Alaska's Undeveloped Commercial Fisheries: Opportunities, Issues, and Policy Considerations. 2009

Department of Commerce, Community and Economic Development
The Office of Economic Development
State of Alaska

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INTRODUCTION

Sustainable, massive in scale, known around the world for its flavor and quality, the Alaska seafood industry accounts for over half of the nations seafood landings worth nearly $2 billion to Alaska commercial fisherman, and twice this amount to the seafood processors. Annual seafood employment for the past five years has exceeded 55,000 people. Historical landings going back over a century including salmon, halibut and herring have in recent times added species such as pollock, cod, sablefish, and crab.

All of these commercial fisheries are scientifically managed under a complex relationship between state and federal fisheries scientists and managers who take their directions from federal and state boards comprised of stakeholders with extensive seafood experience. This paper examines potential economic opportunities for selected commercial marine and anadromous species occurring in Alaska waters and presently not part of the traditionally managed commercial seafood industry - the so called "undeveloped fisheries."[1] Additionally, where applicable, ADF&G protocols followed by commercial fishermen prospecting potential fisheries is presented along with a brief analysis of Oregon's Developmental Fisheries Program for policy consideration when deciding whether a developing fishery is capable of sustaining fully developed commercial status.[2]

U.S. Seafood Demand

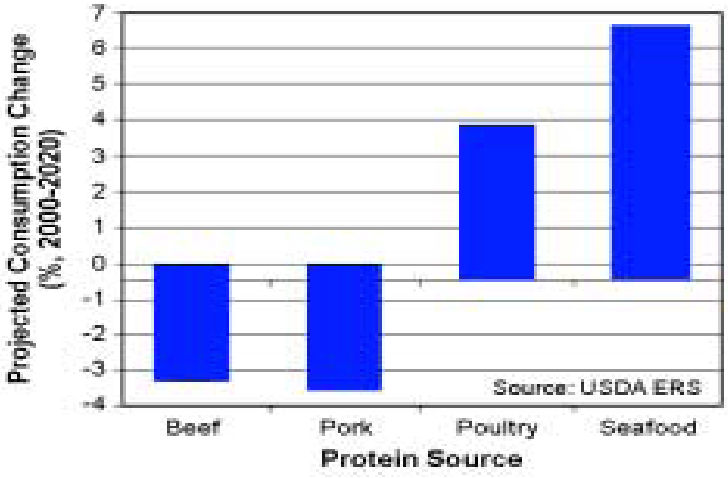
By 2020 seafood demand in the United States will experience the largest growth in volume of all major proteins, increasing 30 percent or an additional 2.5 billion pounds round weight of seafood just to maintain our per capita consumption of 15 pounds.[3] That is like adding another Alaska pollock fishery to the supply line. Retail and food service markets will also see growth as per capita consumption of seafood continues to climb above 16 pounds. Nearly 90 percent of this demand is expected to be filled from foreign seafood imports, much of it aquaculture unless new domestic supplies can be found.

[1] The term "Undeveloped Fisheries" will be used in this report to distinguish those species having potential commercial value but lacking management plans or markets verses the phrase "Underutilized Species" that to many connotes currently managed commercial species that with added processing could achieve higher value through "value-added" technology.

[2] Generally, a developed fishery occurs when the level of participation, catch and effort show the fishery has reached optimal sustainable yield and there is good biological and fishery data such as markets, gear, and harvest methods in place for a management plan to be written for the intended species.

[3] Economic Research Service.

Projected Protein Consumption Shift in U.S. Population, 2000 - 2020



Seafood Export Markets

The International Food Policy Research Institute is projecting a continued increase in finfish and shellfish seafood prices by as much as 16 percent by 2020. Also by 2020, fish meal and oil prices will likely see an 18 percent increase over current prices. A declining Japanese population will place greater emphasis on Chinese and Korean markets as destinations for Alaska seafood, especially the more unique and exotic species potentially available and currently undeveloped. In China alone, the annual per capita seafood consumption level is expected to increase 22 pounds in ten years to 94 pounds per person.

Alaska's Managed Commercial Fish Species

Commercially important species of seafood from Alaska include five species of salmon, five species of crab, walleye pollock, Pacific halibut, Pacific cod, sablefish, herring, four species of shrimp, several species of flatfish and rockfish, lingcod, Atka mackerel, geoducks, weathervane scallops, sea cucumbers, and sea urchins.[4] Commercial harvests of octopus and squid occur in the Bering Sea and Gulf of Alaska, primarily as bycatch in other fisheries. The commercial fisheries of Alaska fall under a mix of state and federal management jurisdictions. Generally, the state has management authority for all salmon, herring, and shellfish fisheries, whereas the federal government has management authority for the majority of groundfish fisheries, except those within three nautical miles of shore. The Alaska Department of Fish and Game (ADF&G) is the primary state fisheries management agency, and NOAA Fisheries is the primary federal fisheries management agency. Except for some of the groundfish fisheries in the eastern Gulf of Alaska and Prince William Sound, NOAA Fisheries is primarily responsible for management of all groundfish fisheries off Alaska, and ADF&G is primarily responsible for management of commercial fisheries for salmon, herring, crabs, and other invertebrates. Today, fishery management has evolved into a complex of state, federal,

[4] Alaska Department of Fish and Game "Alaska's Fisheries Overview."

and international advisory and regulatory bodies that affect management of the marine fishery resources off Alaska's coast.

Selected Marine Animals and Plants with Commercial Development Potential

The following selected list of marine species found in Alaska waters was developed as the result of discussions held with state and federal commercial fishermen and fisheries managers, seafood market specialists, marine advisory agents, and a review of current research papers on the subject of undeveloped commercial seafood species. Some of these are species currently captured as commercial bycatch or of interest to commercial fishermen requesting ADF&G new species prospecting permits. Other potential species for future review include the Arctic Lamprey, green urchin and several varieties of scallops, and mussels. Literature from places with formalized underdeveloped commercial species programs like Oregon, New Zealand, and the Falkland Islands was also consulted.

