	Bolinia euryptera	
	Malacocottus sp.	

Table 16- 1 Continued
BSAI Other Category

Scientific name	Common name
Malacocottus kincaidi	blackfin sculpin
Malacocottus zonurus	darkfin sculpin
Hemilepidotus sp.	Irish lord
Hemilepidotus gilberti	banded Irish lord
Hemilepidotus spinosus	brown Irish lord
Hemilepidotus zapus	longfin Irish lord
Hemilepidotus hemilepidotus	red Irish lord
Hemilepidotus jordani	yellow Irish lord
Hemilepidotus papilio	butterfly sculpin
Archistes plumarius	
Triglops sp.	
Triglops forficata	scissortail sculpin
Triglops metopias	crescent-tail sculpin
Triglops scepticus	spectacled sculpin
Triglops pingeli	ribbed sculpin
Triglops macellus	roughspine sculpin
Micrococttus sellaris	brightbelly sculpin
Myoxocephalus verrucosus	warty sculpin
Myoxocephalus niger	warthead sculpin
Myoxocephalus polyacanthocephalus	great sculpin
Myoxocephalus jaok	plain sculpin
Myoxocephalus stelleri	frog sculpin
Myoxocephalus sp.	
Megalocottus platycephalus	belligerent sculpin
Myoxocephalus quadricornis	fourhorn sculpin
Myoxocephalus scorpioides	Arctic sculpin
Leptocottus armatus	Pacific staghorn sculpin
Gilbertidia sigalutes	soft sculpin
Enophrys sp.	
Enophrys bison	buffalo sculpin
Enophrys lucasi	leister sculpin
Enophrys diceraus	antlered sculpin
Dasycottus setiger	spinyhead sculpin
Psychrolutes sp.	
Psychrolutes paradoxus	tadpole sculpin
Psychrolutes phrictus	blob sculpin
Blepsias bilobus	crested sculpin
Nautichthys pribilovius	eyeshade sculpin
Nautichthys oculofasciatus	sailfin sculpin
Nautichthys robustus	shortmast sculpin
Hemitripterus bolini	bigmouth sculpin
Hemitripterus villosus	sea raven
Eurymen gyrinus	smoothcheek sculpin
Triglops xenostethus	
Icelus spiniger	thorny sculpin
Icelus canaliculatus	porehead sculpin
Icelus euryops	
Icelus spatula	spatulate sculpin
Icelus uncinalis	uncinate sculpin
Rastrinus scutiger	roughskin sculpin

Table 16- 1 Continued BSAI Other Category	Scientific name	Common name
	Jordania zonope	longfin sculpin
	Icelus sp.	
	Paricelinus hopliticus	thornback sculpin
	Cephalopoda unident.	cephalopod unident.
		cuttlefish unident.
		octopus unident.
		pelagic octopus unident.
	Octopus leioderma	smoothskin octopus
	Opisthoteuthis californiana	flapjack devilfish
	Octopus dofleini	giant octopus
	Benthoctopus sp.	
	Vampyroteuthis infernalis	
		squid unident.
	Rossia pacifica	eastern Pacific bobtail
	Loligo opalescens	California market squid
	Gonatus sp.	
	Gonatus onyx	clawed armhook squid
	Berryteuthis magister	magistrate armhook squid
	Gonatopsis sp.	
	Gonatopsis borealis	boreopacific armhook squid
	Moroteuthis robusta	robust clubhook squid
	Taonius pavo	

Table 16- 2. Life history information available for BSAI and GOA skate species.

Species	Common	Max Length (cm)[1]	Max Age	Age Length Mature[2]	Feeding mode[3]	n / egg case[1]	Depth range (m)[4]	Est. of M[6]
Raja binoculata	**big skate**	**180-240**	**?**	**8-12 yrs 109-130 cm**	**predatory?[1]**	**1-7**	**3-800[5]**	**0.10**
Raja rhina	**longnose skate**	**137**	**?**	**7-10 yrs 74-100 cm**	**?**	**1**	**25-675[5]**	**0.10**
Bathyraja interrupta	**Bering skate**	**86**	**?**	**?**	**benthophagic**	**1**	**50-1380**	**0.10**
Bathyraja tanaretzi	**mud skate**	**70***	**?**	**?**	**?**	**1**		**0.10**
Bathyraja trachura	**black skate**	**89**	**?**	**?**	**?**	**1**	**800-2050**	**0.10**
Bathyraja parmifera	**Alaska skate**	**61-91, 113***	**?**	**?**	**predatory**	**1**	**25-300**	**0.10**
Bathyraja aleutica	**Aleutian skate**	**120-150**	**?**	**?**	**predatory**	**1**	**300-950**	**0.10**
Bathyraja lindberghi	**commander skate**	**93***	**?**	**?**	**?**	**1**	**175-950**	**0.10**
Bathyraja maculata	**whiteblotched skate**	**120***	**?**	**?**	**predatory**	**1**	**175-550**	**0.10**
Bathyraja minispinosa	**whitebrow skate**	**82***	**?**	**?**	**benthophagic**	**1**	**100-1400**	**0.10**
Bathyraja violacea	**Okhotsk skate**	**150***	**?**	**?**	**benthophagic**	**1**	**25-500**	**0.10**

