APPENDIX

# Sharks in the Gulf of Alaska, Eastern Bering Sea, and Aleutian Islands

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## Executive Summary

Sharks are managed as part of the Other Species complex in both the GOA and BSAI FMP's. Projections and harvest alternatives for Other Species are provided in the Other Species assessment reports for the GOA and BSAI. This report summarizes available assessment data for shark species in the Gulf of Alaska, Eastern Bering Sea, and Aleutian Islands. It is intended to provide resource managers and fisheries researchers with information on the incidental catch, abundance trends, distribution, and independently estimated life history parameters for shark species from these regions. In the past, these data have been irregularly available in separate SAFE documents for the GOA and BSAI.

Incidental catches were estimated from NMFS Alaska Regional Office data from 1997 – 2004 and from NMFS North Pacific Observer Program data (Gaichas et al. 1999, Gaichas 2001 and 2002). Survey data on these species were available from NMFS AFSC bottom trawls in the Gulf of Alaska (1984 – 2003), EBS shelf (1975 – 2004), EBS slope (historical 1979-1991, and new time series 2002, 2004), and Aleutian Islands (1979 – 2002); IPHC longline surveys in the GOA and PWS (1994-2003); ADF&G sablefish longline surveys in PWS (1996-2003).

Reported total incidental catches of Other Species have been relatively small in the GOA (averaging less than 3% of total catch from 1977- 1998) and in the BSAI (approximately 1.5% of

total catch in 2001). From 1997 – 2001, shark catches composed from 19% to 32% and from 1.3% to 2.5% of estimated Other Species total catches in the GOA and BSAI respectively. In the GOA, spiny dogfish composed 42% of total shark catch, Pacific sleeper sharks 25%, unidentified sharks 26%, salmon sharks 6%, Blue sharks, sixgill sharks, and brown cat sharks were rarely identified in catches. In the BSAI, Pacific sleeper sharks composed 78% of total shark catch, unidentified sharks 17%, salmon shark 3.7%, and spiny dogfish 1.5%.

There are currently no directed commercial fisheries for shark species in federally or state managed waters of the GOA or BSAI and most incidentally captured sharks are not retained. Spiny dogfish are allowed as retained bycatch in some ADF&G managed salmon fisheries, and salmon sharks are targeted in some ADF&G managed sport fisheries. Incidental catches of shark species in the GOA and BSAI fisheries have been very small compared to catch rates of target species. Preliminary comparisons of incidental catch estimates with available biomass estimates suggest that current levels of incidental catches are low relative to available biomass for spiny dogfish and Pacific sleeper sharks in the GOA and for Pacific sleeper sharks in the BSAI. There is also an increasing trend in bottom trawl survey biomass estimates (used here as an index of relative abundance) for Pacific sleeper sharks and perhaps for spiny dogfish in the GOA. An independent analysis of NMFS AFSC bottom trawl surveys in the Gulf of Alaska found that Pacific sleeper shark abundance had significantly increased in the central Gulf of Alaska during 1984 - 1996 (Mueter and Norcross 2002). Salmon sharks are rarely captured in the GOA or BSAI in either the fishery or the bottom trawl surveys. However, a recent demographic analysis suggests that salmon shark populations in the eastern and western North Pacific are stable at this time (Goldman 2002-b). Spiny dogfish are rarely captured in the BSAI in either the fishery or the bottom trawl surveys. Other shark species are rarely captured and incidental catches are not to likely play a significant role in their stock structure because catches were small and generally occurred near the edge of their ranges.

Since the late 1990's, the Scientific and Statistical Committee (SSC) of the North Pacific Fisheries Management Council (NPFMC) has suggested that sharks along with skates and many rockfishes warrant particular concern because of their late maturity, low productivity, long life spans, and low reproductive rates. The SSC has noted that these life history characteristics make these species especially vulnerable to overfishing and that they should be evaluated separately to ensure appropriate conservation and protection within the current management system. A Non-Target Species Committee of the NPFMC is currently working on developing appropriate conservation actions for non-target species and species complexes within the current FMP framework and this report intends to provide guidance.

## Management of sharks in the GOA and BSAI

Sharks are currently managed in aggregate as part of an "Other Species" complex in both the GOA and BSAI Fishery Management Plans (FMP's) (Gaichas et al. 1999, Gaichas 2003). Other Species are considered ecologically important and may have future economic potential; therefore an aggregate annual quota limits their catch. Under the current GOA FMP, the Other Species complex includes sharks, sculpins, smelts, octopi, and squids. Skates were separated from the GOA Other Species complex in 2003 (Gaichas et al. 2003). The TAC for the GOA Other Species complex is set in aggregate at 5% of the sum of the TAC's of managed GOA species. Under the current BSAI FMP, the Other Species complex includes sharks, skates, sculpins and octopus, and is managed in aggregate under an interim management policy. The rational for managing Other Species in aggregate under alternative management strategies is that the Tier-6 criteria for establishing ABC and OFL requires a reliable catch history from 1978-1995 which does not exist for most individual species or species groups within the Other Species complexes prior to 1990. Similarly reliable point estimates for biomass and natural mortality, required for management under Tier-5 criteria, also do not exist for most of the individual species or species groups within the Other Species complexes.

## Life History Information

Shark species known or suspected to occur from AFSC survey and fishery observer catch records in the BSAI and GOA are listed in Table 1. Information on distribution, stock structure, and life history characteristics for sharks in the GOA and BSAI is extremely limited. 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 (Holden 1974 and 1977, Compagno 1990, Hoenig and Gruber 1990). Shark reproductive strategies in general 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, Hoff and Musick 1990, Castro et al. 1999). The three shark species most likely to be encountered in GOA and BSAI fisheries are the Pacific sleeper shark, *Somniosus pacificus*, the piked or spiny dogfish, *Squalus acanthias*, and the salmon shark, *Lamna ditropis*.

### Pacific Sleeper Sharks

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. 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).

### Spiny Dogfish

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(BC) than in the Gulf of Alaska (Hart 1973, Ketchen 1986, Mecklenburg 2002). This species may once have been the most abundant living shark. However, it is commercially fished worldwide, and has been heavily depleted in many locations. The population structure of spiny dogfish in the North Pacific is unknown. Complex population structure characterizes spiny dogfish stocks in other areas. Tagging studies show separate migratory stocks that mix seasonally on feeding grounds in the UK. BC and Washington state have both local and migratory stocks that don't mix (Compagno 1984, McFarlane and King 2003). In some areas, 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 that enter shallow bays to pup.

While all parameters may vary by population, British Columbia female spiny dogfish are reported to mature at 35 years, and males at 19 (Saunders and McFarlane 1993). Historic estimates of the age at 50% maturity for the eastern North Pacific range from 20 to 34 years.

However, ages from the spines of oxytetracycline-injected animals provided validation of an age-length relationship and indicate that 50% sexual maturity occurs at 35.3 years of age (Beamish and McFarlane 1985, McFarlane and Beamish 1987). The same study suggested that longevity in the eastern North Pacific is between 80 and 100 years, and stated that several earlier published ages at maturity, and therefore longevity, were low due to the rejection of difficult to read spines and the grouping of annuli that were very close together. Based on this life history information, there is a generation time of 42 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).

This species is ovoviviparous with gestation periods of 18-24 months. The majority of biological knowledge of spiny dogfish is based on controlled laboratory experiments, stock assessments, and field biology conducted in the North Atlantic and European waters (Tsang and Callard 1987, da Silva and Ross 1993, Polat and Guemes 1995, Rago et al. 1998, Koob and Callard 1999, Jones and Ugland 2001, Soldat 2002, Stenberg 2002). Little research has been conducted in the North Pacific waters. Ketchen (1972) reported timing of parturition in BC to be October through December, and in the Sea of Japan it was reported to occur between February and April (Yamamoto and Kibezaki 1950, Sato and Inukai 1934, Anon 1956, Kaganovskaia 1937). Washington State spiny dogfish have a long pupping season, which peaks in October and November (Tribuzio 2004). Pupping is believed to occur in estuaries and bays (Richards 2004) or mid-water over depths of about 90-200fm (Ketchen 1986). Immature juveniles tend to inhabit the water column near the surface and are not available to the targeted fishery until they mature and descend to the benthos (Beamish et al. 1982). The average litter size for spiny dogfish in Puget Sound, WA is 6.9 pups (Tribuzio 2004) and 6.2 for BC (Ketchen 1972). The number of pups per female also increases with the size of the female with estimates ranging from 0.20 – 0.25 more pups for every centimeter in female length from the onset of maturity (Ketchen 1972, Richards 2004, Tribuzio 2004).

Dogfish have been shown to be opportunistic feeders (Alverson and Stansby 1963), not wholly dependent on one food source. Only the smallest dogfish are limited to consuming smaller fish and invertebrates, while the larger animals will eat a wide variety of foods (Bonham 1954). Diet changes are consistent with the changes of the species assemblages in the area by season (Laptikhovsky et al. 2001), and they eat twice as much in the summer than winter (Jones and Geen 1977). Spiny dogfish have also been shown to prey heavily on outmigrating salmon smolts (Beamish et al. 1992). In general, feeding studies on spiny dogfish show that they are generalists, eating anything from snails and clams to salmon, and even scavenging the remains of discarded dogfish.

### Salmon Sharks

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 as high as 21.2 ºC above ambient water temperatures, and appear to maintain a constant body core temperature regardless of ambient temperatures (Goldman 2002-b, Goldman et al. in press). Salmon sharks have been both considered a nuisance for eating salmon and damaging fishing gear (Macy et al. 1978, 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.

Salmon sharks occur in both the near-shore and oceanic environments. Adult salmon sharks typically range in size from 180-210 cm PCL (where TL = 1.1529•PCL + 15.186, from Goldman 2002-b) for eastern North Pacific (no conversions are given in the literature for salmon sharks in the western North Pacific), and can weigh upwards of 220 kg. Reported lengths of 260 cm PCL (>300 cm TL) and greater with weights exceeding 450 kg are unsubstantiated (Goldman and Musick in press-a). Length-at-maturity in the western North Pacific (WNP) has been estimated to occur at approximately 140 cm PCL (age five) for males and 170-180 cm PCL (ages eight to ten) for females (Tanaka 1980). Length-at-maturity in the eastern North Pacific (ENP) has been estimated to occur between 125-145 cm PCL (age three to five) for males and between 160-180 cm PCL (age six to nine) for females (Goldman 2002-b, Goldman and Musick in press-b).

In addition to length and age-at-maturity, growth rates and weight-at-length of *L. ditropis* also differ between males and females from ENP and the WNP. Tanaka (1980, also see Nagasawa 1998) states that maximum age from vertebral analysis for WNP *L. ditropis* is at least 25 years for males and 17 for females, and that the growth coefficient (k) for males and females are 0.17 and 0.14 respectively. Goldman (2002-b) and Goldman and Musick (in press-b) gave maximum ages for ENP *L. ditropis* (also from vertebral analysis) of 17 years for males and 20 years for females, with growth coefficients of 0.23 and 0.17 for males and females, respectively. Longevity estimates are similar (20-30 years) for the ENP and WNP. Salmon sharks in the ENP and WNP attain the same maximum length (approximately 215cm PCL for females and about 190 cm PCL for males). However, males past approximately 140 cm PCL and females past approximately 110 cm PCL in the ENP are of a greater weight-at-length than their same-sex counterparts in the WNP (Goldman 2002-b, Goldman and Musick in press-b).

The reproductive mode of salmon sharks is ovoviviparous and includes an oophagous stage (Gilmore 1993, Tanaka 1986 cited in Nagasawa 1998). Litter size in the western Pacific is four to five pups and litters have been reported to be male dominated 2.2:1 (Nagasawa 1998), but this is from a very limited sample size. The number of pups and sex ratio of eastern North Pacific litters is currently unknown. Gestation times throughout the North Pacific appear to be nine months with mating occurring during the late summer and early fall, and parturition occurring in the spring (Tanaka 1980, Nagasawa 1998, Goldman 2002-b, Goldman and Human 2004, Goldman and Musick in press-b). Size at parturition is between 60-65 cm PCL in both the ENP and WNP (Tanaka 1980, Goldman 2002-b, Goldman and Musick in press-b).

In the WNP, a salmon shark pupping and nursery ground may exist just north of the transitional domain in oceanic waters. According to Nakano and Nagasawa (1996), larger juveniles than term (70-110cm PCL) were caught in waters with SST's of 14º-16ºC with adults occurring in colder waters further north. Another pupping and nursery area appears to range from southeast Alaska to northern Baja California, Mexico, in the ENP (Goldman and Musick in press-a & b).

Salmon sharks are opportunistic feeders, sharing the highest trophic level of the food web in subarctic Pacific waters with marine mammals and seabirds (Brodeur 1988, Nagasawa 1998, Goldman and Human 2004). They feed on a wide variety of prey including salmon (Oncorhynchus), rockfishes (Sebastes), sablefish (Anoplopoma fimbria), lancetfish (Alepisaurus), daggerteeth (Anotopterus), lumpfishes (Cyclopteridae), sculpins (Cottidae), Atka mackerel

(Pleurogrammus), mackerel (Scomber), pollock and tomcod (Gadidae), herring (Clupeidae), spiny dogfish (Squalus acanthias), tanner crab (Chionocetes), squid and shrimp (Sano 1960 & 1962, Farquhar 1963, Hart 1973, Urquhart 1981, Compagno 1984 and 2001, Nagasawa 1998). Bycatch in the central Pacific has been significantly reduced since the elimination of the drift gillnet fishery and the population appear to have rebounded to its former levels (Yatsu 1993, H. Nakano pers. comm.). Additionally, the most recent demographic analysis support the contention that salmon shark populations in the eastern and western North Pacific are stable at this time (Goldman 2002-b).

## Fishery Information

There are currently no directed commercial fisheries for shark species in federally or state managed waters of the GOA or BSAI and most incidentally captured sharks are not retained. Spiny dogfish are allowed as retained bycatch in some ADF&G managed salmon fisheries, and salmon sharks are targeted in some ADF&G managed sport fisheries.

### NMFS bycatch data

Aggregate incidental catches of the Other Species management category from federally prosecuted fisheries for Alaskan groundfish in the GOA and BSAI are tracked in-season by the NMFS Alaska Regional Office in Juneau (Tables 2 and 3). Other Species reported catches have been relatively small each year since 1977 in the GOA (averaging less than 3% of total catch from 1977 – 1998, Gaichas et al. 1999) and BSAI (e.g., in 2001 Other Species catches of 25,482 tons made up 1.5% of the 1,652,802 ton total BSAI catch). The Other Species management category is not broken out by species at the Regional Office and interpretation of Other Species reported catches by species is complicated by the changes to these management categories, which have occurred over time (Gaichas et al. 1999, Gaichas 2002).

This report summarizes incidental shark catches by species as two data time series (1990 – 1996, and 1997 – 2002). These time series are not directly comparable because different methods were used to estimate incidental catch. After 2002 it was no longer possible to estimate Other Species incidental catches by species using either of these methods because of changes made to the structure of the NMFS Regional Office blend database.

Annual Other Species catches by species must be estimated independently using data reported by fishery observers. Gaichas et al. (1999) estimated catches by species group and catches by species for sharks (reported in this document) for the domestic fishery, 1990 - 1998, using the following method: each year's observed catch by species group was summed within statistical area, gear type, and target fishery. The ratio of observed Other Species group catch to observed target species catch was multiplied by the Regional Office blend-estimated target species catch within that area, gear, and target fishery (Table 4). Other Species annual total catches estimated in this manner were generally lower than Regional Office reported catches of Other Species due to both targeting assignment discrepancies and gear strata with no observer coverage (i.e., jig gear fisheries, Gaichas et al. 1999). Direct application of this method to estimate Other Species catches using foreign and joint venture observer data is not possible due to differences in database structure. Consequently, incidental catches for sharks by species are not available prior to the beginning of the domestic observer program in 1990. Using the Gaichas et al (1999) pseudo-blend estimates from 1990 – 1998 in the GOA, spiny dogfish composed 49% of total shark catch, Pacific sleeper sharks 19%, salmon sharks 12%, and unidentified sharks 18%, and Blue sharks, sixgill sharks, and brown cat sharks were rarely identified in catches (Table 4).

Gaichas (2001, 2002) used a new pseudo-blend method to estimate species group catches, and catches by species for sharks (reported in this document) within the Other Species complex in the BSAI and GOA for 1997-2001. In the new pseudo-blend method, 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 NMFS Alaska 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 Regional Office blend-estimated target species catch within that area, gear, and target fishery (Tables 5 and 6). This method more closely matched the Regional Office blend catch estimation system and is considered more accurate and an improvement over the previous pseudo-blend method. However, because the pseudo-blend catch estimates from Gaichas et al (1999) and Gaichas (2001, 2002) were not identical (e.g., compare years 1997 and 1998 in Tables 4 and 5), the time series 1990 – 1996 and 1997 – 2001 are presented separately and are not comparable.

Using the improved Gaichas (2001, 2002) pseudo-blend estimates from 1997 – 2001 in the GOA, shark catches composed from 19% to 32% of estimated Other Species total catches and spiny dogfish composed 42% of total shark catch, Pacific sleeper sharks 25%, unidentified sharks 26%, salmon sharks 6%, Blue sharks, sixgill sharks, and brown cat sharks were rarely identified in catches (Table 5).

Using the improved Gaichas (2001, 2002) pseudo-blend estimates from 1997 – 2001 in the BSAI, shark catches composed from 1.3% to 2.5% of estimated Other Species total catches and Pacific sleeper sharks composed 78% of total shark catch, unidentified sharks 17%, salmon shark 3.7%, and spiny dogfish 1.5% (Table 6). An additional year (2002) of shark catch by species and statistical area is also available and reported in this document (Tables 16, 18, 20 and 22).

The size distribution of vessels fishing in the GOA results in approximately 30% observer coverage overall, although some target fisheries (ie. rockfish) are prosecuted on larger vessels with 100% observer coverage. 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 the GOA. Because observer assignment to vessels is not at random, there is a possibility that this assumption is incorrect. The same assumption applies in the BSAI although a higher percentage of the fishery is prosecuted on larger vessels with 100% coverage.

From 1990 – 1996 in the GOA pseudo-blend estimates (Gaichas et al. 1999), spiny dogfish were caught primarily with flatfish trawl (35%), sablefish longline (23%), and pollock trawl (18%) in NMFS statistical and reporting area 630 (83%, Tables 7 and 15, Figure 1). Pacific sleeper sharks were caught primarily with pollock trawl (52%) and sablefish longline (21%) in areas 630 (43%), 620 (38%), and 610 (11%, Tables 9 and 17, Figure 2). Salmon sharks were caught primarily with pollock trawl (85%) in areas 630 (49%), 620 (41%), and 610 (9%, Tables 11 and 19, Figure 3). Incidental catches of other and unidentified shark species were rare in the GOA from 1990 –1996 (Tables 13 and 21).

From 1997 – 2002, in the GOA improved pseudo-blend estimates (Gaichas 2001, 2002), spiny dogfish were caught primarily with Pacific cod longline and trawl (42%), sablefish longline

(20%), flatfish trawl (18%), and rockfish longline (17%) in areas 630 (45%), 640 (29%), and 650 (22%, Tables 8 and 16, Figure 1). Pacific sleeper sharks were caught primarily with Pacific cod longline (61%) and pollock trawl (25%) in areas 630 (60%), 620 (23%), and 610 (14%, Tables 10 and 18, Figure 2). Salmon sharks were caught primarily with pollock trawl (66%) in areas 630 (55%), 620 (25%), and 610 (16%, Tables 12 and 20, Figure 3). Incidental catches of other and unidentified shark species were rare in the GOA except for a large catch in 1998 with sablefish longline gear in area 659 (Tables 14 and 22).

From 1997 – 2002 in the BSAI improved pseudo-blend estimates (Gaichas 2001, 2002), Pacific sleeper sharks were caught primarily with Pacific cod longline (30%), pollock trawl (26%), turbot longline (17%), flatfish trawl (12%), and sablefish longline (10%) in areas 521 (57%) and 517 (20%, Tables 24 and 28, Figure 5). There appears to be an increasing trend in bycatch of Pacific sleeper sharks from BSAI area 521 from 1997 – 2003 (Figure 5). Catches of spiny dogfish, salmon shark, and other shark were rare in the BSAI (Tables 23, 25 - 27, 29, and 30, Figures 4 and 6).

## Survey Data

### NMFS AFSC Bottom Trawl Surveys

NMFS AFSC bottom trawl survey biomass estimates are available for shark species in the GOA (1984 – 2003), Eastern Bering Sea (EBS) shelf (1979 – 2004), EBS slope (historical 1979-1991 and new time series 2002, 2004), and Aleutian Islands (AI, 1979 – 2002, Table 31). Where available, individual species biomass trends were evaluated for the three most commonly encountered shark species (spiny dogfish, Pacific sleeper shark, and salmon shark). Sharks may not be well sampled by bottom trawl surveys (as evidenced by the high uncertainty in many of the biomass estimates). The efficiency of bottom trawl gear also varies by species and trends in these biomass estimates should be considered at best a relative index of abundance and of distribution for shark species until more formal analyses of survey efficiencies by species can be conducted. In particular, pelagic shark species such as salmon sharks are encountered by the trawl gear while it is not in contact with the bottom, either on the way down or on the way up. Biomass estimates are based, in part, on the amount of time the net spends in contact with the bottom; consequently, bottom trawl survey biomass estimates for pelagic species are unreliable. Spiny dogfish are patchily distributed and their distribution may vary seasonally both geographically and within the water column. This can result in highly uncertain biomass estimates. Pacific sleeper sharks are large animals and may be able to avoid the bottom trawl gear. In addition, biomass estimates for Pacific sleeper sharks are often based on a very small number of individual hauls within a given survey and a very small number of individual sharks within a haul. Consequently, these biomass estimates are also highly uncertain.