For each of the selected species the following factors were examined: life histories, commercial fishery, North Pacific stock status, markets, permits and regulations, and summary.[5]

Spiny Dogfish (*Squalus acanthias*)

Increasingly over the last two decades spiny dogfish have become an important commercial fishery, providing commercial fishing opportunities during a time when the harvest of other species was seriously curtailed.

Although there is a low market demand in the US, the European market commonly sells spiny dogfish as fish and chips and pickled beer garden snacks. Over the last ten years, however, tremendous growth in the East Coast fishery has exceeded the availability of the resource and resulted in the development and implementation of stringent fishery management measures in federal waters, and complementary management measures in state waters. With these restrictions, overfishing is no longer occurring, but in some areas the spiny dogfish stock is depleted. Dogfish is a late maturing (12 years old) species with a long gestation period (two years). These life history characteristics make for a lengthy rebuilding period (over two decades).

[5] The order of each species is not a ranking of their potential for successful development.

Life History

From American Fisheries Society notes:[6] Spiny dogfish can be found on both sides of the North Atlantic and North Pacific Oceans, mostly in the temperate and subarctic areas. Dogfish occupy the upper slopes of waters in the Bering Sea and occur more commonly in waters off British Columbia than in the Gulf of Alaska and Bering Sea / Aleutian Islands. Spiny dogfish migrate north in the spring and summer and south in the fall and winter. In the winter and spring along the East Coast, dogfish congregate primarily in Mid-Atlantic waters but also extend onto the shelf break of southern Georges Bank. In the summer, they are located farther north in Canadian waters and move inshore into bays and estuaries. By autumn, dogfish have migrated north with high concentrations in Southern New England, on Georges Bank, and in the Gulf of Maine. They remain in northern waters throughout the autumn until water temperatures begin to cool and then return to the Mid-Atlantic.

Immature spiny dogfish school by size until reaching sexual maturity when they school by both size and sex. Female dogfish reach sexual maturity at about 30 inches or twelve years, while males reach sexual maturity at 24 inches or six years. Mating occurs in the winter months and the pups are delivered on the offshore wintering grounds. Dogfish litters range from two to 15 pups. While carrying one litter, the female will begin developing eggs for the fertilization of her next litter. After an 18 to 24 month gestation period, the pups are released live and fully formed at about 14 inches.

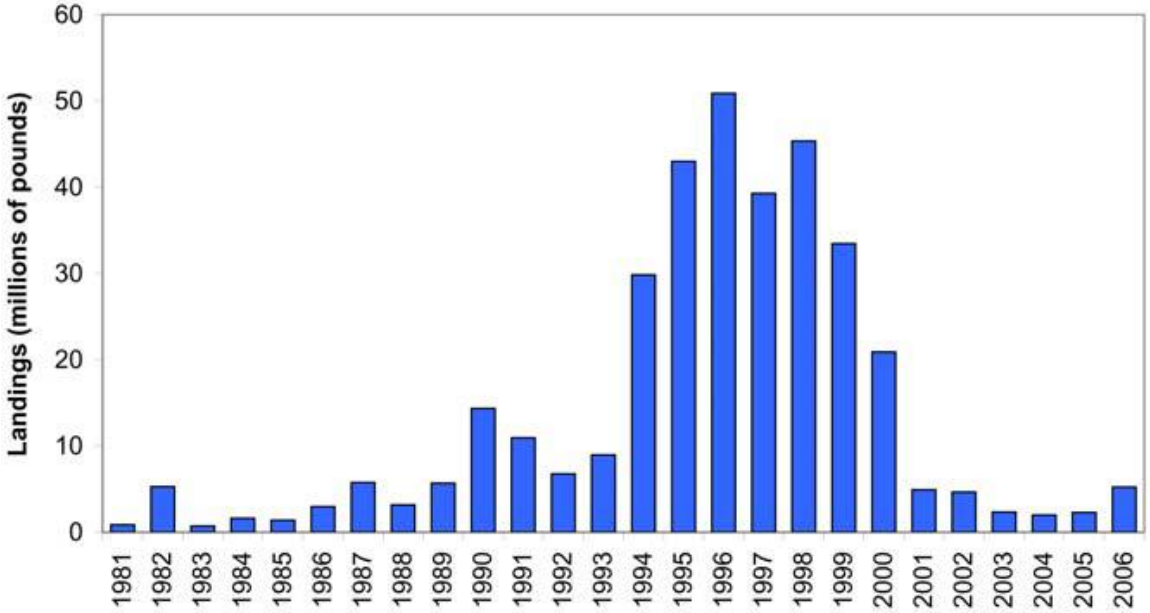
Commercial Fishery

Spiny dogfish are harvested using longline, trawls, and purse seines. Fishermen prefer to target female dogfish because the females grow larger than males and school together. The commercial fishery supplies the European food fish markets that use ‘belly flaps’ as fish and chips in England and as a popular beer garden snack called shiller locken in Germany. Foreign fleets caught the majority of dogfish in U.S. waters prior to the Fishery Conservation and Management Act of 1976 that regulated foreign fishing in U.S. waters. U.S. fishermen have had uncontested access ever since.

Landings were approximately 30 million pounds in 1994 gradually increasing to a peak of about 51 million pounds in 1996. Landings declined to an average of around 33.5 million pounds in the late 1990s. After federal and state regulations were implemented on the East Coast, landings significantly declined ranging between two and six million pounds since 2001 (see Figure 1). Commercial landings continue to mostly consist of female dogfish, with female landings comprising about 98 percent of the total commercial catch in 2003 and 2004.