[1]Eschemeyer, 1983 (assuming that *B. kincaidii* = *B. interrupta*) and *species id notes by Jay Orr (AFSC)
[2]Zeiner and Wolf, 1993.
[3]Orlov, 1998 & 1999 (benthophagic eats mainly amphipods, worms. Predatory diet primarily fish, cephalopods)
[4]McEachran and Miyake, 1990b
[5]Allen and Smith, 1988
[6] Gaichas et al, 1999

Table 16- 3. Estimated total (retained and discarded) catches of squid (mt) in the eastern Bering Sea and Aleutian Islands by groundfish fisheries, 1977-2002. JV=Joint ventures between domestic catcher boats and foreign processors.

Year	Eastern Bering Sea				Aleutian Islands				Grand Total
	Foreign	JV	Domestic	Total	Foreign	JV	Domestic	Total	
1977	4,926			4,926	1,808			1,808	6,734
1978	6,886			6,886	2,085			2,085	8,971
1979	4,286			4,286	2,252			2,252	6,538
1980	4,040			4,040	2,332			2,332	6,372
1981	4,178	4		4,182	1,763			1,763	5,945
1982	3,833	5		3,838	1,201			1,201	5,039
1983	3,461	9		3,470	509	1		510	3,980
1984	2,797	27		2,824	336	7		343	3,167
1985	1,583	28		1,611	5	4		9	1,620
1986	829	19		848	1	19		20	868
1987	96	12	1	109		23	1	24	131
1988		168	246	414		3		3	417
1989		106	194	300		1	5	6	306
1990			532	532			94	94	626
1991			544	544			88	88	632
1992			819	819			61	61	880
1993			611	611			72	72	683
1994			517	517			87	87	604
1995			364	364			95	95	459
1996			1,083	1,083			84	84	1,167
1997			1,403	1,403			71	71	1,474
1998			891	891			25	25	915
1999			432	432			9	9	441
2000			375	375			8	8	384
2001			1,761	1,761			5	5	1,766
2002			1,334	1,334			10	10	1,344
2003*									1,278

*2003 catch reported through October 18, 2003 and DOES NOT include CDQ squid catch.

Data Sources: Foreign and JV catches-U.S. Foreign Fisheries Observer Program, Alaska Fisheries Science Center, National Marine Fisheries Service, NOAA, BIN C15700, Bld.4, 7600 Sand Point Way NE, Seattle, WA 98115. Domestic catches before 1989 (retained only; do not include discards): Pacific Fishery Information Network (PacFIN), Pacific Marine Fisheries Commission, Portland, OR 97201. Domestic catches since 1989: NMFS Regional Office BLEND database, Juneau, AK 99801.

Table 16- 4. Estimated total (retained and discarded) catches of other species (mt) in the eastern Bering Sea and Aleutian Islands by groundfish fisheries, 1977-2002. JV=Joint ventures between domestic catcher boats and foreign processors. Estimated catches of other species from 1977-98 include smelts.