GOA bottom trawl survey biomass estimates are available from 1984 – 2003. Analysis of GOA biomass trends is subject to the following caveats regarding the consistency of the survey time series. Survey efficiency in the GOA may have increased for a variety of reasons between 1984 and 1990, but should be stable after 1990 (Gaichas et al. 1999). Surveys in 1984, 1987, and 1999 included deeper strata than the 1990 - 1996 surveys; therefore the biomass estimates for deeper-dwelling species are not comparable across years. The 2001 survey did not include all areas of the Eastern GOA and consequently, the 2001 survey may not be comparable with the other surveys for species such as spiny dogfish which appear to be relatively abundant in the Eastern GOA.

From 1984 – 2003 in the GOA bottom trawl surveys, there is an increasing biomass trend for the shark species group as a result of increases in spiny dogfish and sleeper shark biomass between 1990 and 2003 (Tables 31 and 32, Figure 7). An independent analysis of NMFS AFSC bottom trawl surveys in the Gulf of Alaska found that Pacific sleeper shark abundance had significantly increased in the central Gulf of Alaska during 1984 - 1996 (Mueter and Norcross 2002). Salmon shark biomass has been stable to decreasing according to this survey, but salmon sharks are pelagic and unlikely to be well sampled by a bottom trawl. Both salmon shark and Pacific sleeper shark biomass estimates are also based on a very small number of individual hauls in a given survey (Table 32). No salmon sharks were encountered in either the 1999 or 2000 survey. Spiny dogfish were captured in a relatively large number of hauls each year. However, spiny dogfish distributions in the GOA water column are not well known and may affect biomass estimation. In particular, if spiny dogfish are caught off the bottom, then biomass estimates may be unreliable and should be considered at best a relative index of abundance and distribution. However, because spiny dogfish are captured in a large number of hauls each year, the NMFS AFSC bottom trawl surveys in the Gulf of Alaska may be useful for determining the relative proportion of spiny dogfish biomass by area in the Gulf of Alaska and this type of analysis should be conducted in the future.

EBS shelf bottom trawl survey biomass estimates are available from 1979 – 2004. Analysis of EBS shelf biomass trends is subject to following time series caveats. The EBS shelf survey started as a crab survey in the 1960's. The survey was standardized in 1982 to its current gear type, fixed stations, and survey time period (June 1 – August 4). Prior to 1982, the set of survey stations varied greatly, and prior to 1979 the set of survey stations was very small. Consequently, surveys from 1982 to the present may be useful for identifying trends in relative abundance of commonly encountered species, while surveys between 1979 and 1982 should only be used for identifying the relative distribution of species (Gary Walters, personal communication).

From 1979 – 2004 in the EBS shelf bottom trawl surveys, shark catches were very rare and there does not appear to be any biomass trend for shark species (Tables 31 and 33, Figure 8). Catches of Pacific sleeper sharks and spiny dogfish are so rare in the EBS shelf survey that relative abundance tends are probably unreliable (as evidenced by the high uncertainty in the biomass estimates). Salmon sharks were only captured in one haul during the entire time series of the EBS shelf survey.

EBS slope bottom trawl survey biomass estimates are available from 1979 – 2004. Analysis of EBS slope survey biomass trends is subject the following time series caveats. The slope survey was standardized in 2002 to its current gear type, survey strata, and survey design. Because the survey stratification changed in 2002, biomass estimates are not comparable between the historical EBS slope survey (1979 – 1991) and the new slope survey biomass (2002 and 2004). In addition, prior to 2002, the survey utilized a mix of commercial and research vessels with various gear configurations. Consequently, surveys from 2002 and 2004 may be useful for estimating relative abundance of commonly encountered species, while surveys between 1979 and 1991 should only be used for identifying the relative distribution of species (Gary Walters, personal communication).

From 1979 – 1991 in the historical EBS slope bottom trawl surveys there was an increasing biomass trend for sleeper sharks (Tables 31 and 34). However, catches of Pacific sleeper sharks and spiny dogfish are so rare that relative abundance trends are probably unreliable for these species (as evidenced by the high uncertainty in the biomass estimates). Salmon sharks were not captured in the historical EBS slope survey (1979 – 1991).

In the 2002 and 2004 EBS slope bottom trawl surveys, a substantial biomass of Pacific sleeper sharks was reported (Tables 31 and 34, Figure 9). Until the 2000 EBS slope pilot slope survey, it was thought that bottom trawl surveys did not adequately sample large shark species such as Pacific sleeper sharks. However, Pacific sleeper sharks were the third highest CPUE on the 2000 EBS slope pilot slope survey (Gaichas 2002). This recent information suggests that Pacific sleeper sharks can be sampled by bottom trawls and that differences in the location and timing of EBS trawl surveys may result in differing biomass estimates for sharks in the EBS. Changes in distribution of particular species may also account for some of the biomass fluctuations. It should be noted that most of the sharks captured in the 2002 survey probably came from one or two large tows (as evidenced by the high uncertainty in the biomass estimate) and that the 2004 biomass estimate which comes from more hauls is probably a more reliable biomass estimate. It should also be noted, that even the very large biomass estimate in 2002 was only based upon the capture of 148 individual sharks. This may be a relatively low number of individuals compared to the numbers of individuals commonly captured for assessed fish species. Spiny dogfish and salmon sharks were not captured in the new EBS slope survey (2002, 2004).

AI bottom trawl survey estimates are available from 1980 – 2002. From 1980 – 2002 in the AI bottom trawl surveys, shark catches have been relatively rare and there does not appear to be any biomass trends for shark species (Tables 31 and 35, Figure 10). As with the EBS shelf survey, spiny dogfish and Pacific sleeper shark catches are so rare in the AI survey that relative abundance tends are probably unreliable (as evidenced by the high uncertainty in the biomass estimates). Salmon sharks were only captured in one haul during the entire time series of the AI survey.

NMFS bottom trawl research catches of sharks from the GOA, EBS and AI between 1977 and 2004 are listed in Table 36.

**IPHC Longline Surveys Gulf of Alaska and Prince William Sound**

The International Pacific Halibut Commission (IPHC) conducts an annual halibut longline survey (5-7 skates per set, 67-106 hooks per skate) at standard index stations. The timing of the survey varies among years between the end of May and early September, which may affect shark bycatch. The 10 years of bycatch data are summarized herein as 2 data sets, 1994-1996 and 1997-2003, and expressed as number of sharks per 100 hooks. Comparison problems stem from changes in the method of data collection and in the identification of sharks to species vs. non-species specific identification as a "shark" or "unidentified shark" category. From 1994 to 1996, every hook was observed as they came from the water, whereas, from 1997 to the present, 20 hooks per skate were sub-sampled in a non-random manner. For subsampling, the first 20 hooks from each skate were observed, although at times the 20-hook subsample began at a haphazard point in the skate. Methods are likely not comparable even if it is assumed that catchability is equal for all hooks on all skates. For example, non-random sub-sampling may result in an underestimate of the true variance. The IPHC is currently conducting field studies and statistical analyses to examine this question (Boldt et al. 1993). The geographical area surveyed also expanded during the time series. In addition to the change in sampling methods, 18.5% of the sharks caught between 1994 and 1996 were categorized as "unidentified shark" compared to only 0.4% between 1997 and 2000. Therefore, average catch per unit effort (ACPUE) by species underestimates actual ACPUE during 1994 to 1996. Consequently the 1994 to 1996 IPHC data are not comparable to data from 1997 to 2003. In the past IPHC shark bycatch reports likely underestimated actual catch because ineffective stations (stations with high halibut predation, by sharks or other animals, or high shark bycatch) were excluded from the IPHC data set for halibut stock assessment (Boldt et al. 2003). IPHC shark bycatch reported here now includes catch from ineffective stations in 2003 as well as retrospectively from 1997 to 2002 and may result in higher reported bycatch estimates of sharks in some areas, such as sleeper sharks in PWS and Cook Inlet, and spiny dogfish in PWS and Southeast Alaska. IPHC shark bycatch reported here for 1994 to 1996 does not include ineffective stations.

IPHC spiny dogfish and Pacific sleeper shark bycatch data is reported here for IPHC Areas 185, 190, 200, 210, 220, 230, 240, 250, 260, 232, and 243 (Figures 11 – 14). IPHC Areas 260, 250, and 240 are within the NMFS Statistical area 630; IPHC Areas 210, 220 and 230 cover virtually the same area as NMFS Area 640; and IPHC Areas 185, 190 and 200 within NMFS Area 650 (e.g., see Figures 1 and 11). IPHC Areas 232 and 242 are in Prince William Sound and cover the same area as NMFS Area 649 (e.g., see Figures 1 and 13). Salmon sharks are rarely captured on IPHC longline surveys and are not reported here. Because of its consistent survey coverage, The IPHC longline survey data may suitable for analysis of spiny dogfish and Pacific sleeper shark distribution in the Gulf of Alaska and Prince William Sound. No IPHC survey data was available for 1994-95 in areas 185-230; therefore, comparisons among areas are limited to the 1997 – 2003 time series. In the future, analysis of IPHC spiny dogfish and Pacific sleeper shark bycatch data should be extended to cover more NMFS Areas in the GOA, and BSAI.

From 1997-2003, GOA spiny dogfish average catch per 100 hooks (ACPUE) was generally higher in areas 185-240 than in areas 250 and 260 (Figure 11). ACPUE ranged from 7 to 46 across areas 185-240 and from 4-23 in areas 250 and 260. In most areas, peak ACPUE, 22-46, occurred in 2003 (Figure 11). This is in contrast to NMFS bycatch data presented above. From 1997 – 2002, in the GOA improved pseudo-blend estimates (Gaichas 2001, 2002), spiny dogfish were caught primarily in areas 630 (45%), 640 (29%), and 650 (22%, Table 16, Figure 1). This may be due to differing fishing pressures in these areas. However, the IPHC data presented here only coves NMFS Area 640 completely. In the future, analysis of IPHC spiny dogfish bycatch data should be extended to cover all NMFS Areas 630 and 650 in the GOA.

From 1997-2003, GOA Pacific sleeper shark ACPUE was generally highest in area 220 (Figure 12). ACPUE ranged from 0.6 (1999) to 8.6 (2000) in area 220 and from zero to 3.5 outside of area 220. This is also in contrast to NMFS bycatch data presented above. From 1997 – 2002, in the GOA improved pseudo-blend estimates (Gaichas 2001, 2002), Pacific sleeper sharks were caught primarily in areas 630 (43%), 620 (38%), and 610 (11%, Table 17, Figure 2). This may also be due to differing fishing pressures in these areas. However, in the future, analysis of IPHC Pacific sleeper shark bycatch data should also be extended to cover all NMFS Areas 630, 620, 610 and 650 in the GOA. In addition, in the 2002 and 2004 EBS slope bottom trawl surveys, a substantial biomass of Pacific sleeper sharks was reported (Tables 31 and 34, Figure 9). Consequently, it might also be worthwhile to extend analysis of IPHC Pacific sleeper shark bycatch data to the EBS if the data is available.

From 1998-2003, PWS spiny dogfish ACPUE has been generally lower (0.7-13.3) in IPHC survey area 242 of PWS compared to area 232 (zero-23.0) (Figure 13). ACPUE of spiny dogfish was also generally lower in PWS areas 242 and 232 (zero-23.0) than in the adjacent GOA areas 230 and 240 (8.8-33.5) (Figures 11 and 13).

From 1998-2003, PWS Pacific sleeper shark ACPUE has been relatively consistent between IPHC survey areas 242 and 243 in all years ranging from a low of 1.7 (1999) to a high of 10 (2001) (Figure 14). ACPUE of Pacific sleeper shark was also generally higher in PWS areas 242 and 232 (1.7-10) than in the adjacent GOA areas 230 and 240 (zero-3.1) (Figures 12 and 14).

### ADF&G Sablefish Longline Surveys Prince William Sound

The ADF&G sablefish longline survey has been conducted, and bycatch recorded (number of sharks per 100 hooks), in Prince William Sound (PWS) annually since 1996 and in the North GOA in 1999, 2000, and 2002. Shark bycatch in the North GOA is negligible. While the survey methods have not changed (~675 hooks per set), the areas sampled within PWS are not the same for every year of the survey. In 1996 and 2002, only the northwest area of the Sound was surveyed. In 1997, 1999, and 2001, the northwest and southwest areas of the sound were surveyed, while in 1998 and 2000 the northwest and eastern areas of PWS were surveyed (Boldt et al. 2003). Because of differences in survey locations over time, the ADF&G longline survey may not be suitable for analysis of shark distribution in PWS. ADF&G spiny dogfish and Pacific sleeper shark bycatch data is reported here for only the northwest area 1996 – 2002 and updated for 2003 (Figures 13 and 14). ADF&G shark bycatch data from NW PWS provided a continuous time series and catch trends and were compared to IPHC catch from stations in the NW PSW region (IPHC Stations 4144, 4145, and 4146) during years with overlapping coverage.

From 1996-2003, catch per 100 hooks (CPUE) of spiny dogfish in the ADFG sablefish longline surveys in the NW PSW region have typically been low ranging from 0.02 (1997) to 3.8 (1998) (Figure 13). There were peaks in 1998 and 2003 but there does not appear to be any trends in the time series data. If IPHC bycatch of spiny dogfish from 1998-2003 in PWS is evaluated according to the ADFG-defined northwest area (IPHC Stations 4144, 4145, and 4146), then ACPUE also peaked in 1998 and 2003 and was zero in all other years (Figure 13).

From 1996-2003, catch per 100 hooks (CPUE) of Pacific sleeper sharks in the ADFG sablefish longline surveys in the NW PSW were fairly consistent over time and there did not appear to be any peaks or trends in CPUE (Figure 14). If IPHC bycatch of Pacific sleeper sharks from 1998-2003 in PWS is evaluated according to the ADFG-defined northwest area (IPHC Stations 4144, 4145, and 4146; Figure), then ACPUE was also fairly consistent over time, but average catches were higher in the IPHC survey than in the ADF&G survey (Figure 14). The differing catch rates in the same areas over the same time period may be due to differences in survey design (particularly survey depths surveyed), and gear types used between the two surveys.

## Analytic approach, Model Evaluation, and Results

The available data do not support modeling for shark species in the GOA or BSAI at this time. Tier-6 criteria for establishing ABC and OFL require a reliable catch history from 1978 – 1995, which does not exist for spiny dogfish, Pacific sleeper shark or salmon shark prior to 1990. Tier-5 criteria for establishing ABC and OFL require reliable point estimates for biomass and natural mortality. The efficiency of bottom trawl gear varies by species and these biomass estimates should be considered at best a relative index of abundance for shark species until more formal analyses of survey efficiencies by species can be conducted. Published natural mortality estimates exist for spiny dogfish (M=0.09 Gaichas et al. 1999), but not for Pacific sleeper sharks or salmon sharks. Age estimation is possible for spiny dogfish and salmon sharks, but age determination has not been possible for Pacific sleeper sharks.

### Catch relative to biomass based on NMFS bottom trawl survey estimates

Although the catch and biomass estimates described above are uncertain, they are used here to obtain approximate exploitation rates for shark species in the GOA and BSIA. Incidental shark catches from 1997 – 2001 obtained from the improved pseudo-blend method (Gaichas 2001, 2002) were compared to AFSC bottom trawl survey biomass estimates during similar years in the GOA and BSAI. These preliminary comparisons suggest that current levels of incidental catches are low relative to available biomass for spiny dogfish and Pacific sleeper sharks in the GOA and for Pacific sleeper sharks in the BSAI.

In the GOA, average catch of spiny dogfish from 1997 – 2001 (545 tons, Table 5) represented 2% of the available spiny dogfish biomass from GOA bottom trawl surveys in 1996 and 1999 (average of 30,110 tons, Table 32). The 2001 survey did not include all areas of the Eastern GOA and consequently, the 2001 survey may not be comparable with the other surveys for species such as spiny dogfish which appear to be relatively abundant in the Eastern GOA. Average catch of Pacific sleeper sharks from 1997 – 2001 (325 tons, Table 5) represented 1% of the available Pacific sleeper shark biomass from GOA bottom trawl surveys in 1996, 1999, and 2001 (average of 26,053 tons, Table 32). Average catch of salmon sharks from 1997 – 2001 (79 tons, Table 5) was relatively small and GOA bottom trawl survey biomass estimates for salmon sharks were unreliable because salmon sharks were only caught in one haul from 1996 – 2001 (Table 32).

In the BSAI, average catch of Pacific sleeper sharks from 1997 – 2001 (427 tons, Table 6) represented 1.5% of the available Pacific sleeper shark biomass from BSAI bottom trawl surveys conducted between the years 1997 – 2002 (estimated below as 25,445 tons). A substantial biomass of sharks was found on EBS slope survey in 2002 (Table 31, identified as predominantly Pacific sleeper sharks in Gaichas 2002, Table 34). Biomass estimates for Pacific sleeper sharks are also available from the EBS shelf bottom trawl surveys in 1998, 1999, and 2000 (average of 1,897 tons, Table 33), and from AI bottom trawl surveys in 1997 and 2000 (average of 1,530 tons, Table 35). Adding these average biomass estimates together results in an estimate of total available biomass of Pacific Sleeper sharks from the BSAI bottom trawl slope surveys conducted between the years 1997 – 2002 of 25,445 tons. Average catches of spiny dogfish and salmon sharks from 1997 – 2001 (8 tons, and 20.5 tons respectively, Table 6) were relatively small and BSAI bottom trawl survey biomass estimates for spiny dogfish and salmon sharks were unreliable because catches of spiny dogfish and salmon sharks in BSAI bottom trawl surveys were relatively rare.

## Other considerations

Understanding shark species population dynamics is fundamental to describing ecosystem structure and function in the Gulf of Alaska. Shark species are top predators and likely play an important ecological role so fluctuations in their populations may have significant effects on community structure.

## Summary

There is no evidence to suggest that overfishing is occurring for any shark species in the GOA or BSAI. There are currently no directed commercial fisheries for shark species in federally or state managed waters of the GOA or BSAI and most incidentally captured sharks are not retained. Spiny dogfish are allowed as retained bycatch in some ADF&G managed salmon fisheries, and salmon sharks are targeted in some ADF&G managed sport fisheries. Incidental catches of shark species in the GOA and BSAI fisheries have been very small compared to catch rates of target species. Preliminary comparisons of incidental catch estimates with available biomass estimates suggest that current levels of incidental catches are low relative to available biomass for spiny dogfish and Pacific sleeper sharks in the GOA and for Pacific sleeper sharks in the BSAI. There is also an increasing trend in bottom trawl survey biomass estimates (used here as an index of relative abundance) for Pacific sleeper sharks and perhaps for spiny dogfish in the GOA. An independent analysis of NMFS AFSC bottom trawl surveys in the Gulf of Alaska found that Pacific sleeper shark abundance had significantly increased in the central Gulf of Alaska during 1984 - 1996 (Mueter and Norcross 2002). Salmon sharks are rarely captured in the GOA or BSAI in either the fishery or the bottom trawl surveys. However, a recent demographic analysis suggests that salmon shark populations in the eastern and western North Pacific are stable at this time (Goldman 2002-b). Spiny dogfish are rarely captured in the BSAI in either the fishery or the bottom trawl surveys. Other shark species are rarely captured and incidental catches are not likely play a significant role in their stock structure because catches were small and generally occurred near the edge of their ranges.

It should be clear from this assessment that data limitations are severe, and that further investigation is necessary to be sure that shark species are not adversely affected by groundfish fisheries. Salmon sharks in particular, and other less common pelagic sharks such as blue sharks, are not likely to be effectively sampled by bottom trawl surveys. In addition, the catchability of sharks in bottom trawl gear is unknown. Bottom trawl survey biomass estimates for shark species should be considered a relative index of abundance at best. If target fisheries develop for any shark species, effective management will be extremely difficult with the current limited information. Regardless of management decisions regarding TAC and the future structure for Other Species management category, it is essential that we continue to improve shark species survey sampling and biological data collection if we hope to ensure their continued conservation.

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Table 1. Shark species in the Gulf of Alaska, Eastern Bering Sea, and Aleutian Islands by scientific and common name.

| Scientific name | Common name | Source of information | |
|---|---|---|---|
| | | AFSC Survey | AFSC Observed Fishery |
| *Apristurus brunneus* | brown cat shark | | X |
| *Cetorhinus maximus* | basking shark | X | |
| *Hexanus griseus* | sixgill shark | X | X |
| *Lamna ditropis* | salmon shark | X | X |
| *Prionace glauca* | blue shark | | X |
| *Somniosus pacificus* | Pacific sleeper shark | X | X |
| *Squalus acanthias* | spiny dogfish | X | X |

Source: Gaichas et al. (1999, Table 1).

Table 2. Summary of NMFS Alaska Regional Office blend-estimated annual catches (tons) for the Gulf of Alaska Other Species management category, which includes sharks.

| Year | Foreign | Joint Venture | Domestic | Total |
|---|---|---|---|---|
| 1977 | 4,725 | | | 4,725 |
| 1978 | 6,299 | | | 6,299 |
| 1979 | 4,507 | 38 | | 4,545 |
| 1980 | 6,395 | 49 | | 6,445 |
| 1981 | 8,247 | 33 | | 8,280 |
| 1982 | 2,326 | 317 | | 2,643 |
| 1983 | 2,523 | 395 | | 2,918 |
| 1984 | 696 | 1,273 | | 1,969 |
| 1985 | 103 | 2,253 | | 2,356 |
| 1986 | 146 | 262 | | 408 |
| 1987 | | 182 | | 182 |
| 1988 | | 129 | | 129 |
| 1989 | | | 1,560 | 1,560 |
| 1990 | | | 6,289 | 6,289 |
| 1991 | | | 5,700 | 5,700 |
| 1992 | | | 12,313 | 12,313 |
| 1993 | | | 6,867 | 6,867 |
| 1994 | | | 2,721 | 2,721 |
| 1995 | | | 3,421 | 3,421 |
| 1996 | | | 4,480 | 4,480 |
| 1997 | | | 5,439 | 5,439 |
| 1998 | | | 3,781 | 3,781 |
| 1999 | | | 3,859 | 3,859 |
| 2000 | | | 5,649 | 5,649 |
| 2001 | | | 4,801 | 4,801 |
| 2002 | | | 4,040 | 4,040 |
| 2003 | | | 6,339 | 6,339 |
| 2004* | | | 1,530 | 1,530 |

*2004 catch reported through October 7, 2004.