[6] From: Species Profile: Spiny Dogfish Stock Rebuilding Hinges on Robust Spawning Stock http://www.asmfc.org/speciesDocuments/dogfish/speciesProfile.pdf

Figure 1. Spiny Dogfish Commercial Landings, 1981 - 2006
Source: NMFS Fisheries Statistics and Economics Division, 2008



There are presently no directed commercial fisheries for spiny dogfish in federal or state managed waters off Alaska and most bycatch of spiny dogfish are not retained. Exceptions have occurred in Kodiak for example, for the following years: 2004, 2005, and 2007 when one metric ton annual was reported. Spiny dogfish are allowed as retained incidental catch in state managed fisheries with some landings reported in Yakutat for 2005-2008. There currently exists an ADF&G Commissioner's Permit fishery for spiny dogfish in lower Cook Inlet; with one permit application received to date.[7] The highest reported landings occurred in 2005 (25,000 lbs) decreasing to 303 pounds in 2008.

North Pacific Stock Status

The Alaska Fisheries Science Center survey and observer data provide most of what is currently known about spiny dogfish populations in the Gulf of Alaska.[8] The majority of what is known about the biology of this species is based on work undertaken in the North Atlantic. According to NOAA scientists, little research has been undertaken in the North Pacific with the exception of work underway off of British Columbia. Spiny dogfish can grow as much as five feet in length, averaging between three to three and one half feet. The shark has been known to live as much as 100 years but more typically for 40-60 years. Dogfish stocks are currently not being overfished, but are considered depleted in some of their world wide range. In Alaska waters, until more formal surveys can be conducted, biomass figures should be considered an index of abundance.

[7] For an explanation of this permit process see section titled Permitting and Regulations this report.
[8] NMFS Gulf of Alaska SAFE report: http://www.afsc.noaa.gov/refm/docs/2008/GOAshark.pdf

Incidental catch data for spiny dogfish was not available prior to the start of the domestic observer program in 1990. Current estimates show spiny dogfish compose about half of all shark species taken incidentally. From 1997-2008, shark catches composed from 19 percent to 60 percent of the estimated "Other Species" total catches reported to NOAA Fisheries. Spiny dogfish made up half of that total, having been landed mostly in the flatfish (29 percent) and sablefish (26 percent) fisheries.

Federal regulatory area 630 appears to hold large numbers of sharks in general and especially spiny dogfish (Figure 2). For the years 1997-2008, area 630 accounted for half of the dogfish catch landed statewide. Table A compares survey biomass estimates for dogfish and several other shark species incidentally taken in federal and state waters off Alaska.

Figure 2. Statistical Areas for NOAA Fisheries Observer Data Gulf of Alaska

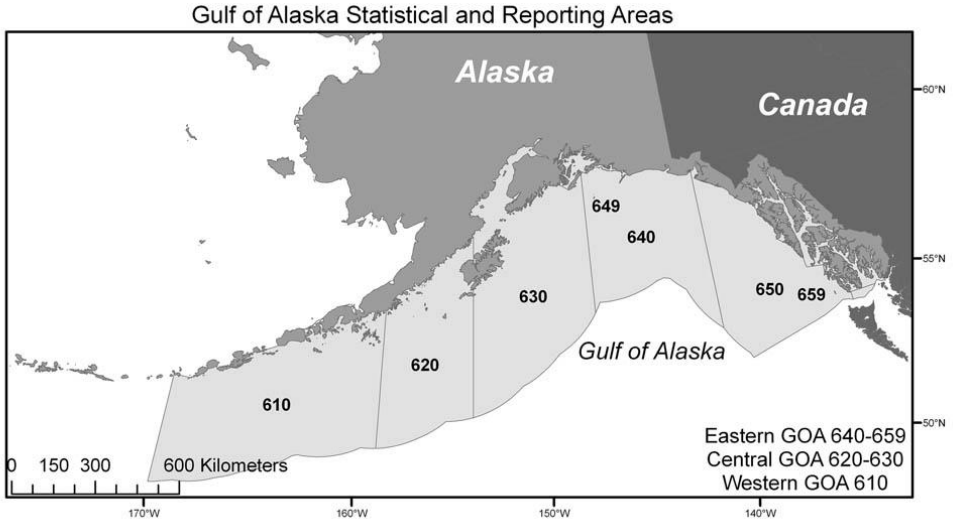


Table A [9] GOA Trawl Survey Estimates of Individual Shark Species Total Biomass (Tons), 2008 Update

Spiny Dogfish					Sleeper Shark			Salmon Shark		
Year	Survey Hauls	Haul with catch	Estimated Biomass (tons)		Haul with catch	Estimated Biomass (tons)		Haul with catch	Estimated Biomass (tons)	Total Shark Biomass (tons)
1984	929	125	10,143.0		1	163.2		5	7848.8	18,155.0
1987	783	122	10,106.8		8	1,319.2		15	12622.5	24,048.5
1990	708	114	18,947.6		3	1,651.4		13	12462	33,061.0
1993	775	166	33,645.1		13	8,656.8		9	7728.6	50,030.5
1996	807	99	28,477.9		11	21,100.9		1	3302	52,880.8
1999	764	168	31,742.9		13	19,362.0		0	na	51,104.9
2001	489	75	31,774.3		15	37,694.7		0	na	69,469.0
2003	809	204	98,743.8		28	52,115.6		2	3612.8	154,472.2
2005	839	156	47,926.1		26	57,022.0		1	2455.3	107,403.4
2007	820	164	161,965.1		15	39,634.8		2	12339.7	213,939.6
Ten Survey Year Average			47,347.3			23,872.1			6237.17	77,456.5

Source: AFSC NOAA Fisheries Gulf of Alaska SAFE Report, 2008 *http://www.afsc.noaa.gov/refm/docs/2008/GOAshark.pdf*

[9] The biomass estimates presented here should be considered a relative index of abundance for shark species until more formal analyses of survey efficiencies by species can be conducted: NOAA Fisheries Gulf of Alaska SAFE report comments.