Year	Eastern Bering Sea				Aleutian Islands				Grand Total
	Foreign	JV	Domestic	Total	Foreign	JV	Domestic	Total	
1977	35,902			35,902	16,170			16,170	52,072
1978	61,537			61,537	12,436			12,436	73,973
1979	38,767			38,767	12,934			12,934	51,701
1980	33,955	678		34,633	13,028			13,028	47,661
1981	32,363	3,138	100	35,651	7,028	246		7,274	42,925
1982	17,480	720		18,200	4,781	386		5,167	23,367
1983	11,062	1,139	3,264	15,465	3,193	439	43	3,675	19,140
1984	7,349	1,159		8,508	184	1,486		1,670	10,178
1985	6,243	4,365	895	11,503	40	1,978	32	2,050	13,553
1986	4,043	6,115	313	10,471	1	1,442	66	1,509	11,980
1987	2,673	4,977	919	8,569		1,144	11	1,155	9,724
1988		11,559	647	12,206		281	156	437	12,643
1989		4,695	298	4,993		1	107	108	5,101
1990			16,115	16,115			4,693	4,693	20,808
1991			16,261	16,261			938	938	17,199
1992			29,994	29,994			3,081	3,081	33,075
1993			20,574	20,574			3,277	3,277	23,851
1994			23,456	23,456			1,099	1,099	24,555
1995			20,923	20,923			1,290	1,290	22,213
1996			19,733	19,733			1,706	1,706	21,440
1997			23,656	23,656			1,520	1,520	25,176
1998			23,077	23,077			2,455	2,455	25,531
1999			18,884	18,884			1,678	1,678	20,562
2000			23,098	23,098			3,010	3,010	26,108
2001			23,148	23,148			4,029	4,029	27,178
2002			26,639	26,639			1,980	1,980	28,619
2003*									23,921

*2003 catch reported through October 18, 2003.

Data Sources: Foreign and JV catches-U.S. Foreign Fisheries Observer Program, Alaska Fisheries Science Center, National Marine Fisheries Service, NOAA, BIN C15700, Bld.4, 7600 Sand Point Way NE, Seattle, WA 98115. Domestic catches before 1989 (retained only; do not include discards): Pacific Fishery Information Network (PacFIN), Pacific Marine Fisheries Commission, Portland, OR 97201. Domestic catches since 1989: NMFS Regional Office BLEND database, Juneau, AK 99801.

Table 16- 5. Estimated total catch (t) of BSAI non-target species groups by FMP category, 1997-2002.

Source: NORPAC observer database and year-end estimates of target species catch from the NMFS Regional Office BLEND database (see text for estimation methods).

Category	**BSAI**					
Species group	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Other						
squid	1,573.4	1,255.8	501.8	412.9	1,810.4	1,748.1
skates	17,747.4	19,317.9	14,079.8	18,876.5	20,570.5	27,214.7
sculpin	7,477.8	6,285.5	5,470.0	7,086.5	7,669.8	8,662.9
dogfish	4.1	6.4	5.0	8.9	17.3	9.4
salmon shark	6.8	18.0	30.0	23.3	24.4	46.6
sleeper shark	304.1	336.0	318.7	490.4	687.3	838.5
unid shark	52.8	136.1	176.4	67.6	35.0	63.2
octopus	248.4	189.7	326.1	418.1	227.3	418.2
Other Total	27,414.7	27,545.3	20,907.7	27,384.3	31,041.9	39,001.7
Forage						
smelts	29.8	36.6	45.3	51.7	80.1	19.4
sandfish	1.1	0.4	3.3	20.3	1.8	1.9
sticheidae	0.4	0.2	0.0	0.1	0.4	0.1
lanternfish	0.4	0.4	0.0	0.1	0.3	2.7
sandlance	0.1	0.0	0.0	0.0	0.1	0.3
gunnel	0.0	0.0	0.0	0.0	0.0	0.0
Forage Total	31.8	37.6	48.7	72.2	82.8	24.4
Non-specified						
grenadier	5,851.6	6,589.0	7,388.2	7,320.9	3,753.9	8,165.9
otherfish	1,569.2	1,362.7	1,327.3	1,458.2	1,459.9	1,282.8
jellyfish	8,849.2	7,147.5	7,153.3	10,491.2	3,861.5	1,990.3
starfish	6,191.0	3,287.2	3,051.5	3,174.0	4,221.5	5,100.2
invert unid	1,608.6	638.3	140.1	1,121.4	923.3	986.0
tunicate	1,793.7	728.1	372.0	1,055.7	1,525.3	1,401.3
sponge	530.1	500.8	321.8	164.9	245.4	333.6
benthic invert	672.7	531.4	226.4	366.0	556.4	435.5
crabs	303.8	185.9	108.9	142.7	144.2	178.6
anemone	183.0	113.7	171.5	347.2	209.2	331.7
echinoderms	44.9	24.3	30.3	42.4	43.4	33.3
snails	-	-	-	-	0.0	0.6
birds	28.7	43.5	24.4	27.0	17.4	14.5
coral	38.9	27.7	52.5	43.1	183.3	80.7
seapen/whip	2.6	2.4	5.0	5.0	8.2	43.5
shrimp	2.7	1.7	1.2	3.7	2.4	3.3
Non-specified Total	27,670.5	21,184.2	20,374.4	25,763.5	17,154.8	20,382.0
Grand Total	55,117.0	48,767.1	41,330.7	53,220.0	48,279.5	59,408.1