Data Sources: 1977 - 1997. Gaichas et al. (1999, Table 2); 1998 - 2004; NMFS Alaska Regional Office BLEND database, Juneau, AK 99801.

Table 3. Summary of NMFS Alaska Regional Office blend-estimated annual catches (tons) for the Eastern Bering Sea and Aleutian Islands Other Species management category, which includes sharks.

| | Eastern Bering Sea | | | | Aleutian Islands | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Year | Foreign | JV | Domestic | Total | Foreign | JV | Domestic | Total | Grand 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 | | | | | | | | | 26,296 |
| 2003 | | | | | | | | | 25,373 |
| 2004* | | | | | | | | | 21,795 |

*2004 catch reported through October 7, 2004.

Data Sources: 1977- 2001 Gaichas (2002); 2002 - 2004 NMFS Alaska Regional Office BLEND database, Juneau, AK 99801.

Table 4. NMFS REFM estimated catches (tons) of sharks in the Gulf of Alaska by species, 1990-1998; from a pseudo-blend catch estimation procedure (Gaichas et al. 1999).

| Year | Spiny Dogfish | Pacific Sleeper Shark | Salmon Shark | Brown Cat Shark | Blue Shark | Sixgill Shark | Unidentified Shark | Total Sharks |
|---|---|---|---|---|---|---|---|---|
| 1990 | 170.89 | 19.69 | 52.65 | 0.21 | | 3.27 | 26.96 | 274 |
| 1991 | 141.23 | 49.36 | 41.58 | | | 4.21 | 103.93 | 340 |
| 1992 | 320.62 | 37.57 | 141.92 | 0.01 | | | 17.23 | 517 |
| 1993 | 383.36 | 214.78 | 89.16 | | | | 339.62 | 1,027 |
| 1994 | 160.23 | 119.50 | 24.52 | | | 0.40 | 55.45 | 360 |
| 1995 | 140.63 | 62.97 | 54.93 | | 7.54 | | 41.81 | 308 |
| 1996 | 336.91 | 65.86 | 27.76 | | 2.85 | | 50.58 | 484 |
| 1997 | 233.48 | 118.12 | 24.63 | | 3.25 | | 56.28 | 436 |
| 1998 | 298.03 | 161.40 | 78.52 | 1.29 | 5.33 | | 124.78 | 669 |
| Total | 2,185.37 | 849.25 | 535.68 | 1.52 | 18.98 | 7.89 | 816.64 | 4,415 |
| % of Total | 49% | 19% | 12% | 0% | 0% | 0% | 18% | 100% |

Source: Gaichas et al. (1999, Table 14).

Table 5. NMFS REFM estimated catches (tons) of sharks in the Gulf of Alaska by species, 1997-2001; from an improved pseudo-blend catch estimation procedure (Gaichas 2001, 2002).

| Year | Spiny dogfish | Pacific sleeper shark | Salmon shark | Unidentified shark | Total sharks | Total other species | % of Total |
|---|---|---|---|---|---|---|---|
| 1997 | 657.5 | 135.9 | 123.8 | 123.5 | 1,040.7 | 5,396.7 | 19% |
| 1998 | 864.9 | 74.0 | 71.0 | 1,379.9 | 2,389.8 | 7,577.9 | 32% |
| 1999 | 313.6 | 557.7 | 131.6 | 33.0 | 1,035.9 | 3,787.6 | 27% |
| 2000 | 397.6 | 608.2 | 37.8 | 73.6 | 1,117.2 | 5,493.3 | 20% |
| 2001 | 494.0 | 249.0 | 32.8 | 77.0 | 852.8 | 3,461.4 | 25% |
| Average | 545.5 | 325.0 | 79.4 | 337.4 | 1,287.3 | 5,143.4 | |
| Total | 2,727.6 | 1,624.8 | 397.0 | 1,687.0 | 6,436.4 | 25,716.9 | |
| % of Total | 42% | 25% | 6% | 26% | 100% | 25% | |

Source: Gaichas (2002, Table 15-5).

Table 6. NMFS REFM estimated catches (tons) of sharks in the Eastern Bering Sea and Aleutian Islands by species, 1997-2001; from an improved pseudo-blend catch estimation procedure (Gaichas 2001, 2002).

| Year | Spiny dogfish | Pacific sleeper shark | Salmon shark | Unidentified shark | Total sharks | Total other species | % of Total |
|---|---|---|---|---|---|---|---|
| 1997 | 4.1 | 304.1 | 6.8 | 52.8 | 367.8 | 27,414.7 | 1% |
| 1998 | 6.4 | 336.0 | 18.0 | 136.1 | 496.5 | 27,545.3 | 2% |
| 1999 | 5.0 | 318.7 | 30.0 | 176.4 | 530.1 | 20,907.7 | 3% |
| 2000 | 8.9 | 490.4 | 23.3 | 67.6 | 590.2 | 27,384.3 | 2% |
| 2001 | 17.3 | 687.3 | 24.4 | 35.0 | 764.0 | 31,041.9 | 2% |
| Average | 8.3 | 427.3 | 20.5 | 93.6 | 549.7 | 26,858.8 | |
| Total | 41.7 | 2,136.5 | 102.5 | 467.9 | 2,748.6 | 134,293.9 | |
| % of Total | 2% | 78% | 4% | 17% | 100% | 2% | |

Source: Gaichas (2002, Table 15-5).

Table 7. Estimated catches (tons) of spiny dogfish in the Gulf of Alaska by fishery and gear type, 1990-1996 using a pseudo-blend catch procedure (Gaichas et al. 1999).

| **Fishery** | **Gear** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** | **Total** | **% of Total** |
|---|---|---|---|---|---|---|---|---|---|---|
| Bottom Pollock | TWL | 57.1 | 26.7 | 73.4 | 114.5 | 20.8 | 2.8 | 0.5 | 295.8 | 18% |
| Pelagic Pollock | TWL | 0.5 | 2.6 | 11.0 | 22.5 | 1.2 | 0.0 | 2.4 | 40.2 | 2% |
| Pollock Total | | 57.6 | 29.2 | 84.4 | 137.0 | 22.0 | 2.9 | 2.9 | 336.0 | 20% |
| | | | | | | | | | | |
| Pacific Cod | LGL | 6.3 | 34.7 | 35.0 | 5.6 | 13.1 | 20.6 | 11.1 | 126.4 | 8% |
| | POT | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0% |
| | TWL | 29.6 | 18.0 | 15.5 | 4.5 | 3.8 | 7.5 | 4.1 | 83.0 | 5% |
| Pacific Cod Total | | 36.0 | 52.6 | 50.5 | 10.1 | 16.9 | 28.1 | 15.3 | 209.5 | 13% |
| | | | | | | | | | | |
| Flatfish | LGL | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0% |
| | TWL | 13.3 | 16.2 | 116.0 | 138.5 | 83.4 | 24.1 | 182.5 | 574.1 | 35% |
| Flatfish Total | | 13.5 | 16.2 | 116.0 | 138.5 | 83.4 | 24.1 | 182.6 | 574.3 | 35% |
| | | | | | | | | | | |
| Rockfish | JIG | | | 0.0 | | | | | | |
| | LGL | 0.0 | 13.9 | 18.3 | 0.0 | 1.2 | 11.9 | 18.2 | 63.6 | 4% |
| | TWL | 1.8 | 2.6 | 4.0 | 2.4 | 1.2 | 6.5 | 1.6 | 20.1 | 1% |
| Rockfish Total | | 1.8 | 16.4 | 22.4 | 2.4 | 2.5 | 18.4 | 19.8 | 83.7 | 5% |
| | | | | | | | | | | |
| Other | LGL | 3.1 | 0.0 | 0.1 | 0.0 | 0.0 | 15.3 | 23.0 | 41.5 | 3% |
| | POT | | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0% |
| | TWL | 0.0 | 0.5 | 6.6 | 0.0 | 0.0 | 1.0 | 13.8 | 22.0 | 1% |
| Other Total | | 3.1 | 0.5 | 6.7 | 0.0 | 0.0 | 16.4 | 36.8 | 63.5 | 4% |
| | | | | | | | | | | |
| Atka Mackerel | TWL | | | | | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | | | | | | | | | | |
| Sablefish | LGL | 59.0 | 26.2 | 40.7 | 95.3 | 35.4 | 50.7 | 79.5 | 386.8 | 23% |
| | TWL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| Sablefish Total | | 59.0 | 26.2 | 40.7 | 95.3 | 35.4 | 50.7 | 79.5 | 386.9 | 23% |
| | | | | | | | | | | |
| Grand Total | | 170.9 | 141.2 | 320.6 | 383.4 | 160.2 | 140.6 | 336.9 | 1,653.9 | 100% |

Table 8. Estimated catches (tons) of spiny dogfish in the Gulf of Alaska by fishery and gear type, 1997-2001 using the improved pseudo-blend estimation procedure (Gaichas 2002).

| Fishery | Gear | 1997 | 1998 | 1999 | 2000 | 2001 | Total | % of Total |
|---|---|---|---|---|---|---|---|---|
| Bottom Pollock | TWL | 1.2 | 0.4 | 0.0 | 4.1 | 4.4 | 10.1 | 0% |
| Pelagic Pollock | TWL | 1.6 | 4.5 | 8.6 | 14.6 | 7.2 | 36.4 | 1% |
| Pollock Total | | 2.8 | 4.9 | 8.6 | 18.7 | 11.6 | 46.5 | 2% |
| | | | | | | | | |
| Pacific Cod | LGL | 27.6 | 103.6 | 146.2 | 8.0 | 111.3 | 396.8 | 15% |
| | POT | 0.0 | 0.0 | 0.3 | 0.4 | 0.6 | 1.3 | 0% |
| | TWL | 29.9 | 623.6 | 13.8 | 21.0 | 60.9 | 749.2 | 27% |
| Pacific Cod Total | | 57.6 | 727.2 | 160.2 | 29.4 | 172.8 | 1,147.2 | 42% |
| | | | | | | | | |
| Flatfish | LGL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | TWL | 137.2 | 69.0 | 56.6 | 66.3 | 162.5 | 491.5 | 18% |
| Flatfish Total | | 137.2 | 69.0 | 56.6 | 66.3 | 162.5 | 491.5 | 18% |
| | | | | | | | | |
| Rockfish | JIG | | | | | | | |
| | LGL | 314.3 | 0.0 | 2.4 | 139.2 | 19.1 | 475.0 | 17% |
| | TWL | 11.9 | 3.1 | 2.4 | 7.4 | 5.9 | 30.7 | 1% |
| Rockfish Total | | 326.2 | 3.1 | 4.8 | 146.6 | 25.1 | 505.7 | 19% |
| | | | | | | | | |
| Other/Unknown | LGL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | POT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | TWL | 0.0 | 1.1 | 0.0 | 0.0 | 0.0 | 1.1 | 0% |
| Other Total | | 0.0 | 1.1 | 0.0 | 0.0 | 0.0 | 1.1 | 0% |
| | | | | | | | | |
| Atka Mackerel | TWL | | | | | | | |
| | | | | | | | | |
| Sablefish | LGL | 133.7 | 59.6 | 83.4 | 136.6 | 122.1 | 535.4 | 20% |
| | TWL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| Sablefish Total | | 133.7 | 59.6 | 83.4 | 136.6 | 122.1 | 535.4 | 20% |
| | | | | | | | | |
| Grand Total | | 657.5 | 864.9 | 313.6 | 397.6 | 494.0 | 2,727.5 | 100% |

Table 9. Estimated catches (tons) of Pacific sleeper sharks in the Gulf of Alaska by fishery and gear type, 1990-1996 using a pseudo-blend catch procedure (Gaichas et al. 1999).

| Fishery | Gear | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | Total | % of Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Bottom Pollock | TWL | 0.7 | 11.8 | 0.0 | 125.3 | 58.5 | 7.1 | 3.3 | 206.7 | 36% |
| Pelagic Pollock | TWL | 2.2 | 15.4 | 1.1 | 31.2 | 21.1 | 9.8 | 11.2 | 92.0 | 16% |
| Pollock Total | | 2.9 | 27.2 | 1.1 | 156.5 | 79.6 | 16.9 | 14.5 | 298.8 | 52% |
| | | | | | | | | | | |
| Pacific Cod | LGL | 8.4 | 0.0 | 24.6 | 6.3 | 15.0 | 12.5 | 3.9 | 70.8 | 12% |
| | POT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.1 | 0% |
| | TWL | 1.4 | 2.8 | 2.7 | 15.5 | 1.6 | 1.2 | 7.9 | 33.2 | 6% |
| Pacific Cod Total | | 9.9 | 2.8 | 27.4 | 21.8 | 16.6 | 13.7 | 11.9 | 104.1 | 18% |
| | | | | | | | | | | |
| Flatfish | LGL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.2 | 0% |
| | TWL | 0.4 | 3.1 | 2.7 | 1.0 | 0.8 | 20.5 | 12.1 | 40.5 | 7% |
| Flatfish Total | | 0.4 | 3.1 | 2.7 | 1.0 | 0.8 | 20.7 | 12.1 | 40.7 | 7% |
| | | | | | | | | | | |
| Rockfish | JIG | | | 0.0 | | | | | | |
| | LGL | 0.0 | 0.0 | 0.0 | 0.0 | 0.9 | 0.0 | 0.0 | 0.9 | 0% |
| | TWL | 4.3 | 0.0 | 0.0 | 0.0 | 0.4 | 0.1 | 0.0 | 4.8 | 1% |
| Rockfish Total | | 4.3 | 0.0 | 0.0 | 0.0 | 1.3 | 0.1 | 0.0 | 5.7 | 1% |
| | | | | | | | | | | |
| Other | LGL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0% |
| | POT | | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0% |
| | TWL | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 | 0.7 | 0% |
| Other Total | | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 | 0.8 | 0% |
| | | | | | | | | | | |
| Atka Mackerel | TWL | | | | | 0.0 | 0.0 | 0.2 | 0.2 | 0% |
| | | | | | | | | | | |
| Sablefish | LGL | 2.0 | 16.2 | 6.4 | 35.5 | 21.0 | 11.6 | 26.4 | 119.1 | 21% |
| | TWL | 0.2 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.3 | 0% |
| Sablefish Total | | 2.2 | 16.2 | 6.4 | 35.5 | 21.2 | 11.6 | 26.4 | 119.5 | 21% |
| | | | | | | | | | | |
| Grand Total | | 19.7 | 49.4 | 37.6 | 214.8 | 119.5 | 63.0 | 65.9 | 569.7 | 100% |

Table 10. Estimated catches (tons) of Pacific sleeper sharks in the Gulf of Alaska by fishery and gear type, 1997-2001 using the improved pseudo-blend estimation procedure (Gaichas 2002).

| Fishery | Gear | 1997 | 1998 | 1999 | 2000 | 2001 | Total | % of Total |
|---|---|---|---|---|---|---|---|---|
| Bottom Pollock | TWL | 0.0 | 4.6 | 0.9 | 1.3 | 11.1 | 17.9 | 1% |
| Pelagic Pollock | TWL | 22.3 | 27.8 | 33.2 | 177.1 | 134.8 | 395.2 | 24% |
| Pollock Total | | 22.3 | 32.4 | 34.2 | 178.4 | 145.9 | 413.1 | 25% |
| | | | | | | | | |
| Pacific Cod | LGL | 42.3 | 14.0 | 501.0 | 365.8 | 65.8 | 989.0 | 61% |
| | POT | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.4 | 0% |
| | TWL | 16.9 | 5.5 | 4.8 | 10.6 | 0.0 | 37.8 | 2% |
| Pacific Cod Total | | 59.3 | 19.6 | 505.8 | 376.8 | 65.8 | 1,027.2 | 63% |
| | | | | | | | | |
| Flatfish | LGL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | TWL | 46.0 | 10.1 | 6.0 | 35.9 | 6.3 | 104.2 | 6% |
| Flatfish Total | | 46.0 | 10.1 | 6.0 | 35.9 | 6.3 | 104.2 | 6% |
| | | | | | | | | |
| Rockfish | JIG | | | | | | | |
| | LGL | 0.9 | 0.0 | 0.0 | 0.2 | 0.0 | 1.0 | 0% |
| | TWL | 0.0 | 0.2 | 3.0 | 0.2 | 0.7 | 4.1 | 0% |
| Rockfish Total | | 0.9 | 0.2 | 3.0 | 0.3 | 0.7 | 5.1 | 0% |
| | | | | | | | | |
| Other/Unknown | LGL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | POT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | TWL | 0.0 | 0.5 | 0.0 | 0.0 | 0.0 | 0.5 | 0% |
| Other Total | | 0.0 | 0.5 | 0.0 | 0.0 | 0.0 | 0.5 | 0% |
| | | | | | | | | |
| Atka Mackerel | TWL | | | | | | | |
| | | | | | | | | |
| Sablefish | LGL | 7.5 | 11.3 | 8.7 | 16.7 | 30.3 | 74.6 | 5% |
| | TWL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| Sablefish Total | | 7.5 | 11.3 | 8.7 | 16.7 | 30.3 | 74.6 | 5% |
| | | | | | | | | |
| Grand Total | | 135.9 | 74.0 | 557.7 | 608.2 | 249.0 | 1,624.7 | 100% |

Table 11. Estimated catches (tons) of salmon sharks in the Gulf of Alaska by fishery and gear type, 1990-1996 using a pseudo-blend catch procedure (Gaichas et al. 1999).

| **Fishery** | **Gear** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** | **Total** | **% of Total** |
|---|---|---|---|---|---|---|---|---|---|---|
| Bottom Pollock | TWL | 20.7 | 5.4 | 83.3 | 38.1 | 3.3 | 3.3 | 5.8 | 160.0 | 37% |
| Pelagic Pollock | TWL | 24.6 | 30.8 | 39.8 | 48.6 | 20.9 | 22.6 | 21.1 | 208.3 | 48% |
| Pollock Total | | 45.3 | 36.3 | 123.1 | 86.7 | 24.2 | 25.9 | 26.8 | 368.3 | 85% |
| Pacific Cod | LGL | 0.0 | 0.0 | 15.3 | 0.0 | 0.0 | 17.3 | 0.0 | 32.6 | 8% |
| | POT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | TWL | 3.2 | 0.0 | 1.2 | 0.0 | 0.0 | 4.3 | 0.0 | 8.7 | 2% |
| Pacific Cod Total | | 3.2 | 0.0 | 16.5 | 0.0 | 0.0 | 21.6 | 0.0 | 41.2 | 10% |
| Flatfish | LGL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | TWL | 0.2 | 0.0 | 0.2 | 2.5 | 0.0 | 3.2 | 0.0 | 6.0 | 1% |
| Flatfish Total | | 0.2 | 0.0 | 0.2 | 2.5 | 0.0 | 3.2 | 0.0 | 6.0 | 1% |
| Rockfish | JIG | | | 0.0 | | | | | | |
| | LGL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | TWL | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 1.0 | 0% |
| Rockfish Total | | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 1.0 | 0% |
| Other | LGL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.9 | 0.0 | 0.9 | 0% |
| | POT | | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0% |
| | TWL | 1.2 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.6 | 2.1 | 0% |
| Other Total | | 1.2 | 0.0 | 0.0 | 0.0 | 0.3 | 0.9 | 0.6 | 3.0 | 1% |
| Atka Mackerel | TWL | | | | | 0.0 | 0.0 | 0.1 | 0.1 | 0% |
| Sablefish | LGL | 1.9 | 5.3 | 2.1 | 0.0 | 0.0 | 3.1 | 0.2 | 12.7 | 3% |
| | TWL | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0% |
| Sablefish Total | | 2.1 | 5.3 | 2.1 | 0.0 | 0.0 | 3.1 | 0.2 | 12.8 | 3% |
| Grand Total | | 52.7 | 41.6 | 141.9 | 89.2 | 24.5 | 54.9 | 27.8 | 432.5 | 100% |

Table 12. Estimated catches (tons) of salmon sharks in the Gulf of Alaska by fishery and gear type, 1997-2001 using the improved pseudo-blend estimation procedure (Gaichas 2002).