Markets

Spiny dogfish are used in fish and chips; hide for leather, pet food, liver oil for lighting and vitamin A, biological studies and cancer research. The chief suppliers of dogfish are the U.S., Canada, New Zealand, EU and to a smaller extent the countries of Chile and Argentina. The biggest market currently for spiny dogfish is found in Europe, mainly in the fish and chips (market name "rock salmon"), and smoked seafood markets. A small, low value fin market occurs in Asia. The current economic downturn coupled with pressure from environmental organizations pushing to end dogfish fishing has impacted the European market and demand is down.[10] ADF&G recently provided tissue samples from a variety of commercially landed Alaska finfish, including salmon sharks and spiny dogfish, to the Alaska Department of Environmental Conservation for analysis of methyl mercury. The sharks had substantially higher methyl mercury levels than all other species tested. It is unknown to what degree these results are influencing demand.[11] Meanwhile, British Columbia is seeking MSC certification for their catch.

Pacific spiny dogfish are not considered overfished .Over the past five years annual Pacific Northwest landings of spiny dogfish have averaged 4,500 tons, well below the allowable catch of 11,000 tons. This compares to a cap on East Coast dogfish set in 2002 at 2,500 tons. Historically, the Pacific Northwest spiny dogfish liver fishery peaked in the 1940's at 60,000 tons then crashed shortly after as the market for livers ended. Development of new international markets resulted in recent annual harvest of 636 metric tons valued at three dollars per pound to commercial fishermen. Nationwide, during 2008 slightly over 12 million pounds valued at $3.2 million ($3.80/pound) was reported, a 33 percent increase in supply and a 45 percent jump in total value compared with nine million pounds of landed dogfish valued at $2.2 million the previous year.[12]

Permits and Regulations

There have been very few assessments or studies of dogfish populations off Alaska and the Pacific Northwest Coast of the U.S. The spiny dogfish is currently listed as one of the 82 managed species in the Pacific Fishery Management Council (PFMC) Pacific Coast Groundfish Management Plan. However, the PFMC has not adopted any regulation specific to the spiny dogfish fisheries in the Pacific.

In Washington State for example, Washington Department of Fish and Wildlife (WDFW) has adopted several management strategies and regulations that affect commercial dogfish fisheries, which may indirectly help conserve dogfish populations by limiting pressure on large females in potential nursery areas. Nevertheless, these regulations were established to protect other species, provide orderly fisheries, and avoid conflicts with

[10] Personal correspondence: Jason Gasper, NOAA Fisheries, Alaska Fisheries Science Center.

[11] Verbrugge, L. A. 2007. Fish consumption advice for Alaskans: a risk management strategy to optimize the public's health. Alaska Department of Health and Social Services. (http://www.epi.hss.state.ak.us/bulletins/docs/rr2007_04.pdf)

[12] NOAA Fisheries of the United States, 2008

other user groups, not to conserve dogfish. Currently, WDFW has not adopted any regulations protecting dogfish other than a Puget Sound daily recreational fishing limit.

In Alaska, Spiny dogfish cannot be harvested in State of Alaska waters except in very specific circumstances, including harvest under a "Commissioner's Permit" so called because the applicant must first receive approval through the Commissioner's Office. Under this authority the permit is issued by the Commissioner or the Commissioner's designee (generally an area management biologist) [5 AAC 38.062] to the applicant before becoming eligible to prospect the undeveloped fishery. The department can also issue permits under authority of 5 AAC 38.062 to allow retention of certain species as bycatch in commercial pot shrimp fisheries. Permits are available at area offices throughout Alaska. Permit stipulations are customized for the fishery being prospected and can include gear limitations, harvest totals, maintaining a log book, stipulations on bycatch limits, dates for which the permits are valid, and other conditions. Federal regulations currently group dogfish in the "other species" complex open for directed fishing with limits placed on the overall amount that may be harvested or taken as bycatch.

Summary

Demand for spiny dogfish is expected to grow albeit slowly in the near-term despite issues currently facing the consumption of dogfish products generated among environmental groups. Key to improving consumer demand will be the ability to demonstrate that supplies are sustainable and the fishery is scientifically managed. British Columbia already recognizes this in pursuing the MSC label for its spiny dogfish stocks. Without the necessary biological stock assessment information need to mange a sustainable directed fishery on dogfish, Alaska is currently not in a position to supply the dogfish market.

Federal commercial fisheries managers and scientists are continuing to collect and analyze at sea data describing incidental harvests and life history on spiny dogfish. Information is still incomplete and more data is going to be needed from other commercial fisheries where dogfish are being caught incidental to directed harvest. Until this data is analyzed and fishery management plans are written for dogfish, the spiny dogfish fishery will remain undeveloped. Likewise, state fishery managers face similar challenges and will require the necessary funds to undertake basic stock assessment studies on which fishery management plans can be developed before proceeding with a directed commercial fishery on spiny dogfish.

Salmon shark (*Lamna ditropis*)

Salmon sharks range in the North Pacific from Japan through the Bering Sea and Gulf of Alaska (GOA) to Baja, Mexico. They are considered common in coastal waters, both inshore and offshore. Salmon sharks have been considered a nuisance because they eat salmon and damage commercial fishing gear. Recently, salmon shark are being investigated as potential commercial species in the GOA and are currently only targeted by sport fishermen in the state fishery.[13] Salmon sharks are a slow growing, long lived species with a low reproductive rate compared to finfish. These traits have often resulted in the collapse of shark directed international commercial fisheries despite active management programs.

Life History

Salmon sharks are commonly sighted along the outer coast of the Kenai Peninsula and in Prince William Sound. They are most frequently observed during summer months concurrent with inshore returns of salmon. Infrequent observations of sharks during winter months suggest a seasonal migratory pattern associated with availability of prey and birthing. This tendency to aggregate during summer months makes the salmon shark vulnerable to harvest in near coastal waters.[14] The Salmon shark's range extends from cool to temperate seas of the North Pacific Ocean. In the western part of its range, the Salmon shark occurs from the subarctic Bering Sea and Sea of Okhotsk south to the Sea of Japan, and in the eastern part from the Gulf of Alaska to southern California and possibly off the seaward side of the Baja Peninsula.