Table 16-6. 2001 BSAI Squid and Other species and grenadier catches (t) by fishery and gear (1=bottom trawl, 2=pelagic trawl, 6=pot, 8=longline).

2001 Area	Target Fishery	Gear	Squids	Skates	Sculpins	Shark unid.	Salmon shark	Dogfish	Sleeper shark	Octopi	Grenadier
AI	Atka mackerel	1	3.30	80.57	434.79	0	0.36	27.84	2.84	1.23	0.77
	Pacific cod	1	2.26	48.57	102.39	0	0	0.20	0	1.31	0
		6	0	0.02	41.59	0	0	0	0	16.72	0
		8	0	2184.26	1003.87	0.01	0	0.98	1.29	21.07	5.94
	Pacific cod Total		2.26	2232.85	1147.85	0.01	0	1.18	1.29	39.10	5.94
	Rockfish	1	1.87	46.41	18.81	0	0	0	0	0.06	25.34
		8	0	4.07	0	0	0	0	0	0	18.95
	Rockfish Total		1.87	50.48	18.82	0	0	0	0	0.06	44.29
	Other species	8	0	42.89	0.43	0	0	0	0	0	0.01
	Sablefish	6	0	0.06	0.01	0	0	0	0	0.02	6.42
		8	0	79.21	0.69	10.42	0	0.47	0.05	0.66	1291.65
	Sablefish Total		0	79.27	0.70	10.42	0	0.47	0.05	0.68	1298.07
	Turbot	8	0	23.18	0.03	0	0	5.93	0	0.03	111.29
	Unknown target	1	0	0.11	0.02	0	0	0	0	0	0
		8	0	0.21	0.27	0	0	0	0	0.05	0
	Unknown Total		0	0.32	0.29	0	0	0	0	0.05	0
2001 AI Total			7.44	2509.56	1602.90	10.43	0.36	35.41	4.20	41.16	1460.37
EBS	Atka mackerel	1	0	0	777.65	0	0	0	0	0	0
	Bottom pollock	1	1.65	52.30	7.69	0	0	0.01	0	0.04	0.09
		2	27.88	43.20	35.20	0	0.55	5.76	0	0.14	0.93
	B pollock Total		29.53	95.50	42.89	0	0.55	5.76	0	0.18	1.03
	Pacific cod	1	4.31	583.33	748.91	2.32	0	12.02	0.50	16.95	0
		6	0.52	0.09	315.11	0	0	0	0	140.09	0
		8	0	11932.33	1141.58	17.30	1.22	239.51	10.92	15.27	162.02
	Pacific cod Total		4.83	12515.75	2205.60	19.62	1.22	251.53	11.42	172.31	162.02
	Flatfish	1	0.18	20.09	17.89	0	0	0	0	0	0
	Rockfish	1	0.06	1.26	0.29	0	0	0	0	0	19.96
		8	0.00	0.35	0.00	0	0	0	0	0	0.46
	Rockfish Total		0.06	1.61	0.29	0	0	0	0	0	20.42
	Flathead sole	1	10.39	1752.36	744.89	0	0.17	178.93	0	5.00	102.48
	Other species	8	0	27.54	0.04	0	0	0.32	0	0	11.82
	Pelagic pollock	1	0.02	0	0	0	0	0	0	0	0
		2	1746.40	532.08	156.59	2.26	21.95	199.92	0.08	4.62	10.54
	P pollock Total		1746.42	532.08	156.59	2.26	21.95	199.92	0.08	4.62	10.54
	Rock sole	1	1.38	820.60	371.56	0	0	0	0.47	2.80	0
	Sablefish	1	0.46	1.24	0.74	0	0	0	0	0.22	0.61
		6	0	0	0	0	0	0.18	0	0.02	0.69
		8	0	114.91	0.02	0	0	1.20	0	0	682.77
	Sablefish Total		0.46	116.14	0.76	0	0	1.38	0	0.24	684.07
	Turbot	1	2.19	16.66	2.22	0	0	0	0	0.09	34.99
		8	0.00	163.88	0.35	2.66	0	13.39	0	0.07	1252.66
	Turbot Total		2.20	180.55	2.57	2.66	0	13.39	0	0.16	1287.66
	Arrowtooth	1	7.35	89.98	30.30	0	0	0.64	0	0	13.18
	Yellowfin sole	1	0.14	1908.69	1715.85	0	0.19	0	1.16	0.80	0.36
2001 EBS Total			1802.93	18060.90	6066.86	24.54	24.09	651.86	13.13	186.11	2293.56
2001 Grand Total BSAI			1810.37	20570.46	7669.76	34.97	24.45	687.27	17.33	227.28	3753.93