| Fishery | Gear | 1997 | 1998 | 1999 | 2000 | 2001 | Total | % of Total |
|---|---|---|---|---|---|---|---|---|
| Bottom Pollock | TWL | 4.4 | 2.4 | 0.0 | 7.3 | 0.2 | 14.2 | 4% |
| Pelagic Pollock | TWL | 15.4 | 67.3 | 111.8 | 25.4 | 29.3 | 249.3 | 63% |
| Pollock Total | | 19.8 | 69.7 | 111.8 | 32.7 | 29.5 | 263.5 | 66% |
| | | | | | | | | |
| Pacific Cod | LGL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | POT | 0.0 | 0.0 | 0.7 | 0.0 | 0.0 | 0.7 | 0% |
| | TWL | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0% |
| Pacific Cod Total | | 0.1 | 0.0 | 0.7 | 0.0 | 0.0 | 0.8 | 0% |
| | | | | | | | | |
| Flatfish | LGL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | TWL | 0.0 | 0.8 | 0.7 | 3.7 | 1.5 | 6.7 | 2% |
| Flatfish Total | | 0.0 | 0.8 | 0.7 | 3.7 | 1.5 | 6.7 | 2% |
| | | | | | | | | |
| Rockfish | JIG | | | | | | | |
| | LGL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | TWL | 0.0 | 0.4 | 0.0 | 0.8 | 1.8 | 3.0 | 1% |
| Rockfish Total | | 0.0 | 0.4 | 0.0 | 0.8 | 1.8 | 3.0 | 1% |
| | | | | | | | | |
| Other/Unknown | LGL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | POT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | TWL | 103.9 | 0.0 | 0.0 | 0.0 | 0.0 | 103.9 | 26% |
| Other Total | | 103.9 | 0.0 | 0.0 | 0.0 | 0.0 | 103.9 | 26% |
| | | | | | | | | |
| Atka Mackerel | TWL | | | | | | | |
| | | | | | | | | |
| Sablefish | LGL | 0.0 | 0.0 | 18.4 | 0.6 | 0.0 | 19.0 | 5% |
| | TWL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| Sablefish Total | | 0.0 | 0.0 | 18.4 | 0.6 | 0.0 | 19.0 | 5% |
| | | | | | | | | |
| Grand Total | | 123.8 | 71.0 | 131.6 | 37.8 | 32.8 | 396.9 | 100% |

Table 13. Estimated catches (tons) of other and unidentified sharks in the Gulf of Alaska by fishery and gear type, 1990-1996 using a pseudo-blend catch procedure (Gaichas et al. 1999).

| Fishery | Gear | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | Total | % of Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Bottom Pollock | TWL | 1.1 | 13.2 | 2.1 | 129.8 | 34.9 | 2.0 | 9.5 | 192.7 | 29% |
| Pelagic Pollock | TWL | 3.0 | 4.6 | 1.2 | 8.5 | 6.7 | 2.0 | 4.7 | 30.8 | 5% |
| Pollock Total | | 4.1 | 17.8 | 3.3 | 138.3 | 41.5 | 4.1 | 14.3 | 223.4 | 34% |
| | | | | | | | | | | |
| Pacific Cod | LGL | 0.3 | 24.1 | 8.1 | 36.8 | 2.2 | 2.5 | 0.1 | 73.9 | 11% |
| | POT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | TWL | 21.0 | 12.6 | 0.4 | 1.3 | 0.2 | 0.8 | 3.0 | 39.4 | 6% |
| Pacific Cod Total | | 21.3 | 36.7 | 8.4 | 38.1 | 2.3 | 3.4 | 3.1 | 113.4 | 17% |
| | | | | | | | | | | |
| Flatfish | LGL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | TWL | 0.8 | 35.5 | 3.5 | 3.7 | 3.0 | 10.6 | 17.8 | 75.0 | 11% |
| Flatfish Total | | 0.8 | 35.5 | 3.5 | 3.7 | 3.0 | 10.6 | 17.8 | 75.0 | 11% |
| | | | | | | | | | | |
| Rockfish | JIG | | | 0.0 | | | | | | |
| | LGL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 1.9 | 3.0 | 0% |
| | TWL | 1.4 | 4.4 | 0.1 | 0.0 | 0.0 | 8.6 | 0.0 | 14.6 | 2% |
| Rockfish Total | | 1.4 | 4.4 | 0.1 | 0.0 | 0.0 | 9.7 | 1.9 | 17.6 | 3% |
| | | | | | | | | | | |
| Other | LGL | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 5.5 | 0.0 | 5.7 | 1% |
| | POT | | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0% |
| | TWL | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 1.8 | 0.2 | 2.4 | 0% |
| Other Total | | 0.0 | 0.0 | 0.4 | 0.2 | 0.0 | 7.3 | 0.3 | 8.1 | 1% |
| | | | | | | | | | | |
| Atka Mackerel | TWL | | | | | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | | | | | | | | | | |
| Sablefish | LGL | 2.9 | 13.7 | 1.5 | 159.3 | 8.9 | 14.3 | 16.0 | 216.6 | 33% |
| | TWL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| Sablefish Total | | 2.9 | 13.7 | 1.5 | 159.3 | 8.9 | 14.3 | 16.0 | 216.6 | 33% |
| | | | | | | | | | | |
| Grand Total | | 30.4 | 108.1 | 17.2 | 339.6 | 55.9 | 49.4 | 53.4 | 654.1 | 100% |

Table 14. Estimated catches (tons) of other and unidentified sharks in the Gulf of Alaska by fishery and gear type, 1997-2001 using the improved pseudo-blend estimation procedure (Gaichas 2002).

| Fishery | Gear | 1997 | 1998 | 1999 | 2000 | 2001 | Total | % of Total |
|---|---|---|---|---|---|---|---|---|
| Bottom Pollock | TWL | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.2 | 0% |
| Pelagic Pollock | TWL | 8.9 | 24.2 | 6.1 | 12.3 | 34.8 | 86.2 | 5% |
| Pollock Total | | 8.9 | 24.2 | 6.1 | 12.3 | 35.0 | 86.4 | 5% |
| | | | | | | | | |
| Pacific Cod | LGL | 2.4 | 3.6 | 8.1 | 2.1 | 0.6 | 16.8 | 1% |
| | POT | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.1 | 0% |
| | TWL | 11.0 | 6.7 | 4.0 | 1.4 | 0.8 | 23.9 | 1% |
| Pacific Cod Total | | 13.4 | 10.2 | 12.3 | 3.5 | 1.4 | 40.9 | 2% |
| | | | | | | | | |
| Flatfish | LGL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | TWL | 9.0 | 17.9 | 8.1 | 34.0 | 1.5 | 70.6 | 4% |
| Flatfish Total | | 9.0 | 17.9 | 8.1 | 34.0 | 1.5 | 70.6 | 4% |
| | | | | | | | | |
| Rockfish | JIG | | | | | | | |
| | LGL | 45.2 | 0.0 | 0.0 | 3.7 | 0.0 | 48.9 | 3% |
| | TWL | 2.3 | 2.3 | 0.1 | 1.1 | 1.4 | 7.2 | 0% |
| Rockfish Total | | 47.5 | 2.3 | 0.1 | 4.8 | 1.4 | 56.0 | 3% |
| | | | | | | | | |
| Other/Unknown | LGL | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.3 | 0% |
| | POT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | TWL | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 | 0% |
| Other Total | | 0.7 | 0.0 | 0.0 | 0.3 | 0.0 | 1.1 | 0% |
| | | | | | | | | |
| Atka Mackerel | TWL | | | | | | | |
| | | | | | | | | |
| Sablefish | LGL | 43.9 | 1,325.2 | 6.4 | 18.7 | 37.7 | 1,432.0 | 85% |
| | TWL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| Sablefish Total | | 43.9 | 1,325.2 | 6.4 | 18.7 | 37.7 | 1,432.0 | 85% |
| | | | | | | | | |
| Grand Total | | 123.5 | 1,379.9 | 33.0 | 73.6 | 77.0 | 1,687.0 | 100% |

Table 15. Estimated catches (tons) of spiny dogfish in the Gulf of Alaska by statistical area, 1990-1996 using a pseudo-blend catch procedure (Gaichas et al. 1999).

| Year | 610 | 620 | 630 | 640 | 649 | 650 | 659 | Total |
|---|---|---|---|---|---|---|---|---|
| 1990 | 0.2 | 3.6 | 147.8 | 2.3 | 0.0 | 17.0 | 0.0 | 170.9 |
| 1991 | 2.2 | 3.5 | 113.1 | 3.1 | 0.0 | 18.2 | 0.0 | 141.2 |
| 1992 | 2.7 | 8.1 | 283.6 | 1.8 | 0.0 | 24.4 | 0.0 | 320.6 |
| 1993 | 0.6 | 3.0 | 322.3 | 11.0 | 0.0 | 5.4 | 41.2 | 383.4 |
| 1994 | 1.4 | 4.8 | 115.5 | 5.0 | 0.0 | 33.6 | 0.0 | 160.2 |
| 1995 | 0.4 | 8.7 | 103.7 | 13.8 | 0.0 | 14.0 | 0.0 | 140.6 |
| 1996 | 1.3 | 3.4 | 279.2 | 23.0 | 0.5 | 29.5 | 0.0 | 336.9 |
| Total | 8.8 | 35.0 | 1,365.2 | 59.9 | 0.5 | 142.1 | 41.2 | 1,653.9 |
| % of Total | 0.5% | 2.1% | 82.5% | 3.6% | 0.0% | 8.6% | 2.5% | 100.0% |

Table 16. Estimated catches (tons) of spiny dogfish in the Gulf of Alaska by statistical area, 1997-2002 using the improved pseudo-blend estimation procedure (Gaichas 2002).

| Year | 610 | 620 | 630 | 640 | 649 | 650 | 659 | Total |
|---|---|---|---|---|---|---|---|---|
| 1997 | 0.5 | 11.7 | 265.7 | 45.0 | 0.0 | 334.7 | 0.0 | 657.5 |
| 1998 | 3.6 | 3.1 | 255.0 | 574.8 | 2.2 | 26.1 | 0.0 | 864.9 |
| 1999 | 11.0 | 42.8 | 175.6 | 38.9 | 3.2 | 42.2 | 0.0 | 313.6 |
| 2000 | 5.3 | 1.0 | 148.6 | 82.9 | 0.0 | 159.9 | 0.0 | 397.6 |
| 2001 | 3.3 | 1.8 | 396.3 | 40.5 | 0.0 | 52.1 | 0.0 | 494.0 |
| 2002 | 5.2 | 5.8 | 47.1 | 51.9 | 0.0 | 7.0 | 0.0 | 117.0 |
| Total | 28.8 | 66.1 | 1,288.2 | 833.9 | 5.4 | 622.0 | 0.0 | 2,844.5 |
| % of Total | 1% | 2% | 45% | 29% | 0% | 22% | 0% | 100% |

Table 17. Estimated catches (tons) of Pacific sleeper sharks in the Gulf of Alaska by statistical area, 1990-1996 using a pseudo-blend catch procedure (Gaichas et al. 1999).

| Year | 610 | 620 | 630 | 640 | 649 | 650 | 659 | Total |
|---|---|---|---|---|---|---|---|---|
| 1990 | 2.4 | 1.2 | 12.8 | 3.0 | 0.0 | 0.3 | 0.0 | 19.7 |
| 1991 | 4.0 | 3.0 | 40.9 | 1.4 | 0.0 | 0.0 | 0.0 | 49.4 |
| 1992 | 4.0 | 23.2 | 6.3 | 2.2 | 1.9 | 0.0 | 0.0 | 37.6 |
| 1993 | 10.5 | 127.9 | 68.2 | 8.3 | 0.0 | 0.0 | 0.0 | 214.8 |
| 1994 | 11.9 | 23.0 | 75.9 | 8.7 | 0.0 | 0.0 | 0.0 | 119.5 |
| 1995 | 6.5 | 23.3 | 27.0 | 2.4 | 0.1 | 3.7 | 0.0 | 63.0 |
| 1996 | 21.3 | 12.0 | 14.5 | 5.5 | 0.0 | 12.5 | 0.0 | 65.9 |
| Total | 60.6 | 213.6 | 245.6 | 31.5 | 2.0 | 16.5 | 0.0 | 569.7 |
| % of Total | 10.6% | 37.5% | 43.1% | 5.5% | 0.4% | 2.9% | 0.0% | 100.0% |

Table 18. Estimated catches (tons) of Pacific sleeper sharks in the Gulf of Alaska by statistical area, 1997-2002 using the improved pseudo-blend estimation procedure (Gaichas 2002).

| Year | 610 | 620 | 630 | 640 | 649 | 650 | 659 | Total |
|---|---|---|---|---|---|---|---|---|
| 1997 | 16.0 | 45.0 | 69.5 | 1.3 | 0.9 | 3.2 | 0.0 | 135.9 |
| 1998 | 11.0 | 11.4 | 42.5 | 0.7 | 0.0 | 8.5 | 0.0 | 74.0 |
| 1999 | 63.9 | 33.8 | 454.7 | 0.3 | 0.0 | 4.9 | 0.0 | 557.7 |
| 2000 | 18.6 | 162.7 | 415.4 | 1.0 | 0.0 | 10.5 | 0.0 | 608.2 |
| 2001 | 90.7 | 67.3 | 74.6 | 6.0 | 0.0 | 10.3 | 0.0 | 249.0 |
| 2002 | 65.2 | 110.8 | 46.6 | 2.3 | 0.7 | 0.0 | 0.0 | 225.6 |
| Total | 265.5 | 430.9 | 1,103.4 | 11.6 | 1.6 | 37.3 | 0.0 | 1,850.3 |
| % of Total | 14% | 23% | 60% | 1% | 0% | 2% | 0% | 100% |

Table 19. Estimated catches (tons) of salmon sharks in the Gulf of Alaska by statistical area, 1990-1996 using a pseudo-blend catch procedure (Gaichas et al. 1999).

| Year | 610 | 620 | 630 | 640 | 649 | 650 | 659 | Total |
|---|---|---|---|---|---|---|---|---|
| 1990 | 3.4 | 3.0 | 46.2 | 0.1 | 0.0 | 0.0 | 0.0 | 52.7 |
| 1991 | 4.3 | 6.9 | 30.4 | 0.0 | 0.0 | 0.0 | 0.0 | 41.6 |
| 1992 | 0.2 | 130.3 | 11.4 | 0.0 | 0.0 | 0.0 | 0.0 | 141.9 |
| 1993 | 5.2 | 19.5 | 63.1 | 1.4 | 0.0 | 0.0 | 0.0 | 89.2 |
| 1994 | 3.1 | 4.7 | 16.7 | 0.0 | 0.0 | 0.0 | 0.0 | 24.5 |
| 1995 | 8.2 | 4.1 | 41.7 | 0.0 | 0.9 | 0.1 | 0.0 | 54.9 |
| 1996 | 14.1 | 10.8 | 2.7 | 0.0 | 0.0 | 0.2 | 0.0 | 27.8 |
| Total | 38.6 | 179.1 | 212.0 | 1.6 | 0.9 | 0.3 | 0.0 | 432.5 |
| % of Total | 8.9% | 41.4% | 49.0% | 0.4% | 0.2% | 0.1% | 0.0% | 100.0% |

Table 20. Estimated catches (tons) of salmon sharks in the Gulf of Alaska by statistical area, 1997-2002 using the improved pseudo-blend estimation procedure (Gaichas 2002).

| Year | 610 | 620 | 630 | 640 | 649 | 650 | 659 | Total |
|---|---|---|---|---|---|---|---|---|
| 1997 | 5.6 | 10.3 | 107.4 | 0.0 | 0.5 | 0.0 | 0.0 | 123.8 |
| 1998 | 10.0 | 39.6 | 20.7 | 0.4 | 0.3 | 0.0 | 0.0 | 71.0 |
| 1999 | 15.1 | 39.9 | 58.3 | 0.0 | 0.0 | 18.4 | 0.0 | 131.6 |
| 2000 | 7.1 | 11.1 | 19.0 | 0.6 | 0.0 | 0.0 | 0.0 | 37.8 |
| 2001 | 13.0 | 1.7 | 18.1 | 0.0 | 0.0 | 0.0 | 0.0 | 32.8 |
| 2002 | 20.5 | 11.2 | 26.4 | 0.0 | 0.0 | 0.0 | 0.0 | 58.2 |
| Total | 71.3 | 113.8 | 249.8 | 1.0 | 0.8 | 18.4 | 0.0 | 455.1 |
| % of Total | 16% | 25% | 55% | 0% | 0% | 4% | 0% | 100% |

Table 21. Estimated catches (tons) of other and unidentified sharks in the Gulf of Alaska by statistical area, 1990-1996 using a pseudo-blend catch procedure (Gaichas et al. 1999).

| **Year** | **610** | **620** | **630** | **640** | **649** | **650** | **659** | **Total** |
|---|---|---|---|---|---|---|---|---|
| 1990 | 0.9 | 3.6 | 25.1 | 0.1 | 0.0 | 0.7 | 0.0 | 30.4 |
| 1991 | 6.9 | 1.1 | 99.9 | 0.3 | 0.0 | 0.0 | 0.0 | 108.1 |
| 1992 | 4.5 | 1.4 | 11.3 | 0.0 | 0.0 | 0.0 | 0.0 | 17.2 |
| 1993 | 2.1 | 5.6 | 195.0 | 4.0 | 0.0 | 133.0 | 0.0 | 339.6 |
| 1994 | 5.5 | 27.5 | 22.9 | 0.0 | 0.0 | 0.0 | 0.0 | 55.9 |
| 1995 | 2.0 | 0.9 | 32.0 | 1.2 | 0.0 | 13.3 | 0.0 | 49.4 |
| 1996 | 3.0 | 16.1 | 17.6 | 3.9 | 0.0 | 12.8 | 0.0 | 53.4 |
| Total | 25.0 | 56.1 | 403.7 | 9.4 | 0.0 | 159.8 | 0.0 | 654.1 |
| % of Total | 3.8% | 8.6% | 61.7% | 1.4% | 0.0% | 24.4% | 0.0% | 100.0% |

Table 22. Estimated catches (tons) of other and unidentified sharks in the Gulf of Alaska by statistical area, 1997-2002 using the improved pseudo-blend estimation procedure (Gaichas 2002).

| **Year** | **610** | **620** | **630** | **640** | **649** | **650** | **659** | **Total** |
|---|---|---|---|---|---|---|---|---|
| 1997 | 5.9 | 5.6 | 72.6 | 26.4 | 0.0 | 13.0 | 0.0 | 123.5 |
| 1998 | 1.3 | 25.7 | 48.1 | 4.9 | 1.1 | 46.2 | 1,252.6 | 1,379.9 |
| 1999 | 9.3 | 2.1 | 13.4 | 0.5 | 1.9 | 5.7 | 0.0 | 33.0 |
| 2000 | 3.7 | 17.5 | 29.8 | 6.1 | 0.0 | 16.6 | 0.0 | 73.6 |
| 2001 | 0.9 | 19.2 | 21.7 | 1.9 | 0.0 | 33.3 | 0.0 | 77.0 |
| 2002 | NA | NA | NA | NA | NA | NA | NA | NA |
| Total | 21.2 | 70.1 | 185.4 | 39.9 | 3.0 | 114.7 | 1,252.6 | 1,687.0 |
| % of Total | 1% | 4% | 11% | 2% | 0% | 7% | 74% | 100% |

Table 23. Estimated catches (tons) of spiny dogfish in the Eastern Bering Sea and Aleutian Islands by fishery and gear type, 1997-2001 using the improved pseudo-blend estimation procedure Gaichas (2002).

| Fishery | Gear | 1997 | 1998 | 1999 | 2000 | 2001 | Total | % of Total |
|---|---|---|---|---|---|---|---|---|
| Atka Mackerel | TWL | 0.0 | 0.2 | 0.0 | 0.0 | 2.8 | 3.1 | 7% |
| | | | | | | | | |
| Flatfish | TWL | 0.0 | 0.4 | 0.0 | 0.2 | 1.6 | 2.2 | 5% |
| | POT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | LGL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| Flatfish Total | | 0.0 | 0.4 | 0.0 | 0.2 | 1.6 | 2.2 | 5% |
| | | | | | | | | |
| Other/Unknown | TWL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | POT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | LGL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| Other Total | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | | | | | | | | |
| Pacific Cod | TWL | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 0.5 | 1% |
| | POT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | JIG | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | LGL | 4.1 | 5.6 | 4.9 | 8.6 | 12.2 | 35.4 | 85% |
| Pacific Cod Total | | 4.1 | 5.6 | 4.9 | 8.6 | 12.7 | 35.9 | 86% |
| | | | | | | | | |
| Bottom Pollock | TWL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| Pelagic Pollock | TWL | 0.0 | 0.1 | 0.0 | 0.0 | 0.1 | 0.3 | 1% |
| Pollock | LGL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| Pollock Total | | 0.0 | 0.1 | 0.0 | 0.0 | 0.1 | 0.3 | 1% |
| | | | | | | | | |
| Rockfish | TWL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | LGL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| Rockfish Total | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | | | | | | | | |
| Sablefish | TWL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | POT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | LGL | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0% |
| Sablefish Total | | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0% |
| | | | | | | | | |
| Turbot | TWL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | POT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | LGL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| Turbot Total | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | | | | | | | | |
| Grand Total | | 4.1 | 6.4 | 5.0 | 8.9 | 17.3 | 41.6 | 100% |

Table 24. Estimated catches (tons) of Pacific sleeper sharks in the Eastern Bering Sea and Aleutian Islands by fishery and gear type, 1997-2001 using the improved pseudo-blend estimation procedure (Gaichas 2002).