Scientists describe two stocks of salmon sharks occurring in the North Pacific as "western North Pacific" and "eastern North Pacific" sharks. These sharks are separated by their sizes, how rapidly they grow and reach maturity, and sex composition among other factors. While both stocks appear to live similar lengths of time (20-30 years) and grow to about the same lengths (females reach seven feet, males are about one foot shorter), eastern North Pacific Salmon Sharks tend to weigh more for the same length approaching 500 pounds in weight. Following a nine month gestation period litter sizes typically are four pups. Salmon shark recruit to the fishery at around age five.

[13] NOAA Fisheries: Assessment of the Shark Stocks in the Gulf of Alaska, 2008
[14] Alaska Department of Fish and Game

Commercial Fishery

There is no reference in the Fisheries of the United States, 2008 specifically mentioning Salmon shark harvest figures. There are currently no directed commercial fisheries for shark species in federal or state managed waters of the GOA and most incidentally caught sharks are not retained. A limited sport fishery for Salmon shark currently exits in Alaska state waters and a mandatory charter logbook provides estimates of statewide harvests of Salmon shark. Recreational shark fisheries in Alaska are managed under the Sport Shark Fishery Management Plan. The plan mandates that ADF&G shall manage sharks for sustained yield, recognizes the lack of stock status information and potential for rapid growth in the sport fishery, and notes the potential for overfishing. Under the plan, bag limits are set statewide at one shark of any species, with an annual limit of two sharks of any species. There are no size limits. Additionally, ADF&G biologists monitor the sharks and collect species estimates, age, length, and sex composition in Southcentral Alaska waters.

North Pacific Stock Status

According to NOAA Fisheries surveys, salmon shark biomass has been stable or decreasing. From 1997–2008, shark catches composed from 19% to 64% of the estimated "Other Species" total catches. Among shark species sampled, Salmon shark composed six percent of the total (Table A).[15] Among the various target commercial fisheries, Salmon shark were caught incidentally as bycatch primarily in pelagic pollock harvests (57 percent) and bottom pollock (16 percent).

Table A. [16] GOA Trawl Survey Estimates of Individual Shark Species Total Biomass (Tons), 2008 Update

Spiny Dogfish					Sleeper Shark			Salmon Shark		
Year	Survey Hauls	Haul with catch	Estimated Biomass (tons)		Haul with catch	Estimated Biomass (tons)		Haul with catch	Estimated Biomass (tons)	Total Shark Biomass (tons)
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Ten Survey Year Average			47,347.3			23,872.1			6237.17	77,456.5

Source: AFSC NOAA Fisheries Gulf of Alaska SAFE Report, 2008 *http://www.afsc.noaa.gov/refm/docs/2008/GOAshark.pdf*

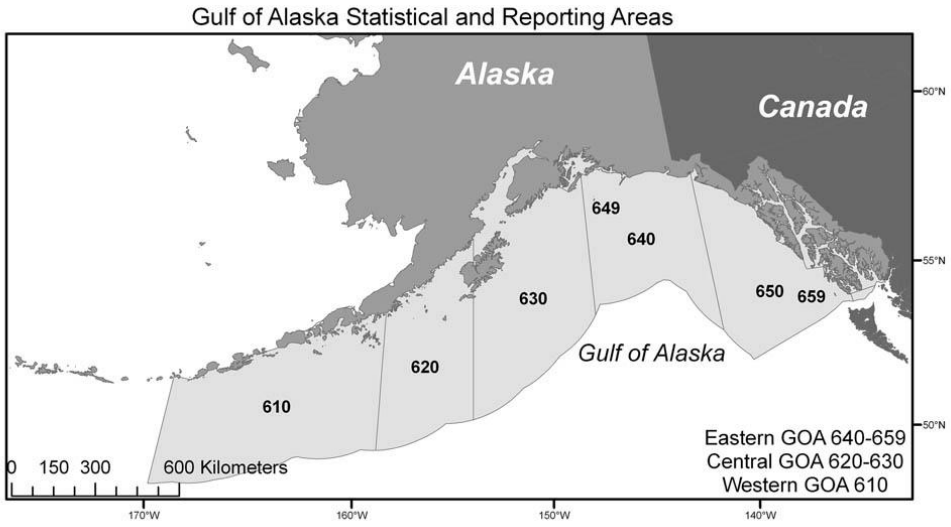
For the years 1997-2008 over half (55 percent) of salmon shark incidental catch occurred primarily in federal management area 630 (Figure 3). The average catch of Salmon

[15] Ibid

[16] The biomass estimates presented here should be considered a relative index of abundance for shark species until more formal analyses of survey efficiencies by species can be conducted: NOAA Fisheries Gulf of Alaska SAFE report comments.

sharks from 1997-2005 (63 tons) was relatively small. Gulf of Alaska bottom trawl survey biomass estimates for Salmon sharks are unreliable because trawl gear is an inefficient sampling technique for salmon sharks, and salmon sharks were only caught in four hauls from 1996-2005.[17] Recent observed increases in nearshore shark abundance have spurred proposals for commercial) shark regulations. However, the Alaska Board of Fisheries has not yet taken action.

Figure 3. Statistical Areas for NOAA Fisheries Observer Data Gulf of Alaska
Source: NOAA Fisheries



Markets

Salmon shark meat is considered fine table fare in certain areas and some consider it on par with thresher shark and swordfish, particularly younger specimens. In the Japanese city of Kesennuma, Miyagi the heart of the Salmon shark is considered a shashimi delicacy. The flesh is used fresh for human consumption in Japan where it is processed into various fish products, and to a lesser extent in Alaska and California for its liver oil, skin (for leather) and fins (for shark-fin soup) are also utilized.