Table 16-7. 2002 BSAI Squid and Other species and grenadier catches (t) by fishery and gear.

Area	Target fishery	Gear	squids	skates	sculpins	shark unid	salmon shark	dogfish	sleeper shark	octopi	grenadiers
AI	Arrowtooth	H&L	0	0.41	0	0	0	0	0	0	0.05
	Atka mackerel	trawl	6.66	73.30	713.74	0	0	0	0	2.20	15.90
	Other	H&L	0	24.49	0.06	0	0	0	0	0	1.23
	Pacific cod	H&L	0	245.57	214.23	0	0	0.08	2.16	7.72	87.66
		trawl	3.87	96.98	130.67	0	0	0	0.05	9.09	8.72
	Pacific cod Total		3.87	342.55	344.89	0	0	0.08	2.21	16.81	96.37
	Rockfish	H&L	0	0.74	0.03	0	0	0	0	0	10.32
		trawl	5.04	70.52	57.91	0.62	0	0	0.00	0.48	85.09
	Rockfish Total		5.04	71.26	57.94	0.62	0	0	0.00	0.48	95.41
	Sablefish	H&L	0.07	178.49	16.02	16.46	0	0.07	2.16	3.93	2,577.31
		pot	0	0.01	0.07	0	0	0	0	0.46	10.94
	Sablefish Total		0.07	178.50	16.09	16.46	0	0.07	2.16	4.39	2,588.25
	Turbot	H&L	0	4.95	0.01	0	0	0	0	0	10.13
2002 AI Total			15.65	695.46	1,132.73	17.08	0	0.15	4.37	23.89	2,807.35
EBS	Arrowtooth	H&L	0	0.08	0	0	0	0	0	0	2.91
		trawl	11.32	81.55	12.78	0	0	0	0.49	0.23	11.89
	Arrowtooth Total		11.32	81.63	12.78	0	0	0	0.49	0.23	14.80
	Atka mackerel	trawl	0	0	0.27	0	0	0	0	0	0
	Flatheadsole	trawl	5.48	2,960.60	1,183.41	0	7.45	0	42.56	1.31	93.39
	Flatheadsole Total		5.48	2,960.60	1,183.41	0	7.45	0	42.56	1.31	93.39
	Other	H&L	0	6.68	0.23	0	0	0	0.05	0.02	0
		trawl	0	8.82	0.68	0	0	0	0	0	0
	Other Total		0	15.49	0.92	0	0	0	0.05	0.02	0
	OtherFlats	trawl	1.04	58.48	16.99	0	1.08	0	12.42	0.48	1.74
	Pacific cod	H&L	0	17,507.14	1,382.54	22.26	10.20	8.42	250.13	76.20	336.29
		pot	0	0	384.44	0	0	0	0.06	254.41	0
		trawl	1.41	1,303.42	925.31	3.47	0.14	0.75	10.44	30.43	0
	Pacific cod Total		1.42	18,810.57	2,692.29	25.72	10.35	9.17	260.63	361.03	336.29
	Pollock	trawl	1,708.49	869.76	199.46	2.27	27.48	0.03	148.69	8.14	6.48
	Rock sole	trawl	0.03	909.44	416.99	0	0	0	0	18.37	0
	Rockfish	H&L	0	0.10	0	0	0	0	0.03	0	0.37
		trawl	3.67	7.62	0.59	0	0	0	0	0.04	12.44
	Rockfish Total		3.67	7.72	0.59	0	0	0	0.03	0.04	12.81
	Sablefish	H&L	0	57.06	0	0	0	0	0.14	0	340.05
		pot	0	0	0.40	0.38	0	0	1.25	3.81	4.30
	Sablefish Total		0	57.07	0.40	0.38	0	0	1.39	3.81	344.35
	Turbot	H&L	0	264.45	2.62	17.74	0	0	367.30	0.05	4,542.50
		pot	0	0	0	0	0	0	0.03	0	0.24
		trawl	0.89	7.76	0.85	0	0	0	0.18	0.02	5.94
	Turbot Total		0.89	272.22	3.46	17.74	0	0	367.51	0.07	4,548.69
	Yellowfinsole	trawl	0.16	2,476.27	3,002.58	0	0.27	0	0.38	0.84	0
2002 EBS Total			1,732.49	26,519.26	7,530.13	46.12	46.63	9.20	834.15	394.35	5,358.56