| Fishery | Gear | 1997 | 1998 | 1999 | 2000 | 2001 | Total | % of Total |
|---|---|---|---|---|---|---|---|---|
| Atka Mackerel | TWL | 0.0 | 0.0 | 2.4 | 0.3 | 27.8 | 30.5 | 1% |
| | | | | | | | | |
| Flatfish | TWL | 0.9 | 0.6 | 39.4 | 42.0 | 179.6 | 262.6 | 12% |
| | POT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | LGL | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.3 | 0% |
| Flatfish Total | | 0.9 | 0.9 | 39.4 | 42.0 | 179.6 | 262.9 | 12% |
| | | | | | | | | |
| Other/Unknown | TWL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | POT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | LGL | 0.0 | 0.5 | 0.4 | 0.0 | 0.3 | 1.2 | 0% |
| Other Total | | 0.0 | 0.5 | 0.4 | 0.0 | 0.3 | 1.2 | 0% |
| | | | | | | | | |
| Pacific Cod | TWL | 7.9 | 32.6 | 3.6 | 0.4 | 12.2 | 56.8 | 3% |
| | POT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | JIG | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | LGL | 66.9 | 114.1 | 99.7 | 114.3 | 240.5 | 635.4 | 30% |
| Pacific Cod Total | | 74.8 | 146.7 | 103.3 | 114.7 | 252.7 | 692.2 | 32% |
| | | | | | | | | |
| Bottom Pollock | TWL | 15.1 | 0.6 | 0.1 | 0.0 | 0.0 | 15.9 | 1% |
| Pelagic Pollock | TWL | 90.0 | 73.8 | 76.7 | 103.8 | 205.7 | 550.0 | 26% |
| Pollock | LGL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| Pollock Total | | 105.2 | 74.4 | 76.8 | 103.8 | 205.7 | 565.9 | 26% |
| | | | | | | | | |
| Rockfish | TWL | 0.0 | 0.0 | 1.4 | 2.7 | 0.0 | 4.1 | 0% |
| | LGL | 0.9 | 0.0 | 1.7 | 0.0 | 0.0 | 2.5 | 0% |
| Rockfish Total | | 0.9 | 0.0 | 3.0 | 2.7 | 0.0 | 6.7 | 0% |
| | | | | | | | | |
| Sablefish | TWL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | POT | 0.0 | 0.0 | 0.0 | 0.4 | 0.2 | 0.6 | 0% |
| | LGL | 45.3 | 0.0 | 15.1 | 143.3 | 1.7 | 205.4 | 10% |
| Sablefish Total | | 45.3 | 0.0 | 15.1 | 143.7 | 1.8 | 206.0 | 10% |
| | | | | | | | | |
| Turbot | TWL | 6.5 | 0.3 | 0.2 | 0.0 | 0.0 | 7.0 | 0% |
| | POT | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.1 | 0% |
| | LGL | 70.5 | 113.1 | 78.1 | 83.1 | 19.3 | 364.1 | 17% |
| Turbot Total | | 77.0 | 113.5 | 78.2 | 83.2 | 19.3 | 371.2 | 17% |
| | | | | | | | | |
| Grand Total | | 304.1 | 336.0 | 318.7 | 490.4 | 687.3 | 2,136.5 | 100% |

Table 25. Estimated catches (tons) of salmon sharks in the Eastern Bering Sea and Aleutian Islands by fishery and gear type, 1997-2001 using the improved pseudo-blend estimation procedure (Gaichas 2002).

| **Fishery** | **Gear** | **1997** | **1998** | **1999** | **2000** | **2001** | **Total** | **% of Total** |
|---|---|---|---|---|---|---|---|---|
| Atka Mackerel | TWL | 0.1 | 0.0 | 0.2 | 0.0 | 0.4 | 0.7 | 1% |
| | | | | | | | | |
| Flatfish | TWL | 0.0 | 0.1 | 2.5 | 0.0 | 0.4 | 3.0 | 3% |
| | POT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | LGL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| Flatfish Total | | 0.0 | 0.1 | 2.5 | 0.0 | 0.4 | 3.0 | 3% |
| | | | | | | | | |
| Other/Unknown | TWL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | POT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | LGL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| Other Total | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | | | | | | | | |
| Pacific Cod | TWL | 0.0 | 0.0 | 0.1 | 3.6 | 0.0 | 3.7 | 4% |
| | POT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | JIG | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | LGL | 0.0 | 0.8 | 1.1 | 0.2 | 1.2 | 3.3 | 3% |
| Pacific Cod Total | | 0.0 | 0.8 | 1.2 | 3.8 | 1.2 | 7.0 | 7% |
| | | | | | | | | |
| Bottom Pollock | TWL | 1.4 | 0.0 | 0.0 | 0.0 | 0.0 | 1.4 | 1% |
| Pelagic Pollock | TWL | 5.3 | 16.2 | 24.7 | 19.5 | 22.5 | 88.2 | 86% |
| Pollock | LGL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| Pollock Total | | 6.7 | 16.2 | 24.7 | 19.5 | 22.5 | 89.6 | 87% |
| | | | | | | | | |
| Rockfish | TWL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | LGL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| Rockfish Total | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | | | | | | | | |
| Sablefish | TWL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | POT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | LGL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| Sablefish Total | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | | | | | | | | |
| Turbot | TWL | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.3 | 0% |
| | POT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | LGL | 0.0 | 0.5 | 1.5 | 0.0 | 0.0 | 2.0 | 2% |
| Turbot Total | | 0.0 | 0.8 | 1.5 | 0.0 | 0.0 | 2.3 | 2% |
| | | | | | | | | |
| Grand Total | | 6.8 | 18.0 | 30.0 | 23.3 | 24.4 | 102.6 | 100% |

Table 26. Estimated catches (tons) of other and unidentified sharks in the Eastern Bering Sea and Aleutian Islands by fishery and gear type, 1997-2001 using the improved pseudo-blend estimation procedure (Gaichas 2002).

| Fishery | Gear | **1997** | **1998** | **1999** | **2000** | **2001** | **Total** | **% of Total** |
|---|---|---|---|---|---|---|---|---|
| Atka Mackerel | TWL | 0.0 | 13.1 | 0.0 | 0.0 | 0.0 | 13.1 | 3% |
| | | | | | | | | |
| Flatfish | TWL | 0.4 | 0.0 | 0.2 | 1.2 | 0.0 | 1.8 | 0% |
| | POT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | LGL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| Flatfish Total | | 0.4 | 0.0 | 0.2 | 1.2 | 0.0 | 1.8 | 0% |
| | | | | | | | | |
| Other/Unknown | TWL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | POT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | LGL | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.3 | 0% |
| Other Total | | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.3 | 0% |
| | | | | | | | | |
| Pacific Cod | TWL | 0.2 | 0.0 | 0.3 | 9.1 | 2.3 | 11.9 | 3% |
| | POT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | JIG | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | LGL | 26.6 | 48.4 | 18.5 | 47.0 | 17.3 | 157.9 | 34% |
| Pacific Cod Total | | 26.8 | 48.4 | 18.8 | 56.1 | 19.6 | 169.8 | 36% |
| | | | | | | | | |
| Bottom Pollock | TWL | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.3 | 0% |
| Pelagic Pollock | TWL | 15.6 | 45.2 | 10.3 | 0.1 | 2.3 | 73.5 | 16% |
| Pollock | LGL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| Pollock Total | | 15.6 | 45.4 | 10.3 | 0.1 | 2.3 | 73.8 | 16% |
| | | | | | | | | |
| Rockfish | TWL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | LGL | 2.5 | 0.0 | 0.0 | 0.0 | 0.0 | 2.5 | 1% |
| Rockfish Total | | 2.5 | 0.0 | 0.0 | 0.0 | 0.0 | 2.5 | 1% |
| | | | | | | | | |
| Sablefish | TWL | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | POT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | LGL | 1.2 | 2.1 | 1.8 | 7.2 | 10.4 | 22.7 | 5% |
| Sablefish Total | | 1.2 | 2.1 | 1.8 | 7.2 | 10.4 | 22.7 | 5% |
| | | | | | | | | |
| Turbot | TWL | 0.0 | 1.1 | 1.0 | 0.5 | 0.0 | 2.6 | 1% |
| | POT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0% |
| | LGL | 6.3 | 25.9 | 143.9 | 2.5 | 2.7 | 181.2 | 39% |
| Turbot Total | | 6.3 | 26.9 | 144.9 | 3.0 | 2.7 | 183.8 | 39% |
| | | | | | | | | |
| Grand Total | | 52.8 | 136.1 | 176.4 | 67.6 | 35.0 | 467.8 | 100% |

Table 27. Estimated catches (tons) of spiny dogfish in the Eastern Bering Sea and Aleutian Islands by statistical area, 1997-2002 using the improved pseudo-blend estimation procedure (Gaichas 2002).

| Year | 508 | 509 | 512 | 513 | 514 | 516 | 517 | 518 | 519 | 521 | 523 | 524 | 530 | 541 | 542 | 543 | 550 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1997 | 0.0 | 1.7 | 0.0 | 0.0 | 0.0 | 0.0 | 1.5 | 0.0 | 0.1 | 0.6 | 0.1 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 4.1 |
| 1998 | 0.0 | 3.1 | 0.0 | 0.1 | 0.0 | 0.0 | 1.3 | 0.2 | 0.1 | 0.8 | 0.1 | 0.0 | 0.0 | 0.4 | 0.1 | 0.0 | 0.0 | 6.4 |
| 1999 | 0.0 | 2.4 | 0.0 | 0.1 | 0.0 | 0.0 | 1.0 | 0.4 | 0.1 | 0.8 | 0.1 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 5.0 |
| 2000 | 0.0 | 5.8 | 0.0 | 0.2 | 0.0 | 0.0 | 1.9 | 0.1 | 0.2 | 0.4 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 | 0.0 | 0.0 | 8.9 |
| 2001 | 0.0 | 5.7 | 0.1 | 1.2 | 0.0 | 0.2 | 3.8 | 0.6 | 0.2 | 1.3 | 0.1 | 0.0 | 0.0 | 1.0 | 2.4 | 0.8 | 0.0 | 17.3 |
| 2002 | 0.0 | 3.9 | 0.0 | 0.2 | 0.0 | 0.3 | 1.9 | 0.0 | 0.0 | 2.8 | 0.1 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 9.4 |
| Total | 0.0 | 22.6 | 0.1 | 1.8 | 0.0 | 0.5 | 11.4 | 1.3 | 0.7 | 6.7 | 0.4 | 0.0 | 0.0 | 2.0 | 2.6 | 0.8 | 0.0 | 51.0 |
| % of Total | 0% | 44% | 0% | 4% | 0% | 1% | 22% | 3% | 1% | 13% | 1% | 0% | 0% | 4% | 5% | 2% | 0% | 100% |

Table 28. Estimated catches (tons) of Pacific sleeper sharks in the Eastern Bering Sea and Aleutian Islands by statistical area, 1997-2002 using the improved pseudo-blend estimation procedure (Gaichas 2002).

| Year | 508 | 509 | 512 | 513 | 514 | 516 | 517 | 518 | 519 | 521 | 523 | 524 | 530 | 541 | 542 | 543 | 550 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1997 | 0.0 | 1.0 | 0.0 | 4.7 | 0.0 | 0.0 | 76.2 | 35.4 | 32.5 | 108.5 | 8.1 | 9.7 | 0.0 | 26.9 | 0.9 | 0.0 | 0.0 | 304.1 |
| 1998 | 0.0 | 0.4 | 0.0 | 1.9 | 0.5 | 0.0 | 44.0 | 36.7 | 36.0 | 193.8 | 4.1 | 15.5 | 0.0 | 3.2 | 0.0 | 0.0 | 0.0 | 336.0 |
| 1999 | 0.0 | 0.5 | 0.0 | 1.5 | 0.0 | 0.0 | 76.4 | 18.9 | 2.8 | 163.8 | 7.7 | 15.6 | 0.0 | 6.8 | 24.7 | 0.0 | 0.0 | 318.7 |
| 2000 | 0.0 | 2.3 | 0.0 | 3.6 | 0.0 | 0.1 | 93.8 | 2.1 | 26.9 | 199.4 | 5.6 | 12.5 | 0.0 | 1.4 | 48.7 | 93.9 | 0.0 | 490.4 |
| 2001 | 0.0 | 11.7 | 0.0 | 6.4 | 0.0 | 0.0 | 142.5 | 9.3 | 48.6 | 420.5 | 3.2 | 9.6 | 0.0 | 26.7 | 8.7 | 0.0 | 0.0 | 687.3 |
| 2002 | 0.0 | 36.8 | 0.0 | 5.7 | 0.0 | 0.0 | 172.0 | 0.2 | 9.3 | 601.8 | 5.7 | 2.5 | 0.0 | 1.9 | 0.1 | 2.4 | 0.0 | 838.5 |
| Total | 0.0 | 52.7 | 0.0 | 23.9 | 0.5 | 0.2 | 605.0 | 102.5 | 156.1 | 1,687.8 | 34.5 | 65.5 | 0.0 | 66.9 | 83.1 | 96.3 | 0.0 | 2,975.0 |
| % of Total | 0% | 2% | 0% | 1% | 0% | 0% | 20% | 3% | 5% | 57% | 1% | 2% | 0% | 2% | 3% | 3% | 0% | 100% |

Table 29. Estimated catches (tons) of salmon sharks in the Eastern Bering Sea and Aleutian Islands by statistical area, 1997-2002 using the improved pseudo-blend estimation procedure (Gaichas 2002).

| Year | **508** | **509** | **512** | **513** | **514** | **516** | **517** | **518** | **519** | **521** | **523** | **524** | **530** | **541** | **542** | **543** | **550** | **Total** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1997 | 0.0 | 1.3 | 0.0 | 0.2 | 0.0 | 0.0 | 4.0 | 0.0 | 0.3 | 0.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 6.8 |
| 1998 | 0.0 | 2.0 | 0.0 | 0.5 | 0.0 | 0.0 | 10.3 | 0.2 | 1.4 | 2.5 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 18.0 |
| 1999 | 0.0 | 2.0 | 0.0 | 1.5 | 0.0 | 0.0 | 18.9 | 0.0 | 0.0 | 7.1 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 | 0.1 | 0.0 | 30.0 |
| 2000 | 0.0 | 4.5 | 0.0 | 0.8 | 0.0 | 0.0 | 6.0 | 0.0 | 0.4 | 7.8 | 0.0 | 0.3 | 0.0 | 0.1 | 3.4 | 0.0 | 0.0 | 23.3 |
| 2001 | 0.0 | 2.3 | 0.0 | 3.3 | 0.0 | 0.1 | 8.2 | 0.0 | 2.0 | 7.5 | 0.5 | 0.3 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 24.4 |
| 2002 | 0.0 | 2.9 | 0.0 | 4.3 | 0.0 | 0.0 | 11.3 | 0.0 | 1.2 | 26.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 46.6 |
| Total | 0.0 | 15.0 | 0.0 | 10.7 | 0.0 | 0.1 | 58.6 | 0.2 | 5.3 | 52.6 | 0.5 | 0.7 | 0.0 | 0.4 | 4.0 | 1.1 | 0.0 | 149.2 |
| % of Total | 0% | 10% | 0% | 7% | 0% | 0% | 39% | 0% | 4% | 35% | 0% | 0% | 0% | 0% | 3% | 1% | 0% | 100% |

Table 30. Estimated catches (tons) of other and unidentified sharks in the Eastern Bering Sea and Aleutian Islands by statistical area, 1997-2002 using the improved pseudo-blend estimation procedure (Gaichas 2002).

| Year | **508** | **509** | **512** | **513** | **514** | **516** | **517** | **518** | **519** | **521** | **523** | **524** | **530** | **541** | **542** | **543** | **550** | **Total** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1997 | 0.0 | 6.8 | 0.0 | 0.6 | 0.0 | 0.0 | 9.3 | 6.3 | 1.7 | 23.0 | 1.9 | 3.0 | 0.0 | 0.1 | 0.1 | 0.0 | 0.0 | 52.8 |
| 1998 | 0.0 | 6.6 | 0.0 | 0.7 | 0.0 | 0.1 | 10.9 | 2.0 | 6.4 | 90.4 | 1.4 | 2.1 | 0.0 | 13.9 | 1.6 | 0.0 | 0.0 | 136.1 |
| 1999 | 0.0 | 0.3 | 0.0 | 0.2 | 0.0 | 0.0 | 3.7 | 3.0 | 2.6 | 21.6 | 3.9 | 140.7 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 | 176.4 |
| 2000 | 0.0 | 0.5 | 0.0 | 0.0 | 0.0 | 0.1 | 8.2 | 3.2 | 0.1 | 46.1 | 1.7 | 0.0 | 0.0 | 0.5 | 7.2 | 0.0 | 0.0 | 67.6 |
| 2001 | 0.0 | 0.7 | 0.0 | 0.2 | 0.0 | 0.0 | 7.5 | 0.0 | 0.3 | 15.2 | 0.7 | 0.0 | 0.0 | 0.0 | 10.4 | 0.0 | 0.0 | 35.0 |
| 2002 | 0.0 | 14.9 | 0.0 | 1.7 | 0.0 | 0.2 | 39.5 | 14.5 | 11.1 | 196.3 | 9.7 | 145.8 | 0.0 | 14.8 | 19.3 | 0.0 | 0.0 | 467.8 |
| Total | 0.0 | 29.7 | 0.0 | 3.4 | 0.0 | 0.4 | 79.0 | 29.0 | 22.3 | 392.6 | 19.4 | 291.6 | 0.0 | 29.6 | 38.6 | 0.0 | 0.0 | 935.7 |
| % of Total | 0% | 3% | 0% | 0% | 0% | 0% | 8% | 3% | 2% | 42% | 2% | 31% | 0% | 3% | 4% | 0% | 0% | 100% |

Table 31. Total shark biomass estimates (tons) from AFSC bottom trawl surveys in the Gulf of Alaska (GOA), Eastern Bering Sea (EBS), and Aleutian Islands (AI).

| Year | GOA | EBS Shelf | EBS Slope | AI |
|---|---|---|---|---|
| 1979 | | 389 | 0 | |
| 1980 | | 0 | | 800 |
| 1981 | | 0 | 1 | |
| 1982 | | 0 | 20 | |
| 1983 | | 379 | | 0 |
| 1984 | 18,155 | 0 | | |
| 1985 | | 47 | 545 | |
| 1986 | | 0 | | 0 |
| 1987 | 24,048 | 223 | | |
| 1988 | | 4,057 | 1,993 | |
| 1989 | | 0 | | |
| 1990 | 33,061 | 0 | | |
| 1991 | | 0 | 1,235 | 2,927 |
| 1992 | | 2,564 | | |
| 1993 | 50,030 | 0 | | |
| 1994 | | 5,012 | | 421 |
| 1995 | | 1,005 | | |
| 1996 | 52,881 | 2,804 | | |
| 1997 | | 37 | | 2,497 |
| 1998 | | 2,378 | | |
| 1999 | 51,461 | 2,079 | | |
| 2000 | | 1,487 | (Pilot survey) | 2,663 |
| 2001 | 69,469 | 0 | | |
| 2002 | | 5,602 | 25,445 | 1,557 |
| 2003 | 155,078 | 734 | | |
| 2004 | | 3,121 | 2,260 | |

Source: Gaichas et al. (1999, Table 15), Gaichas (2003, Table 16-8). GOA updated from RACEBASE May 3, 2004. EBS Shelf and Slope updated Oct, 2004 (Pers. Comm., Gary Walters).

Table 32. Gulf of Alaska AFSC trawl survey estimates of individual shark species total biomass (tons) with cv, and number of hauls.

| Year | Total Hauls | | Spiny Dogfish | Sleeper Shark | Salmon shark |
|---|---|---|---|---|---|
| 1984 | 929 | Hauls with catch | 125 | 1 | 5 |
| | | Biomass | 10,143.0 | 163.2 | 7,848.8 |
| | | cv of Biomass | 0.206 | 1.000 | 0.522 |
| 1987 | 783 | Hauls with catch | 122 | 8 | 15 |
| | | Biomass | 10,106.8 | 1,319.2 | 12,622.5 |
| | | cv of Biomass | 0.269 | 0.434 | 0.562 |
| 1990 | 708 | Hauls with catch | 114 | 3 | 13 |
| | | Biomass | 18,947.6 | 1,651.4 | 12,462.0 |
| | | cv of Biomass | 0.378 | 0.660 | 0.297 |
| 1993 | 775 | Hauls with catch | 166 | 13 | 9 |
| | | Biomass | 33,645.1 | 8,656.8 | 7,728.6 |
| | | cv of Biomass | 0.204 | 0.500 | 0.356 |
| 1996 | 807 | Hauls with catch | 99 | 11 | 1 |
| | | Biomass | 28,477.9 | 21,100.9 | 3,302.0 |
| | | cv of Biomass | 0.736 | 0.358 | 1.000 |
| 1999 | 764 | Hauls with catch | 168 | 13 | 0 |
| | | Biomass | 31,742.9 | 19,362.0 | |
| | | cv of Biomass | 0.138 | 0.399 | |
| 2001 | 489 | Hauls with catch | 75 | 15 | 0 |
| | | Biomass | 31,774.3 | 37,694.7 | |
| | | cv of Biomass | 0.450 | 0.362 | |
| 2003 | 809 | Hauls with catch | 204 | 28 | 2 |
| | | Biomass | 98,743.8 | 52,115.6 | 3,612.8 |
| | | cv of Biomass | 0.219 | 0.247 | 0.707 |

Source: Gaichas et al. (1999, Table 16) updated May 14, 2004. (Pers. Comm. Michael Martins).