A close relative of the Porbeagle shark (*Lamna nasus)* Salmon shark meat is highly substitutable. The Porbeagle is very popular in European markets such as France, Spain, and Germany. The following shark by products are also in high demand in the EU.[18]

Shark fin Market surveys in Italy, France, Germany, the Netherlands, Belgium, the UK, Ireland, Greece, and Cyprus verify the availability of various imported shark fin products in Asian restaurants and shops catering to Asian consumers. Shark fin products most frequently marketed in Europe include canned fin soup; dried, processed fin cartilage with the skin and flesh removed; and whole fin. Product labels state these items have been manufactured in Singapore, Surinam, Hong Kong, Indonesia and China. Norwegian

[17] NOAA Fisheries: Assessment of the Shark Stocks in the Gulf of Alaska, 2008
[18] Source: Shark Fisheries and Trade in Europe

traders export Spiny Dogfish, Porbeagle and Basking Shark fins to Asian countries. German fish processors export Porbeagle fins as byproducts of meat processing, and UK Spiny Dogfish processors export fins via a broker to the Far East.

Shark cartilage Shark cartilage products, which are marketed as health supplements, appear to constitute a fast growing market in Europe. Shark cartilage products occur in the UK, France, Belgium, the Netherlands, Germany, Italy, Spain, and Greece. These appear to have been imported as finished products or as processed cartilage for manufacture and distribution within Europe. Sellers report that shark cartilage is distributed to pharmacies and health products outlets and to homeopathic doctors and other health practitioners. In addition, the use of shark cartilage by the veterinary practice is reportedly on the rise in Europe.

Shark liver oil and squalene The European market for shark liver oil and squalene products also appears to be growing.[19] Commercial products containing shark oil or squalene are sold in Belgium, the UK, France, Germany, the Netherlands, Greece, and Iceland. Companies in France use shark liver oil and squalene in the manufacture of cosmetic and pharmaceutical products, including a factory in southern France that processes shark liver oil used in perfumery.

Shark skin and leather Shark skin and leather are traded in the UK, Spain, Germany, France and Italy. In France, shark and ray leather is used in the manufacture of luxury items such as handbags, wallets and jewellery. Ray skin, known as *galluchat,* is also used to cover furniture and in clothing design.

Permits and Regulations[20]

Presently, all regulatory requirements for salmon shark are confined to a small sport fishery in the North Gulf and Prince William Sound areas. Little information has been available on recreational shark harvest in Alaska until recently. Catch and harvest of all shark species combined have been estimated for all portions of South central Alaska through the Alaska Statewide Harvest Survey since 1998. The charter vessel logbook provides reported harvest of salmon sharks by the guided fishery since 1998 (except 1999). Additional information on species composition, size, age, and area of harvest has also been collected via the groundfish harvest assessment program since 1998. These data indicate that while sharks are caught regularly, only a small percentage is retained. Retention rates are typically much higher for salmon sharks because they are targeted

Area management biologists from Kodiak, Lower Cook Inlet, and North Gulf/Prince William Sound and regional staff review the harvest assessment program and work

[19] Squalene is a low density compound often stored in the bodies of cartilaginous fishes such as sharks, which lack a swim bladder and must therefore reduce their body density with fats and oils. Squalene, which is stored mainly in the shark's liver, is lighter than water with a specific gravity of 0.855.
Recently it has become a trend for sharks to be hunted to process their livers for the purpose of making squalene health capsules.
[20] ADF&G

together to develop management strategies for emerging shark fisheries. Area management staff then reviews the statewide harvest survey and charter logbook program, and coordinate with other resource management and information agencies and user groups. For example, they provide fishery harvest data and regulatory information to the IPHC, North Pacific Fishery Management Council (NPFMC), Alaska Sea Grant Marine Advisory Program, and charter associations and other user groups.

Management of recreational shark fisheries involves a minimum of in season regulatory adjustments, or Emergency Orders. Unlike salmon, the annual harvest is small compared to the total population size. Bag limits and other regulations are set in the hope that they are sufficiently conservative to provide for long-term sustained yield, rather than maximum yield.

Commercial fishermen interested in prospecting salmon shark for commercial purposes will need to obtain a Commissioner's Permit (see information discussed under Spiny Dogfish).

Summary

Work is ongoing to attempt to launch a commercial fishery for salmon shark off Alaska, where it does not appear to be migratory. However, much of the basic life history parameters (population size and structure, recruitment and natural mortality rates, etc.) necessary for sustainable management of its stocks is poorly known;

In Alaska, for salmon sharks and sharks in general, sparse quantitative information is available on stock status. Anecdotal reports indicate that abundance, or at least the occurrence, of all species is much higher than historical levels. Given the low reproductive potential of these species, it is likely that the observed increases in shark abundance are due in large part to changes in distribution as well as increased reproduction. Unfortunately, little information exists on the previous or current distribution of sharks, or on the composition of the stock. Researchers with the Virginia Institute of Marine Science (VIMS), NOAA Fisheries, and ADF&G have cooperated to collect data to obtain a basic understanding of age, growth, and movements.

Giant Pacific Octopus (Enteroctopus dofleini)

The following information while mostly about to the Giant Pacific octopus (*Enteroctopus dofleini*), may also be applied generally to the other less numerous species of octopus found in Alaska waters concerning management strategies, markets and fishing practices.