2002 Grand Total	1,748.14	27,214.72	8,662.86	63.20	46.63	9.35	838.52	418.24	8,165.90

Table 16- 8. Estimated biomass (t) of BSAI squid and other species from various AFSC surveys.

EBS shelf survey biomass estimates					EBS slope survey biomass estimates				
Year	**Sharks**	**Skates**	**Sculpins**	**Octopi**	**Year**	**Sharks**	**Skates**	**Sculpins**	**Octopi**
1975	0	24,349	111,160	6,129					
1976									
1977									
1978									
1979	692	58,147	284,228	30,815	1979	0	3,056	4,555	729
1980									
1981					1981	1	2,743	5,372	234
1982	0	164,084	340,877	12,442	1982	23	2,723	3,261	180
1983	379	161,041	292,025	3,280					
1984	0	186,980	252,259	2,488					
1985	47	149,576	182,469	2,582	1985	314	3,329	2,316	152
1986	0	251,321	303,671	480					
1987	223	346,691	195,501	7,834					
1988	4,058	409,076	233,169	9,846	1988	1,967	3,271	4,944	138
1989	0	410,119	215,666	4,979					
1990	0	534,556	219,020	11,564					
1991	0	448,458	272,653	7,990	1991	2,635	4,031	2,449	61
1992	2,564	390,466	239,947	5,326					
1993	0	375,040	215,922	1,355					
1994	5,012	414,235	260,994	2,183					
1995	1,005	391,768	218,693	2,779					
1996	2,804	423,913	187,817	1,746					
1997	37	393,716	215,766	211					
1998	2,378	354,188	197,675	1,225					
1999	2,079	370,543	146,185	832					
2000	1,487	325,292	161,350	2,041	2000	*pilot survey, no official biomass estimate*			
2001	0	419,508	143,368	5,357					
2002	5,527	405,362	174,807	2,423	2002	25,445	69,275	6,409	979
2003	745	393,036	202,602	8,413					

AI trawl survey estimates

Year	Sharks	Skates	Sculpins	Octopi	Squid	Grenadiers
1980	800	10,123	33,624	757	16,461	322,409
1983	0	16,259	24,570	440	20,786	364,110
1986	0	19,491	32,211	781	25,982	618,102
1991	2,927	14,987	15,904	1,148	28,935	24,597
1994	421	24,964	17,192	1,728	11,082	33,669
1997	2,497	28,902	13,680	1,219	2,677	71,505
2000	2,663	29,206	13,037	775	2,675	219,694
2002	1,557	34,412	14,248	1,384	2,087	218,147

Table 16- 9. Research catches of squid and other species in the BSAI, 1977-1998 (tons).