Table 33. Eastern Bering Sea shelf AFSC trawl survey estimates of individual shark species total biomass (tons) with cv and number of hauls (Gary Walters Pers. Comm. October, 2004).

| Year | Total hauls | | Spiny Dogfish | Sleeper Shark | Salmon Shark |
|---|---|---|---|---|---|
| 1979 | 452 | Hauls with catch | 4 | 0 | 0 |
| | | Biomass | 389 | | |
| | | cv of Biomass | 0.564 | | |
| 1980 | 342 | Hauls with catch | 0 | 0 | 0 |
| | | Biomass | | | |
| | | cv of Biomass | | | |
| 1981 | 290 | Hauls with catch | 0 | 0 | 0 |
| | | Biomass | | | |
| | | cv of Biomass | | | |
| 1982 | 329 | Hauls with catch | 0 | 0 | 0 |
| | | Biomass | | | |
| | | cv of Biomass | | | |
| 1983 | 354 | Hauls with catch | 2 | 0 | 0 |
| | | Biomass | 379 | | |
| | | cv of Biomass | 0.827 | | |
| 1984 | 355 | Hauls with catch | 0 | 0 | 0 |
| | | Biomass | | | |
| | | cv of Biomass | | | |
| 1985 | 353 | Hauls with catch | 1 | 0 | 0 |
| | | Biomass | 47 | | |
| | | cv of Biomass | 0.991 | | |
| 1986 | 354 | Hauls with catch | 0 | 0 | 0 |
| | | Biomass | | | |
| | | cv of Biomass | | | |
| 1987 | 342 | Hauls with catch | 3 | 0 | 0 |
| | | Biomass | 223 | | |
| | | cv of Biomass | 0.602 | | |
| 1988 | 353 | Hauls with catch | 1 | 0 | 1 |
| | | Biomass | 249 | | 3,808 |
| | | cv of Biomass | 1.001 | | 1.000 |

Table 33. Continued.

| Year | Total hauls | | Spiny Dogfish | Sleeper Shark | Salmon Shark |
|---|---|---|---|---|---|
| 1989 | 353 | Hauls with catch | 0 | 0 | 0 |
| | | Biomass | | | |
| | | cv of Biomass | | | |
| 1990 | 352 | Hauls with catch | 0 | 0 | 0 |
| | | Biomass | | | |
| | | cv of Biomass | | | |
| 1991 | 351 | Hauls with catch | 0 | 0 | 0 |
| | | Biomass | | | |
| | | cv of Biomass | | | |
| 1992 | 336 | Hauls with catch | 0 | 2 | 0 |
| | | Biomass | | 2,564 | |
| | | cv of Biomass | | 0.722 | |
| 1993 | 355 | Hauls with catch | 0 | 0 | 0 |
| | | Biomass | | | |
| | | cv of Biomass | | | |
| 1994 | 355 | Hauls with catch | 0 | 2 | 0 |
| | | Biomass | | 5,012 | |
| | | cv of Biomass | | 0.816 | |
| 1995 | 356 | Hauls with catch | 0 | 1 | 0 |
| | | Biomass | | 1,005 | |
| | | cv of Biomass | | 1.000 | |
| 1996 | 355 | Hauls with catch | 0 | 2 | 0 |
| | | Biomass | | 2,804 | |
| | | cv of Biomass | | 0.817 | |
| 1997 | 356 | Hauls with catch | 1 | 0 | 0 |
| | | Biomass | 37 | | |
| | | cv of Biomass | 1.000 | | |
| 1998 | 355 | Hauls with catch | 1 | 1 | 0 |
| | | Biomass | 254 | 2,124 | |
| | | cv of Biomass | 1.000 | 1.000 | |

Table 33. Continued.

| Year | Total hauls | | Spiny Dogfish | Sleeper Shark | Salmon Shark |
|---|---|---|---|---|---|
| 1999 | 353 | Hauls with catch | 0 | 2 | 0 |
| | | Biomass | | 2,079 | |
| | | cv of Biomass | | 0.708 | |
| 2000 | 352 | Hauls with catch | 0 | 1 | 0 |
| | | Biomass | | 1,487 | |
| | | cv of Biomass | | 1.000 | |
| 2001 | 355 | Hauls with catch | 0 | 0 | 0 |
| | | Biomass | | | |
| | | cv of Biomass | | | |
| 2002 | 355 | Hauls with catch | 0 | 3 | 0 |
| | | Biomass | | 5,602 | |
| | | cv of Biomass | | 0.648 | |
| 2003 | 356 | Hauls with catch | 0 | 1 | 0 |
| | | Biomass | | 734 | |
| | | cv of Biomass | | 1.000 | |
| 2004 | 356 | Hauls with catch | 1 | 2 | 0 |
| | | Biomass | 28 | 3,093 | |
| | | cv of Biomass | 0.999 | 0.711 | |

Table 34. Eastern Bering Sea slope AFSC trawl survey estimates of individual shark species total biomass (tons) with cv, and number of hauls (Gary Walters Pers. Comm. October, 2004).

| Year | Total hauls | | Spiny Dogfish | Sleeper Shark | Salmon Shark |
|---|---|---|---|---|---|
| 1979 | 105 | Hauls with catch | 0 | 0 | 0 |
| | | Biomass | | | |
| | | cv of Biomass | | | |
| 1981 | 205 | Hauls with catch | 1 | 0 | 0 |
| | | Biomass | 1 | | |
| | | cv of Biomass | 0.832 | | |
| 1982 | 299 | Hauls with catch | 3 | 1 | 0 |
| | | Biomass | 8 | 12 | |
| | | cv of Biomass | 0.726 | 1.022 | |
| 1985 | 325 | Hauls with catch | 3 | 19 | 0 |
| | | Biomass | 2 | 543 | |
| | | cv of Biomass | 0.655 | 0.101 | |
| 1988 | 131 | Hauls with catch | 0 | 10 | 0 |
| | | Biomass | | 1,993 | |
| | | cv of Biomass | | 0.389 | |
| 1991 | 85 | Hauls with catch | 0 | 6 | 0 |
| | | Biomass | | 1,235 | |
| | | cv of Biomass | | 0.441 | |
| 2002 | 141 | Hauls with catch | 0 | 15 | 0 |
| | | Biomass | | 25,445 | |
| | | cv of Biomass | | 0.874 | |
| 2004 | 231 | Hauls with catch | 0 | 24 | 0 |
| | | Biomass | | 2,260 | |
| | | cv of Biomass | | 0.342 | |

Table 35. Aleutian Islands AFSC trawl survey estimates of individual shark species total biomass (tons) with cv, and number of hauls (Michael Martins Pers Comm May 14, 2004).

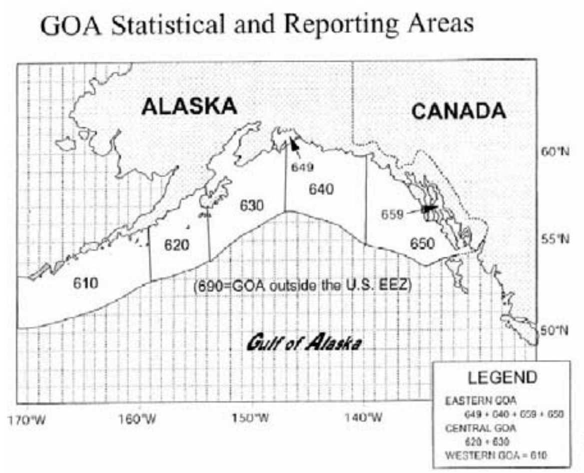
| Year | Total hauls | | Spiny Dogfish | Sleeper Shark | Salmon shark |
|---|---|---|---|---|---|
| 1980 | 129 | Hauls with catch | 0 | 0 | 0 |
| | | Biomass | | | |
| | | cv of Biomass | | | |
| 1983 | 372 | Hauls with catch | 3 | 3 | 0 |
| | | Biomass | 2.3 | 253.5 | |
| | | cv of Biomass | 0.608 | 0.648 | |
| 1986 | 443 | Hauls with catch | 6 | 12 | 0 |
| | | Biomass | 13.6 | 1,994.9 | |
| | | cv of Biomass | 0.513 | 0.365 | |
| 1991 | 331 | Hauls with catch | 0 | 3 | 0 |
| | | Biomass | | 2,926.5 | |
| | | cv of Biomass | | 0.694 | |
| 1994 | 381 | Hauls with catch | 9 | 3 | 0 |
| | | Biomass | 47.0 | 373.5 | |
| | | cv of Biomass | 0.370 | 0.638 | |
| 1997 | 397 | Hauls with catch | 2 | 10 | 0 |
| | | Biomass | 11.4 | 2,485.7 | |
| | | cv of Biomass | 0.708 | 0.289 | |
| 2000 | 419 | Hauls with catch | 3 | 3 | 0 |
| | | Biomass | 23.9 | 2,524.0 | |
| | | cv of Biomass | 0.622 | 0.570 | |
| 2002 | 417 | Hauls with catch | 0 | 4 | 1 |
| | | Biomass | | 536.2 | 1,020.6 |
| | | cv of Biomass | | 0.553 | 1.000 |

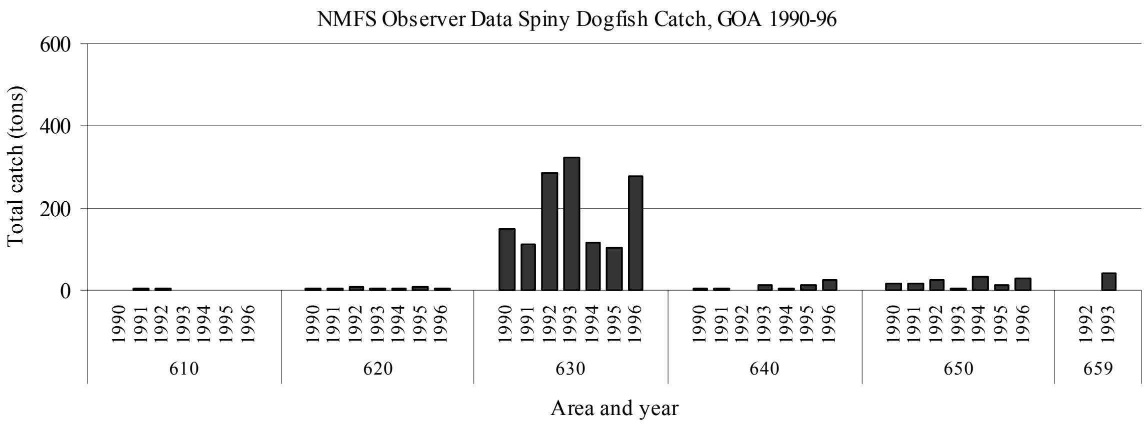
Table 36. Research catches (tons) of sharks between 1977 and 1998 in the Gulf of Alaska (GOA), Eastern Bering Sea (EBS), and Aleutian Islands (AI). Catches do not include longline surveys.

| Year | **GOA** | **EBS** | **AI** | **Total** |
|---|---|---|---|---|
| 1977 | 0.14 | 0 | - | 0.14 |
| 1978 | 1.44 | - | - | 1.44 |
| 1979 | 1 | 0.03 | - | 1.03 |
| 1980 | 0.86 | 0 | 0.3 | 1.16 |
| 1981 | 2.23 | 0.07 | - | 2.3 |
| 1982 | 0.36 | 0.16 | 0.02 | 0.54 |
| 1983 | 1.03 | 0.01 | 0.26 | 1.3 |
| 1984 | 3.12 | - | - | 3.12 |
| 1985 | 0.96 | 0.59 | - | 1.55 |
| 1986 | 1.38 | - | 2.21 | 3.59 |
| 1987 | 3.55 | 0.01 | - | 3.56 |
| 1988 | 0.27 | 1.06 | - | 1.33 |
| 1989 | 0.87 | 0.07 | - | 0.94 |
| 1990 | 3.52 | 0 | - | 3.52 |
| 1991 | 0.15 | 0.56 | 0.52 | 1.23 |
| 1992 | 0.12 | 0.09 | - | 0.21 |
| 1993 | 5.03 | - | - | 5.03 |
| 1994 | 0.43 | 0.17 | 0.13 | 0.73 |
| 1995 | 0.57 | 0.04 | - | 0.61 |
| 1996 | 3.48 | 0.1 | - | 3.58 |
| 1997 | 0.52 | 0.11 | 0.42 | 1.05 |
| 1998 | 0.58 | 0.09 | - | 0.67 |
| 1999 | | 0.08 | | |
| 2000 | | 8.50 | | |
| 2001 | | - | | |
| 2002 | | 5.74 | | |
| 2003 | | 0.03 | | |
| 2004 | | 0.76 | | |

Sources: Gaichas et al. (1999, Table 3), Gaichas (2002, Table 15-9), Gary Walters (Pers. Comm. Oct 2004).

## FIGURES



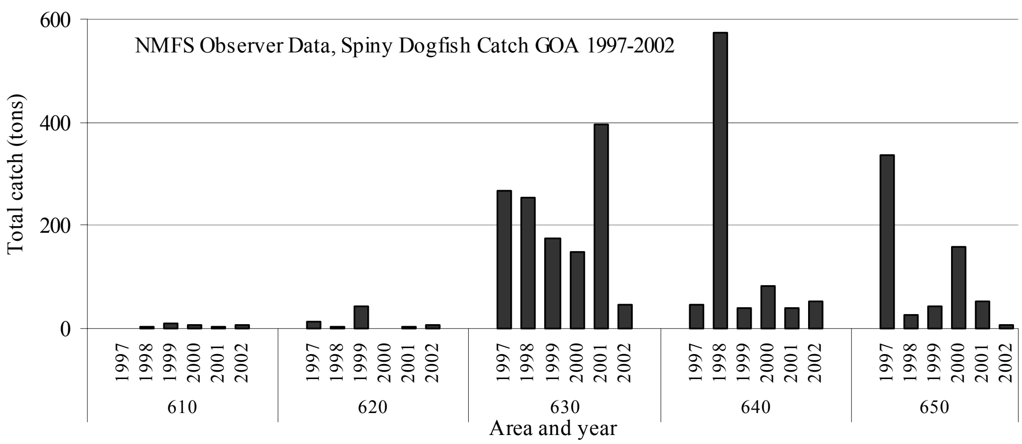




Figure 1. The statistical areas for NMFS observer data in the Gulf of Alaska and spiny dogfish bycatch in the GOA from 1990-1996 using a pseudo-blend catch estimation procedure (Gaichas et al. 1999) and from 1997-2002 using the improved pseudo-blend catch estimation procedure (Gaichas 2002).

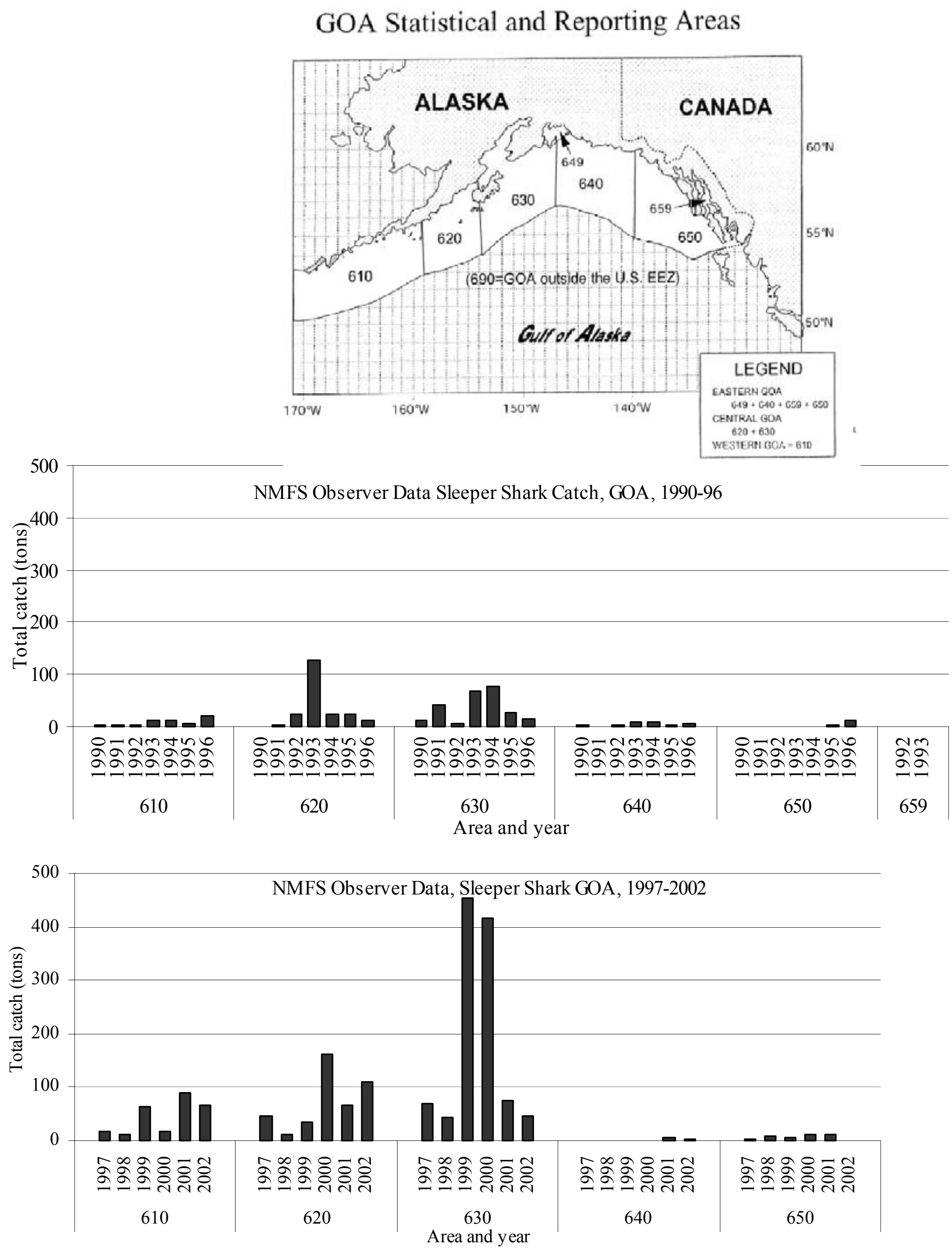



Figure 2. The statistical areas for NMFS observer data in the Gulf of Alaska and sleeper shark bycatch in the GOA from 1990-1996 using a pseudo-blend catch estimation procedure (Gaichas et al. 1999) and from 1997-2002 using the improved pseudo-blend catch estimation procedure (Gaichas 2002).

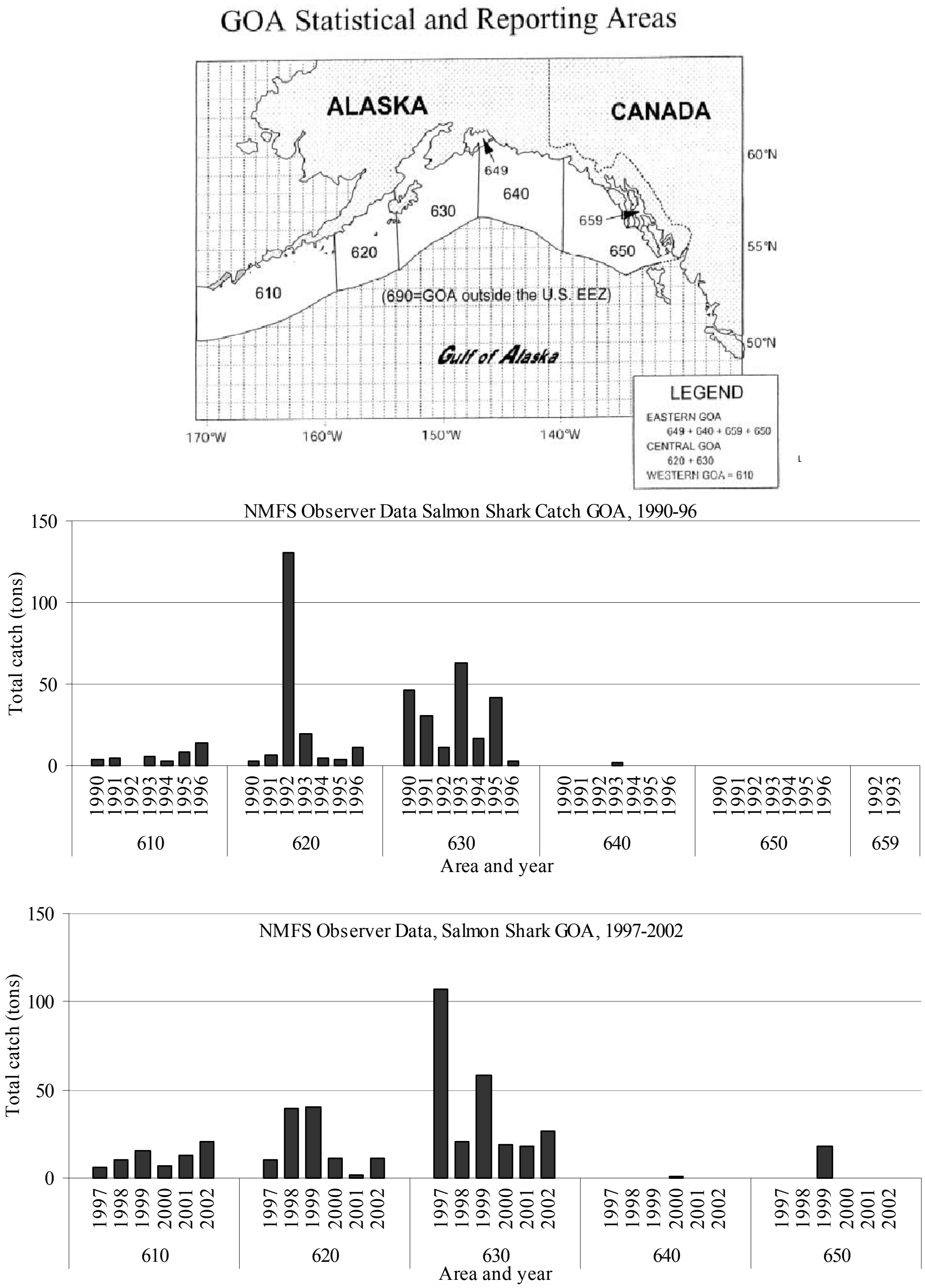
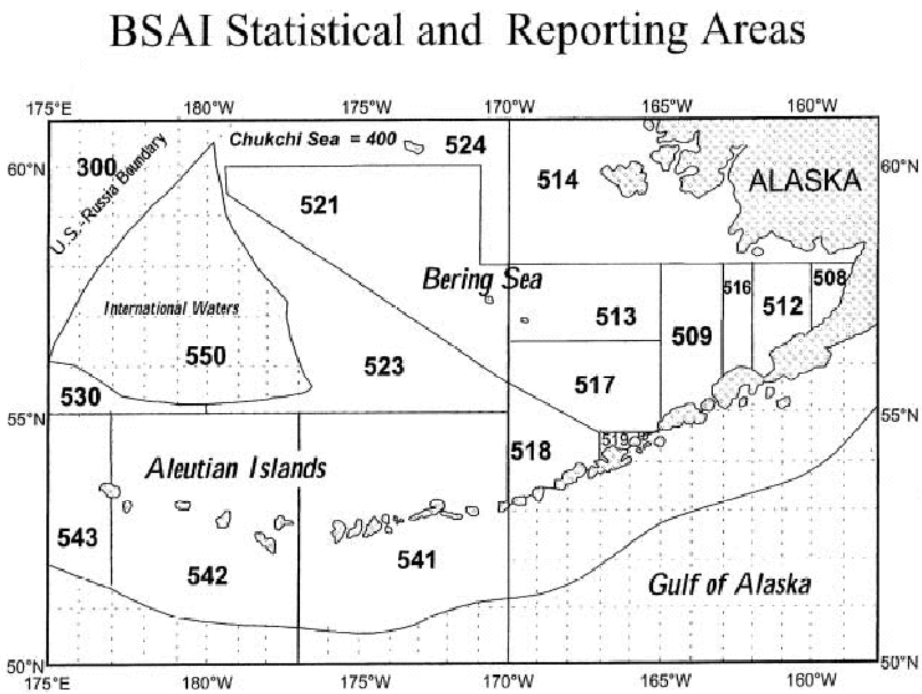



Figure 3. The statistical areas for NMFS observer data in the Gulf of Alaska and salmon shark bycatch in the GOA from 1990-1996 using a pseudo-blend catch estimation procedure (Gaichas et al. 1999) and from 1997-2002 using the improved pseudo-blend catch estimation procedure (Gaichas 2002).