Life History

Part of the cephalopod class of animals, Giant Pacific octopuses occur in nearly all of Alaska's marine waters and are taken as bycatch in pot fisheries for cod and crab, and in trawl and longline commercial fisheries. Additionally, the species is distributed along the North Pacific Rim from Japan to Siberia and down into California. This particular species of octopus can reach four to five feet in length, weigh 150 pounds, and is found in depths approaching 300 feet. Females are sexually mature in three years, mating from July to October and spawning from October to January. *E. dofleini* is a terminal spawner where the female dies after hatching her eggs and the male dies after mating. Their preferred habitat is believed to be comprised of a combination of rock, sand, and mud substrate where they feed upon bivalves and shellfish, reaching a maximum age of three to four years in the wild.[21]

Commercial Fishery

In the State of Alaska commercial fishery, octopus harvest increased in the early 1990's after pot fishermen targeting crab switched to cod when the crab stocks declined, and began landing octopus as bycatch. Between 1995 and 2003 all reported state harvests of octopus in the Bering Sea Aleutian Islands (BSAI) were as bycatch taken during directed cod fisheries. Under a commissioner's permit, vessels targeted octopus along the Alaska Peninsula and Gulf of Alaska (GOA) excluding Cook Inlet and Southeast Alaska. During 2004, nineteen commissioner's permits were issued for directed harvest of Bering Sea octopuses on an experimental basis during the months of September-November. Thirteen vessels using pots reported landings of nearly 5,000 octopuses whose average weight was 31 pounds totaling 85 metric tons (300,000 pounds). The average five year harvests for octopus from 1998-2002 was 286,326 pounds worth $130,000 among 219 permits.[22]

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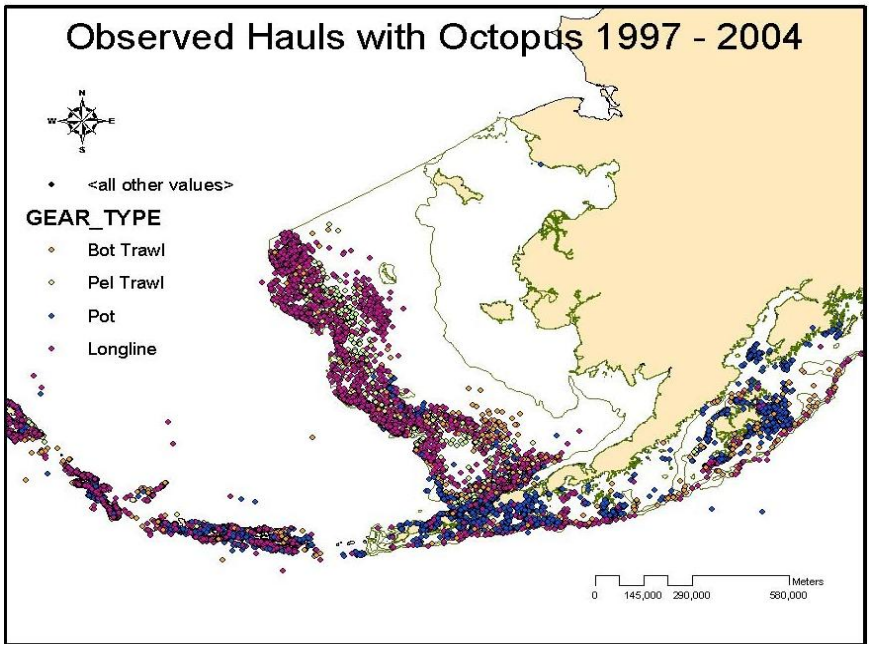
[21] Source: E.B. Hartwick et a. Octopus Dofleini: Biology and Fisheries in "*The Fisheries and Marketing Potential of Octopus in California Proceedings, 1989."* For a very detailed analysis of habitat requirements for E. dofleini undertaken in Alaska, see D. Scheel 2002 "*Characteristics of Habitats Used by Enteroctopus dofleini in Price William Sound and Cook Inlet, Alaska* "

[22] ADF&G. Note: bycatch of octopi is limited to 20 percent of the directed species catch.

There is no federally-directed fishery for octopus in the BSAI. According to NOAA Fisheries, the majority of observed commercial and survey hauls of octopus are concentrated in the outer front region and along the shelf break in the Bering Sea, from the "horseshoe" at Unimak Pass to the northern limit of the federal regulatory area. Octopuses have been taken throughout the western GOA and Aleutian Islands.

Figure. 4 Distribution of Octopus (all species) in the Bering Sea Aleutian Islands



Source: NOAA Fisheries Alaska Fisheries Science Center, BSAI Octopus Complex, 2005

North Pacific Stock Status

There are at least seven species of octopus residing in the Bering Sea an Aleutian Islands and GOA and the species composition of natural communities and commercial harvests is unknown.[23] Octopus numbers can undergo large swings in abundance depending on the geographic area. Southeast Alaska octopus populations tend towards a seven year cycle of low to high numbers. Prior to 1982, octopuses commercially harvested in Alaska were captured as bycatch in trawls, crab pots and shrimp pots averaging around 74,000 pounds annually.[24] Recent harvests are double this with an ex-vessel value of $2.20 per pound. NOAA Fisheries manages octopus as part of the Bering Sea Aleutian Islands (BSAI) "other species" complex but due to increasing market value is currently considering splitting this species into its own management group. The highest catch rates occur during Pacific Cod fisheries especially around Unimak Pass. The long term average estimated incidental catch rate for 1992-2005 is 352 metric tons (776,000 pounds). The allowable biological catch level is estimated at 2,782 tons for the Bering shelf and slope

[23] Source: 2005 NPFMC Bering Sea an Aleutian Islands SAFE report: part 16.5: Octopus Complex
[24] Paust, Brian C. from "Octopus Dofleini: Commercial Fishery in Alaska" in "*The Fisheries and Marketing Potential of Octopus in California Proceedings, 1989."*

and Aleutian Islands. Due to a lack of stock assessment data for octopus, NOAA Fisheries is recommending that directed fishing for octopuses not occur at this time and that bycatch be managed by conservative catch limits.[25]

Markets

Until recently, octopus landed in Alaska was primarily sold for bait. A commercial market for human consumption is developing in Alaska. Primary international octopus markets include Japan, Spain and Italy supplied by harvests originating in Southeast Asia, India, Europe, Japan, South America, and Canada (Globefish). U.S. seafood exports have not played much of role in the Japanese octopus market other than incidental catch.