	Skates			Sharks			Sculpins			Octopus			Squid		
Year	EBS	AI	BSAI	EBS	AI	BSAI	EBS	AI	BSAI	EBS	AI	BSAI	EBS	AI	BSAI
1977	0.97	-	0.97	0.00	-	0.00	5.80	-	5.80	0.10	-	0.10	0.00	-	0.00
1978	2.48	-	2.48	-	-	-	11.80	-	11.80	0.30	-	0.30	0.09	-	0.09
1979	5.63	-	5.63	0.03	-	0.03	19.15	-	19.15	2.11	-	2.11	9.10	-	9.10
1980	4.31	6.21	10.52	0.00	0.30	0.30	10.40	13.90	24.30	0.38	0.85	1.23	0.01	19.77	19.78
1981	9.60	-	9.60	0.07	-	0.07	17.19	-	17.19	1.08	-	1.08	7.45	-	7.45
1982	16.17	0.83	17.00	0.16	0.02	0.18	23.68	2.92	26.60	1.00	0.24	1.24	9.61	0.00	9.61
1983	8.86	6.21	15.07	0.01	0.26	0.27	18.67	12.27	30.94	0.16	0.15	0.32	0.06	14.86	14.92
1984	8.01	-	8.01	-	-	-	12.01	-	12.01	0.08	-	0.08	0.00	-	0.00
1985	19.57	-	19.57	0.59	-	0.59	19.91	-	19.91	0.64	-	0.64	4.87	-	4.87
1986	8.41	8.58	16.98	-	2.21	2.21	10.96	15.93	26.90	0.02	0.14	0.15	0.00	13.64	13.64
1987	13.04	-	13.04	0.01	-	0.01	7.42	-	7.42	0.27	-	0.27	0.01	-	0.01
1988	21.26	-	21.26	1.06	-	1.06	17.02	-	17.02	0.53	-	0.53	1.03	-	1.03
1989	23.47	-	23.47	0.07	-	0.07	11.79	-	11.79	0.32	-	0.32	0.05	-	0.05
1990	23.43	-	23.43	0.00	-	0.00	14.84	-	14.84	0.30	-	0.30	0.40	-	0.40
1991	27.01	3.18	30.19	0.56	0.52	1.09	20.58	3.24	23.82	0.36	0.32	0.68	0.69	2.26	2.94
1992	11.93	-	11.93	0.09	-	0.09	8.07	-	8.07	0.20	-	0.20	0.00	-	0.00
1993	15.27	-	15.27	-	-	-	9.00	-	9.00	0.07	-	0.07	0.01	-	0.01
1994	15.58	6.53	22.11	0.17	0.13	0.31	10.50	5.15	15.65	0.09	0.43	0.52	0.04	2.72	2.76
1995	13.78	-	13.78	0.04	-	0.04	8.51	-	8.51	0.12	-	0.12	0.01	-	0.01
1996	15.31	-	15.31	0.10	-	0.10	6.96	-	6.96	0.07	-	0.07	0.04	-	0.04
1997	15.39	5.63	21.02	0.11	0.42	0.52	8.01	2.53	10.54	0.01	0.22	0.23	0.07	0.44	0.51
1998	14.10	-	14.10	0.09	-	0.09	7.54	-	7.54	0.05	-	0.05	0.02	-	0.02
SUM	293.58	37.17	330.75	3.16	3.86	7.01	279.83	55.93	335.76	8.25	2.35	10.60	33.54	53.69	87.23

Table 16- 10. Published annual natural mortality (M) estimates for other species groups

group	species	estimate	reference
squid	*Todarodes pacificus*	0.4308	Osako and Murata, 1983
octopus	*Octopus vulgaris*	0.5	Sato and Hatanaka, 1983
smelt	*Mallotus villosus*	0.42	Anderson, 1990
sculpin			none found
skate	*Raja erinacea*	0.4	Sosebee, 1998
shark	*Squalus acanthias*	0.094	Anderson, 1990
		0.09	Sosebee, 1998
	Lamna nasus	0.18	Anderson, 1990

Table 16- 11. Recommended BSAI ABC and OFL by species group. These are Tier 5 estimates based on the sum of the following three biomass estimates: EBS shelf survey 10 year average by species group, EBS slope survey 10 year average by species group, and AI survey 10 year average by species group. Note that the EBS slope survey 10 year average actually only includes the 2002 survey because the 2000 survey was not designed for official biomass estimation.

	Sharks	Skates	Sculpins	Octopi
Avg Biomass	29,337	483,791	211,874	4,977
M	0.09	0.10	0.15	0.30
BSAI ABC	**1,980**	**36,284**	**23,836**	**1,120**
BSAI OFL	**2,640**	**48,379**	**31,781**	**1,493**

Table 16-11, continued. Potential ABC and OFL for species groups within the Other species complex based on Tier 6 criteria applied to group specific catches estimated in Other species stock assessments between 1992-2002. This information is provided at the request of the Plan Team.

TIER 6 ESTIMATES based on 1992-2002 average catch	Sharks	Skates	Sculpins	Octopi
EBS ABC	386	12,110	4,481	212
AI ABC	48	1,711	1,263	66
BSAI ABC	434	13,821	5,744	278
EBS OFL	514	16,147	5,975	283
AI OFL	65	2,281	1,684	88
BSAI OFL	579	18,428	7,659	371