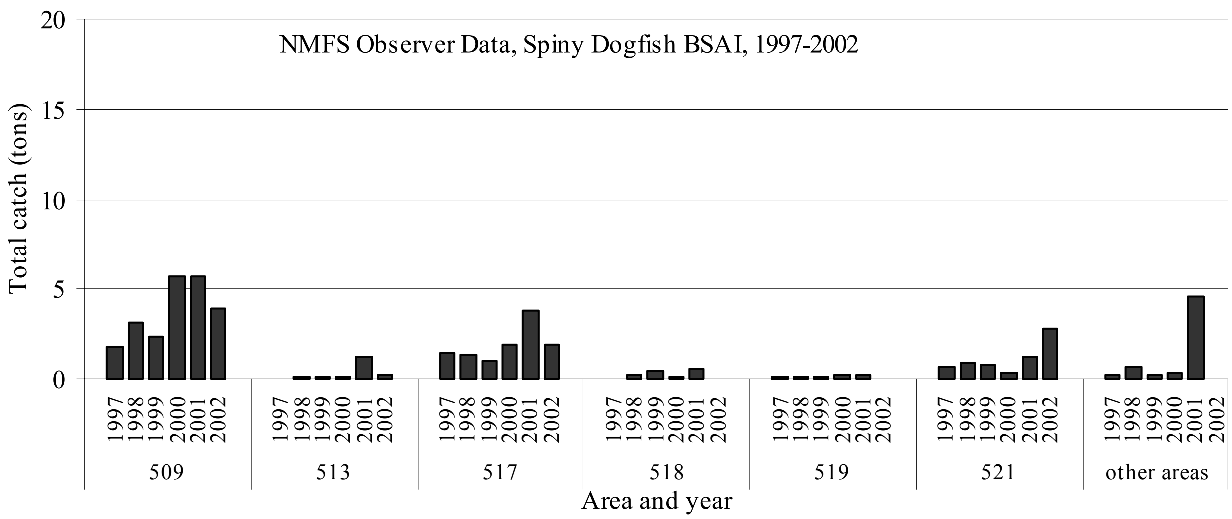




Figure 4. The statistical areas for NMFS observer data in the Bering Sea and Aleutian Islands, and spiny dogfish bycatch from 1997-2002 using the improved pseudo-blend catch estimation procedure (Gaichas 2002).

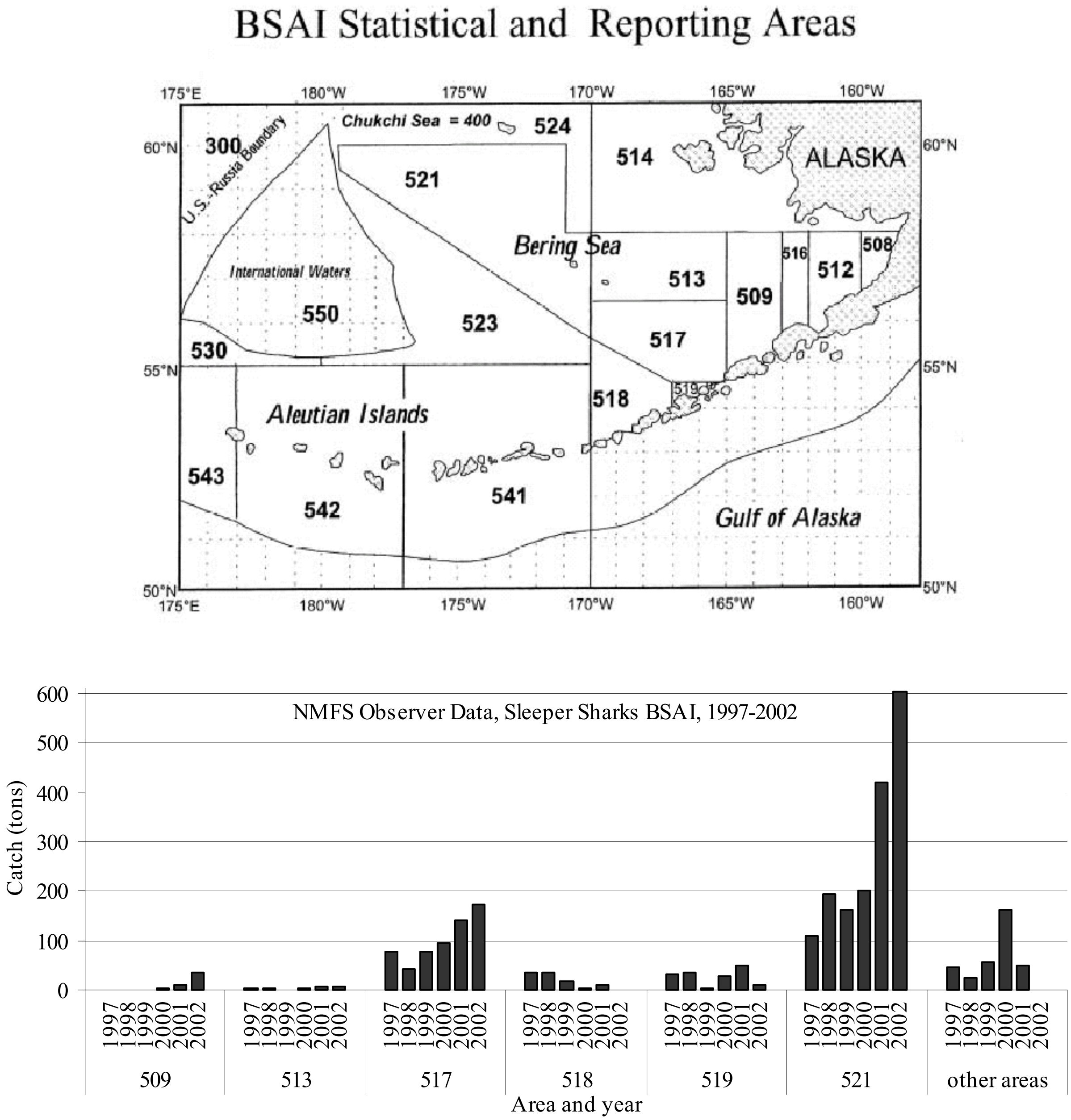



Figure 5. The statistical areas for NMFS observer data in the Bering Sea and Aleutian Islands, and sleeper shark bycatch from 1997-2002 using the improved pseudo-blend catch estimation procedure (Gaichas 2002).

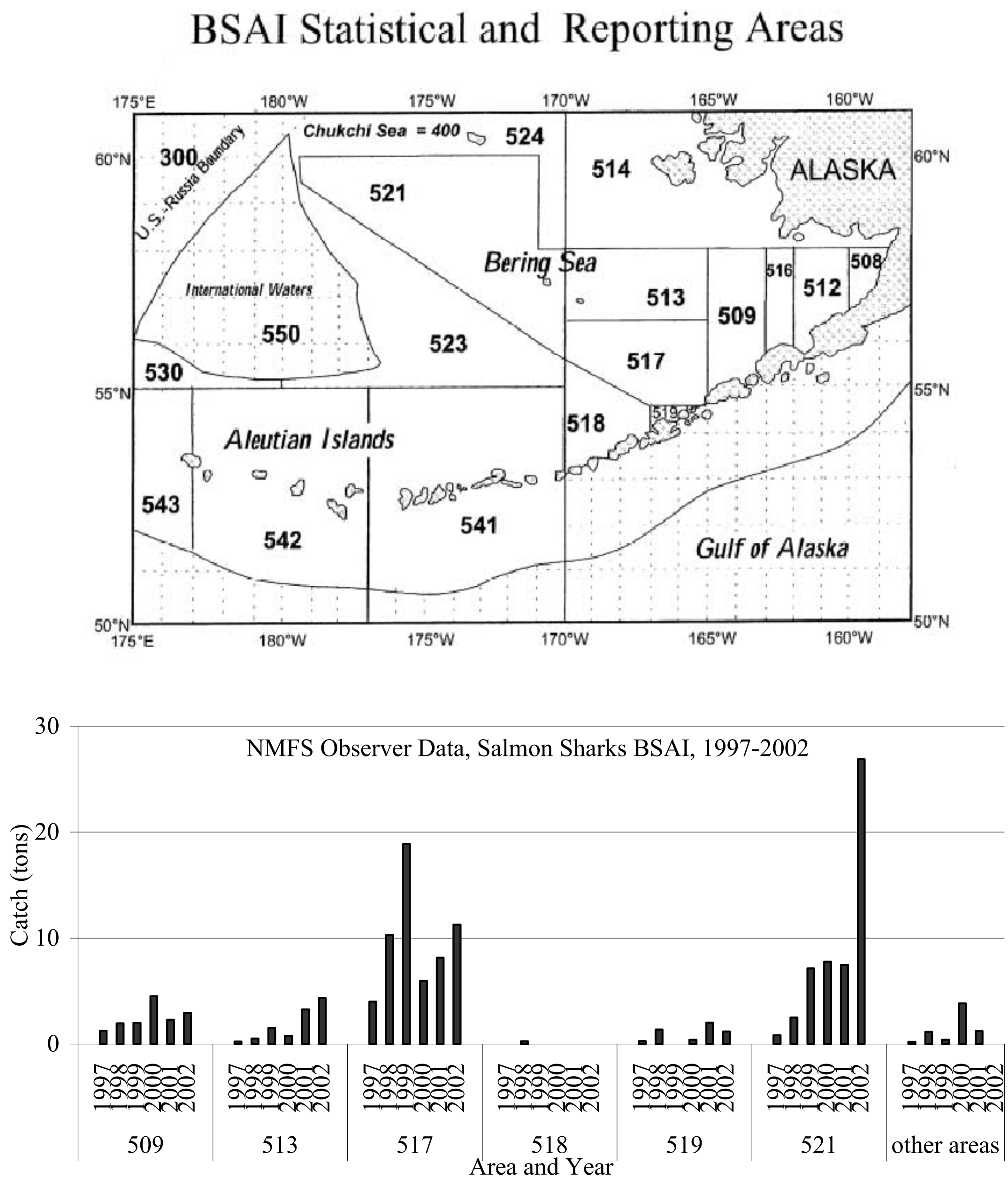
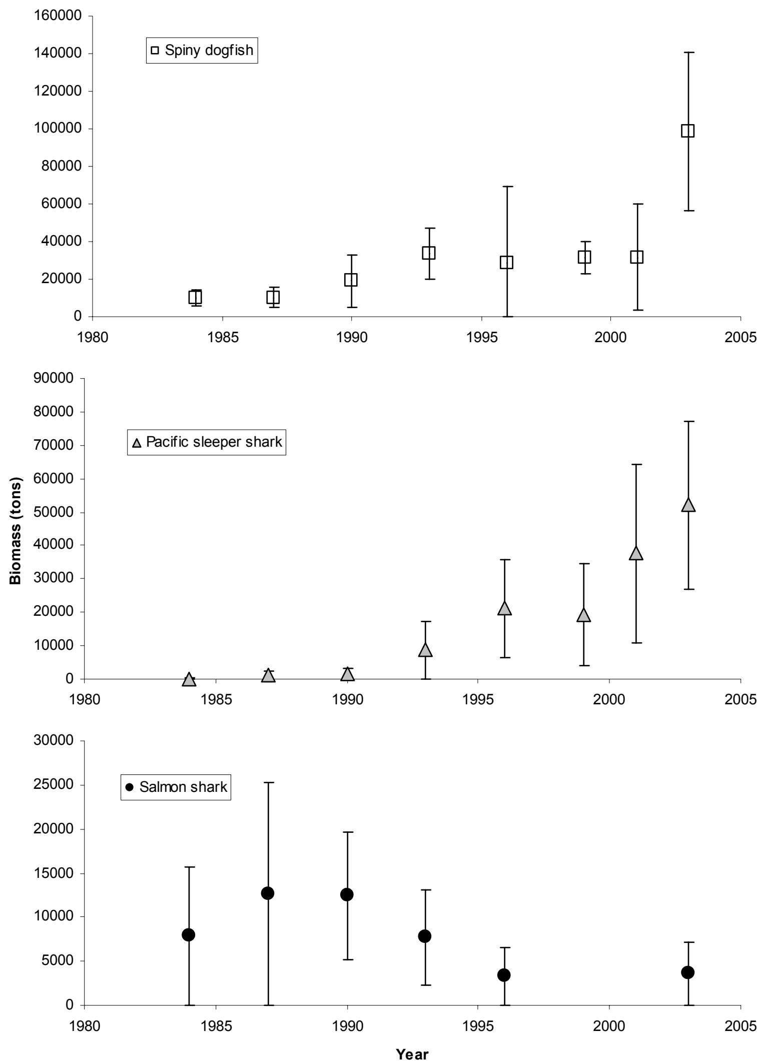



Figure 6. The statistical areas for NMFS observer data in the Bering Sea and Aleutian Islands and salmon shark bycatch from 1997-2002 using the improved pseudo-blend catch estimation procedure (Gaichas 2002).




Source: Gaichas et al. (1999, Figure 3) updated May 14, 2004. (Pers. Comm. Michael Martins).

Figure 7. Trends in Gulf of Alaska AFSC bottom trawl survey estimates of individual shark species total biomass (mt) reported here as an index of relative abundance. Error bars are 95% confidence intervals. Analysis of GOA biomass trends are subject to the following caveats regarding the consistency of the survey time series. Survey efficiency in the GOA may have increased for a variety of reasons between 1984 and 1990, but should be stable after 1990 (Gaichas et al. 1999). Surveys in 1984, 1987, and 1999 included deeper strata than the 1990 - 1996 surveys; therefore the biomass estimates for deeper-dwelling species are not comparable across years. The 2001 survey did not include all areas of the Eastern GOA and consequently, the 2001 survey may not be comparable with the other surveys for species such as spiny dogfish which appear to be relatively abundant in the Eastern GOA.

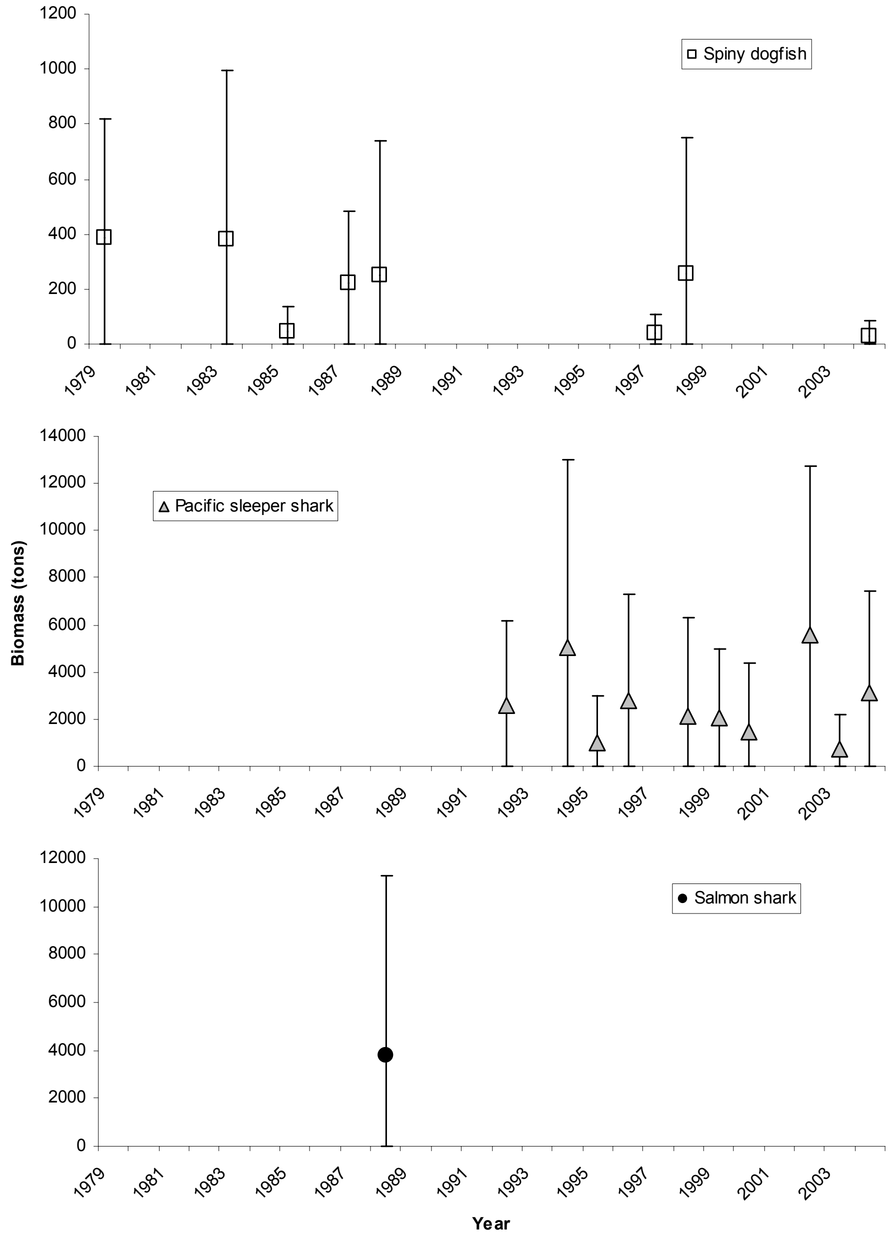



Figure 8. Trends in Eastern Bering Sea shelf AFSC bottom trawl survey estimates of individual shark species total biomass (mt) reported here as an index of relative abundance. Error bars are 95% confidence intervals. Analysis of EBS shelf biomass trends is subject to following time series caveats. The EBS shelf survey started as a crab survey in the 1960's. The survey was standardized in 1982 to its current gear type, fixed stations, and survey time period (June 1 – August 4). Prior to 1982, the set of survey stations varied greatly, and prior to 1979 the set of survey stations was very small.

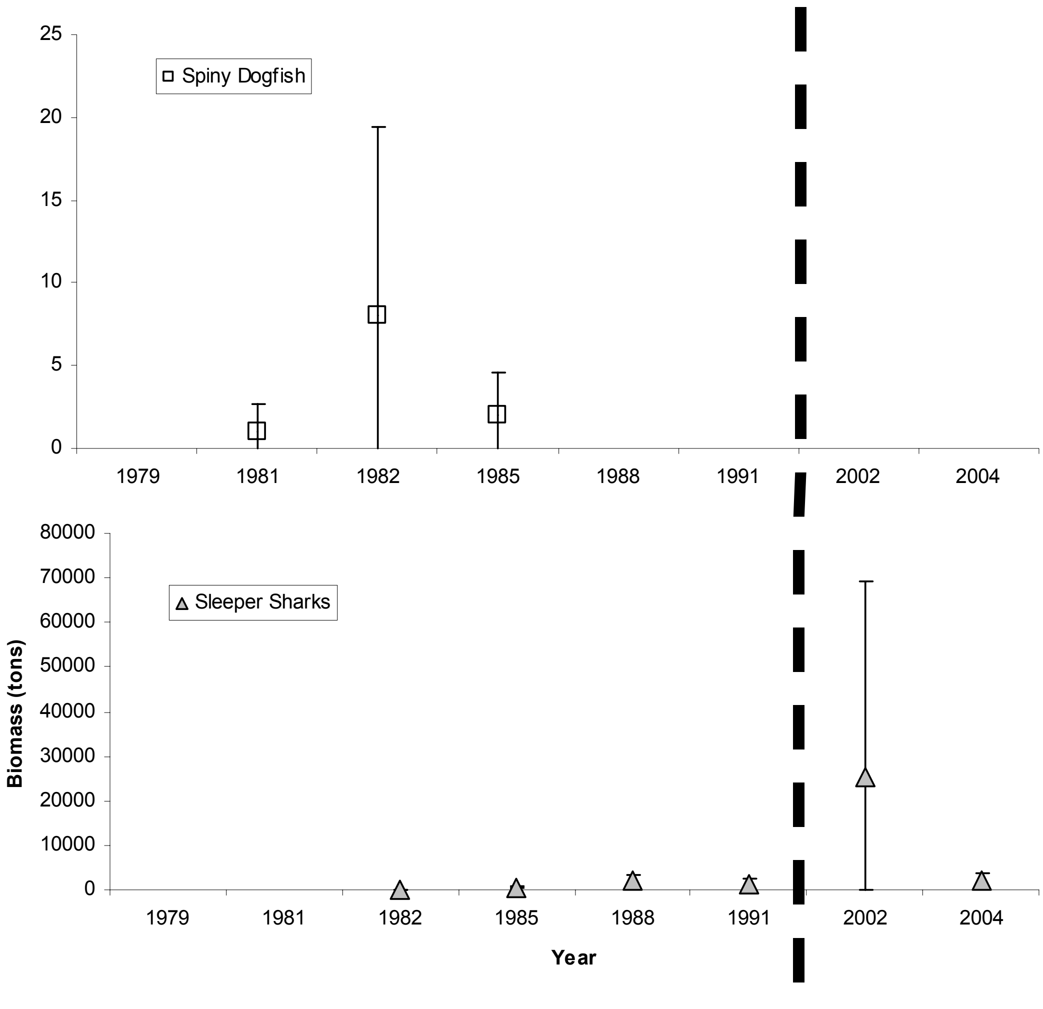



Figure 9. Trends in Eastern Bering Sea slope AFSC bottom trawl survey estimates of individual shark species total biomass (mt) reported here as an index of relative abundance. Error bars are 95% confidence intervals. Dashed line indicates beginning of new EBS slope survey (2002, 2004), which is not comparable to the historical survey (1979 – 1991). Analysis of EBS slope survey biomass trends is subject the following time series caveats. The slope survey was standardized in 2002 to its current gear type, survey strata, and survey design. Because the survey stratification changed in 2002, biomass estimates are not comparable between the historical EBS slope survey (1979 – 1991) and the new slope survey biomass (2002 and 2004). In addition, prior to 2002, the survey utilized a mix of commercial and research vessels with various gear configurations.

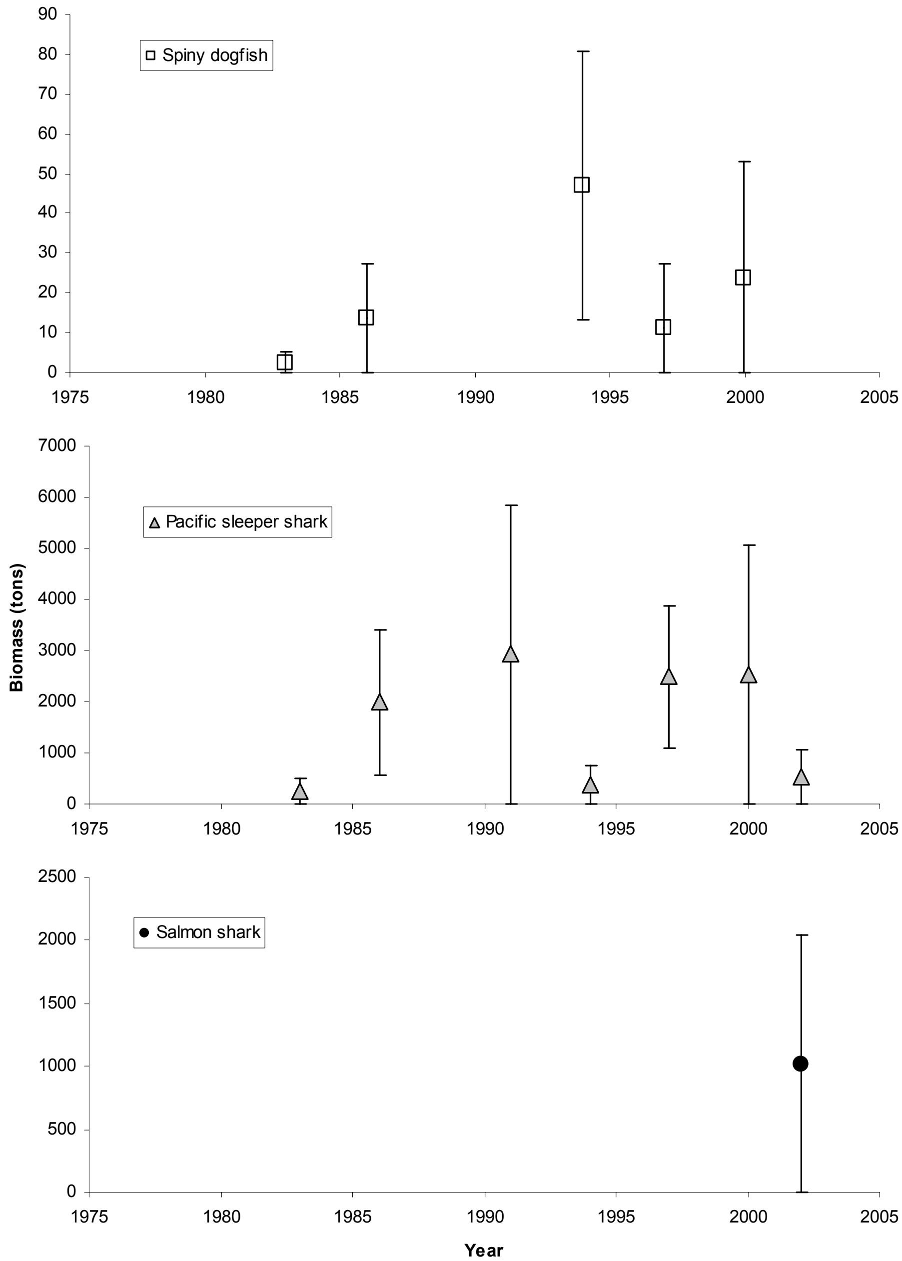



Figure 10. Trends in Aleutian Islands AFSC bottom trawl survey estimates of individual shark species total biomass (mt) reported here as an index of relative abundance. Error bars are 95% confidence intervals.

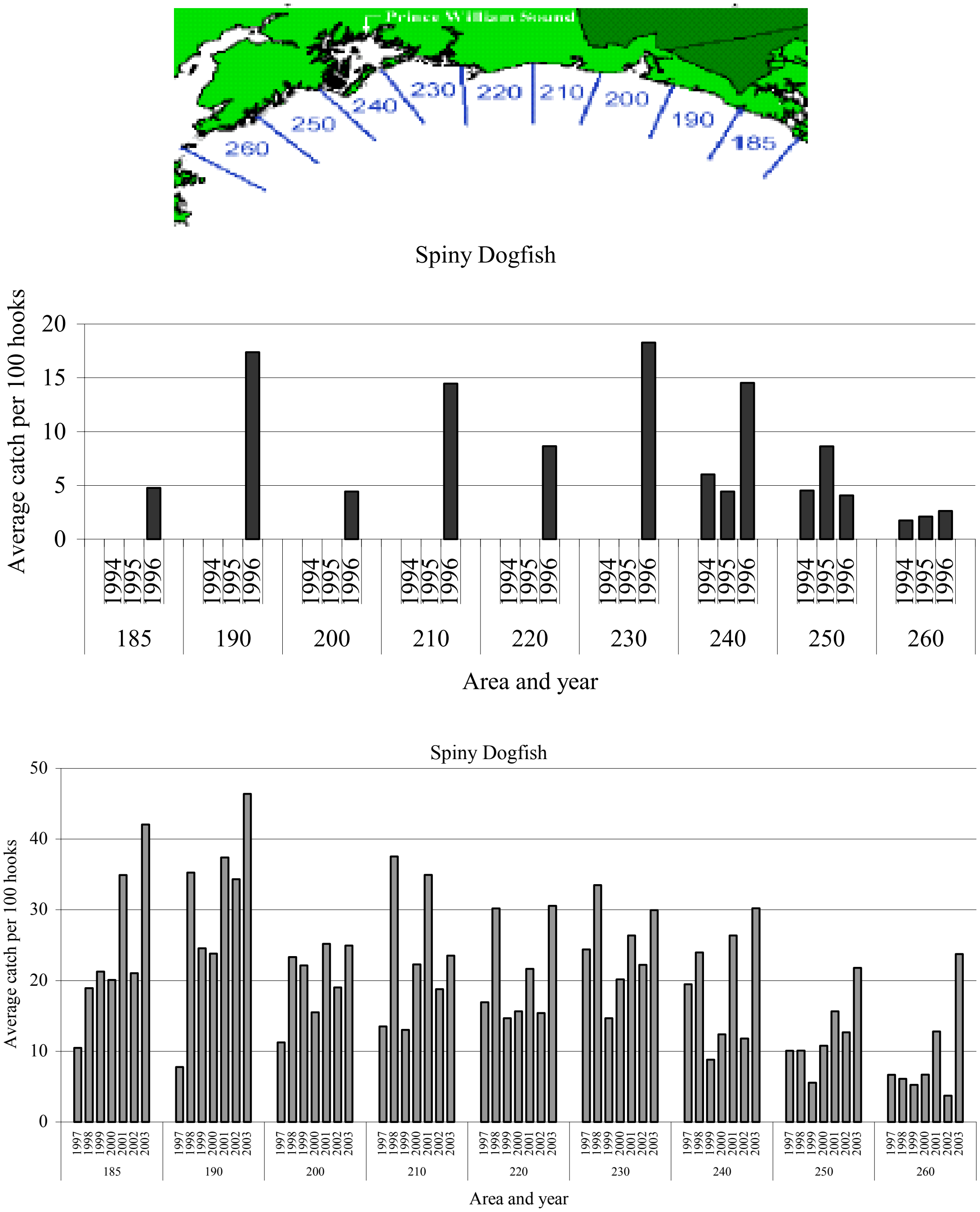



Figure 11. The statistical areas for IPHC survey data in the Gulf of Alaska and spiny dogfish bycatch in the GOA as recorded in the IPHC survey data from 1990 to 1996 and from 1997-2003. Areas 185-230 not sampled in 1994 or 1995.

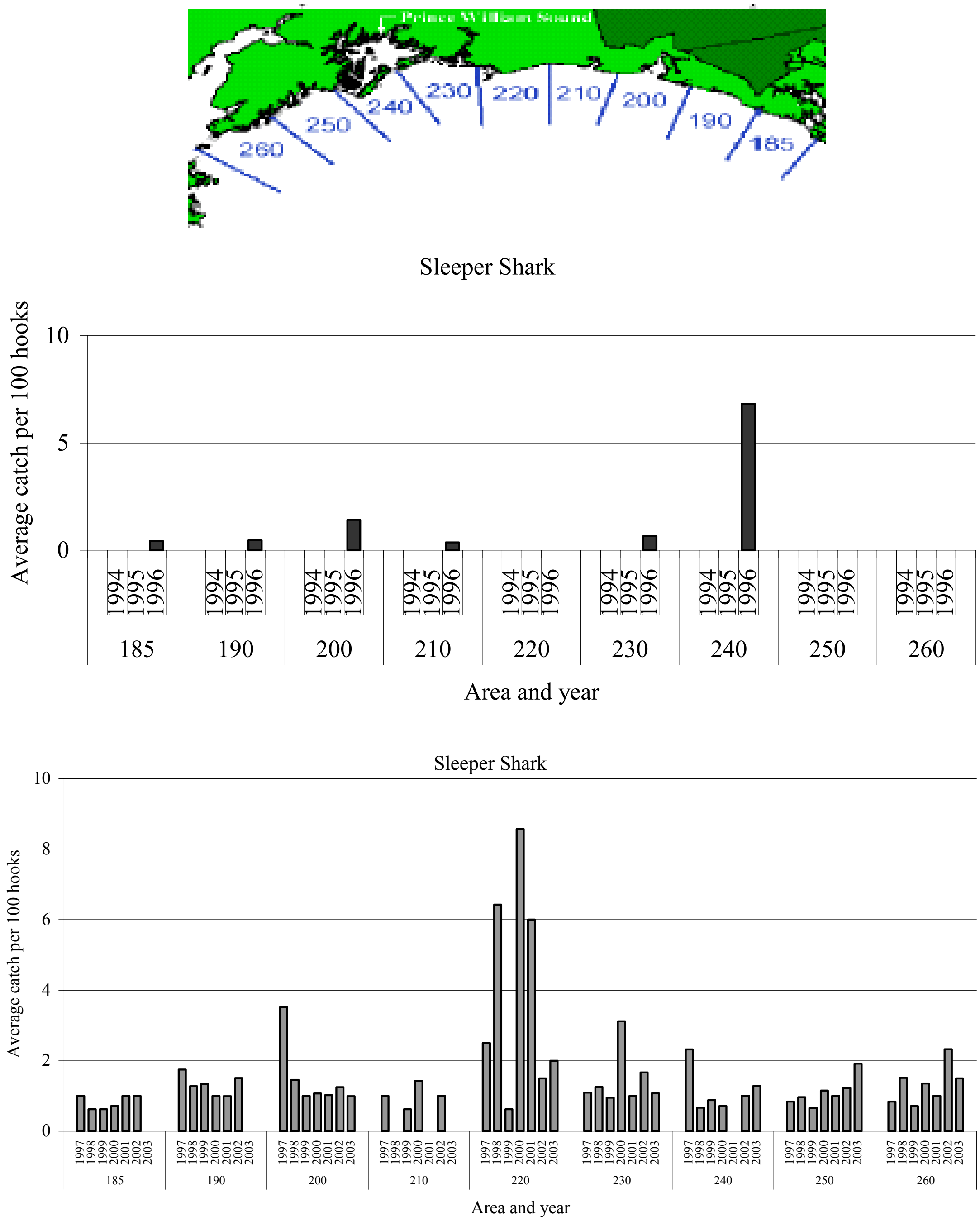



Figure 12. The statistical areas for IPHC survey data in the Gulf of Alaska and sleeper shark bycatch in the GOA as recorded in the IPHC survey data from 1994 to 1996 and from 1997-2003. Areas 185-230 not sampled in 1994 or 1995.

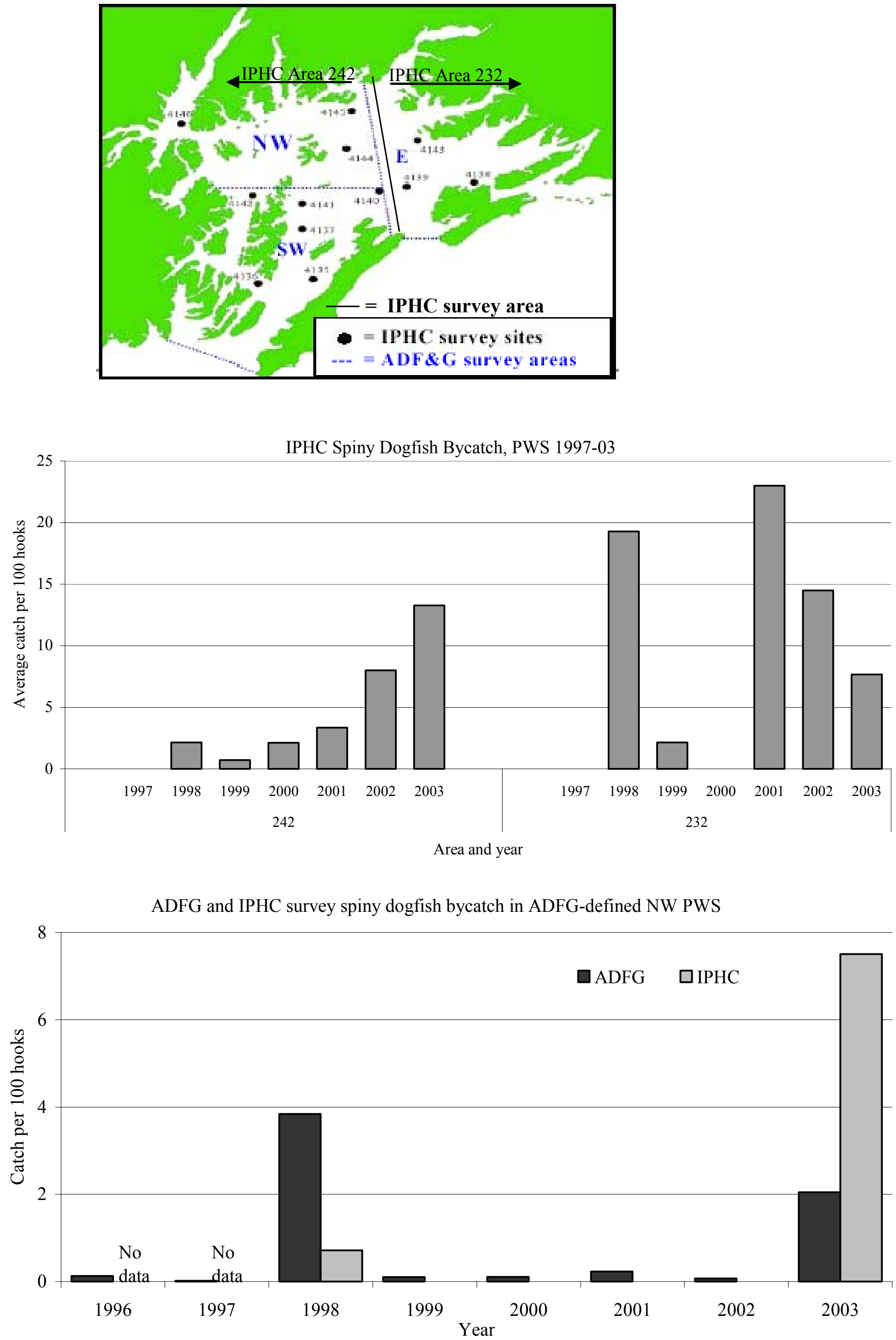



Figure 13. The statistical areas for IPHC survey data and ADFG survey data in Prince William Sound and spiny dogfish bycatch in PWS as recorded in the IPHC and ADFG surveys from 1996 to 2003.

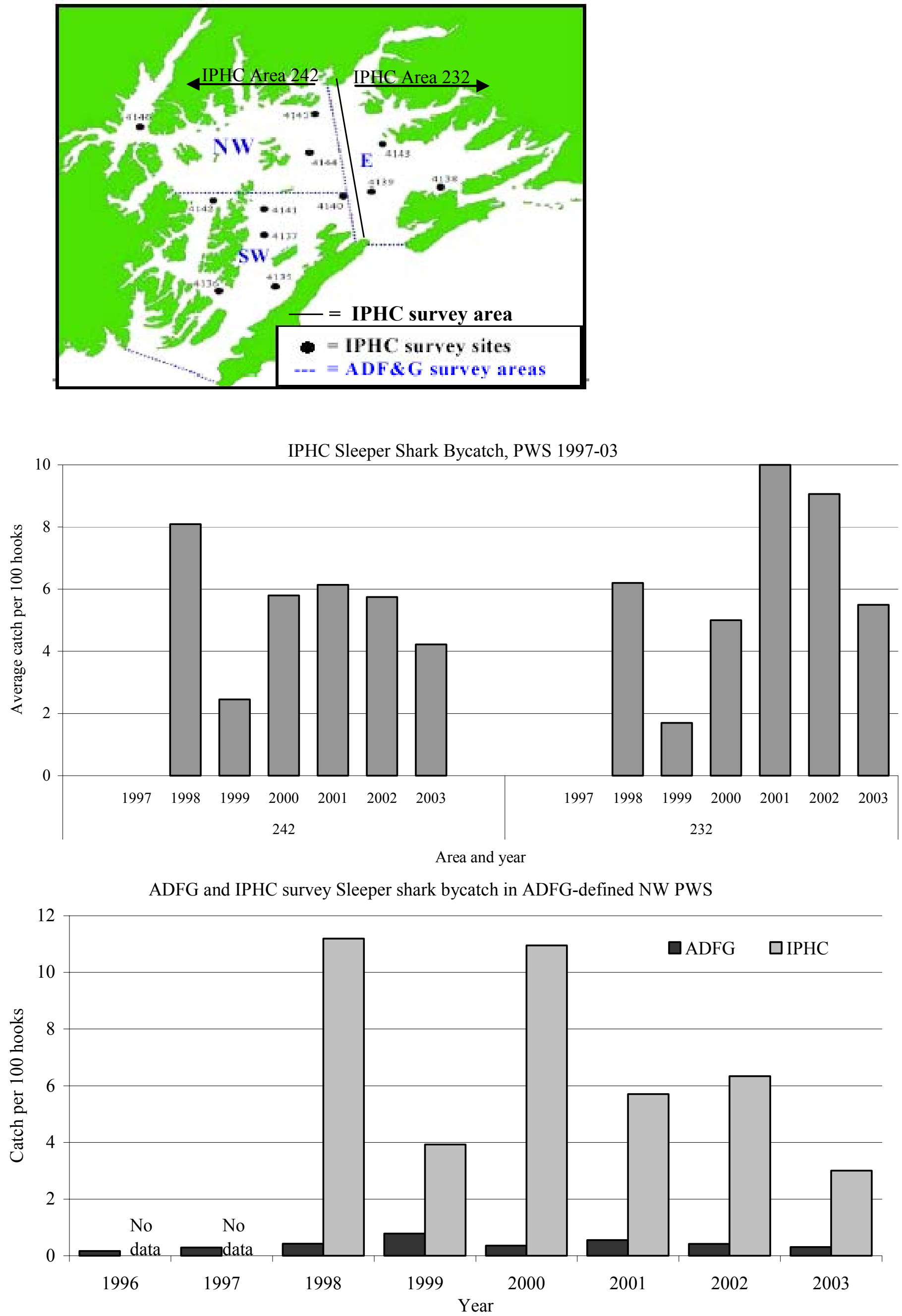



Figure 14. The statistical areas for IPHC survey data and ADFG survey data in Prince William Sound and sleeper shark bycatch in PWS as recorded in the IPHC and ADFG surveys from 1996 to 2003.

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