Octopus is a highly prized food in Japan where consumers eat fresh, cooked or frozen octopus in main meals and snack including sashimi and sushi meals. Recent industry sources place the octopus market in Japan, the largest in the world, at over 100,000 metric tons; half of this market is served through imports, mainly from Mauritania and Morocco. Whole frozen animals, tentacles, or body parts, are the most preferred product styles for Japanese processors. Previously several shipments to Japan from Alaska proved that the quality is generally acceptable to Japanese importers. Since the shipments were an accumulation of incidental catch from other fisheries, and the packer had no intention to grade products by quality or provide samples for inspection by buyers, exports did not continue.[26] Some Japanese buyers are still trying to import octopus from the United States and product quality could improve substantially if targeted octopus fisheries are developed and quality control improved with assistance from Japanese importers.

While Japanese production has been stable, in a range from 51,000 and 57,000 MT, total imports decreased by 35 percent from a peak of 74,000 MT in 2002 to 48,000 MT in 2006. This decrease reflected an increase in average Cost Insurance Freight (CIF) prices by 48 percent to JPY 627/kilo (USD2.45/lb).[27] As a result, the average wholesale price of frozen octopus, for both domestic production and imports, rose eight percent from JPY 739/kilo (USD2.68/lb) in 2002 to JPY 798/kilo (USD3.12/lb) in 2006.

Japan Tariff Association reports Japanese import prices for frozen octopus increased 18.4 percent in Japanese yen terms (up 10.5 percent in USD) from 620 yen/kg (USD2.56/lb) in 2005 to 734 yen/kg (USD2.83/lb) in 2007. According to the Japanese seafood industry press, this increase was attributed to tighter supply conditions from key exporters, especially Mauritania and Morocco. The higher import price reflected a shortage in import supply. In the most current figures available, Japan's octopus imports decreased 16 percent from 55,538 MT in 2005 to 46,784 metric tons (MT) in 2007. Imports from the largest supplier, Mauritania, decreased 28.3 percent, from 19,460 MT in 2005 to

[25] Source: 2008 NPFMC Bering Sea an Aleutian Islands SAFE report: part 19 Octopus Complex in the Bering Sea and Aleutian Islands.

[26] For an excellent market analyses of the Japanese market for octopus see: T. Asakawa: Japan: Octopus Market 2008. U.S. Commercial Service: http://www.buyusainfo.net/docs/x_1512103.pdf

[27] A trade term requiring the seller to arrange for the carriage of goods by sea to a port of destination, and provide the buyer with the documents necessary to obtain the goods from the carrier.

13,960 MT in 2007, due to poor fishing attributed to depleting resources. There is a good opportunity for U.S. exporters to fill the import gap.[28]

Permits and Regulations

In Japan, octopus is managed by placing restrictions on seasons based on migration and spawning seasons while in British Columbia managers use limited licenses and seasonal and area regulations. In State of Alaska commercial fisheries waters, commercial vessels interested in harvesting octopus require a Commissioner's Permit from ADF&G and currently issued for the Alaska Peninsula, and other Gulf of Alaska waters except Cook Inlet and Southeast Alaska. Under this permit, commercial operators targeting octopus cannot be targeting other species so that such efforts do not affect the 20 percent bycatch harvest limit for other managed commercial fish stocks. NOAA Fisheries continues to examine survey and observer data to identify the best strategies for managing octopus in federal waters off Alaska taking into account estimates of biomass and estimated mortality for a portion of the stock vulnerable to commercial fishing prior to spawning. Currently, federal scientists believe more information is needed on how seasonal harvests by gear types relate to each other and stock biomass, and recommends that a BSAI octopus complex be separated from the "other species" complex currently used to improve monitoring and controlling catches especially given the rising value of octopus markets.

Summary

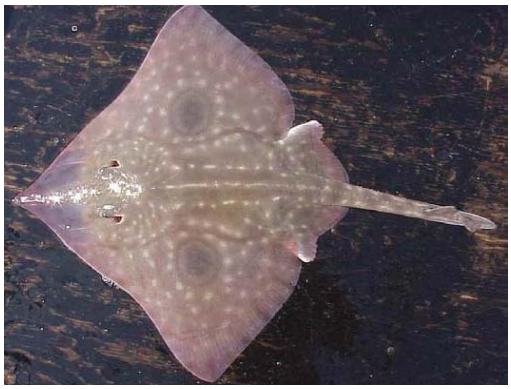
Commercial fishery management biologist at the federal and state levels concur, given the growing market interest in Alaska octopus and the lack of species knowledge, that the distribution, and abundance of octopus especially in the BSAI, be managed conservatively until additional research is performed to address the knowledge gaps, and that no directed or target commercial fishing operation occur on BSAI octopuses until data gaps close. A number of recommended management options are presented in the 2008 North Pacific Fishery Management Council Bering Sea and Aleutian Islands *SAFE* report which concludes:

> "Improved catch accounting, species identification of harvested octopus, and better understanding of seasonal movement and reproductive patterns are all needed to provide responsible management strategies."[29]

[28] T. Asakawa: Japan: Octopus Market 2008. U.S. Commercial Service: http://www.buyusainfo.net/docs/x_1512103.pdf

[29] Source: 2008 NPFMC Bering Sea an Aleutian Islands SAFE report: part 19 Octopus Complex in the Bering Sea and Aleutian Islands.: http://www.afsc.noaa.gov/REFM/docs/2008/BSAIocto.pdf

Skates (*Raja*)



Big Skate (Raja binoculata) Adult

Longnose Skate (Raja rhina) Adult

Skates have long been a major component of fisheries bycatch and more recently as new markets for their meat develop, are the target of commercial fisheries along Alaska's coast. However, detailed biological information needed to enact effective management practices is lacking for most skate species. Since many skates possess characteristics that may make them prone to over fishing, such as slow growth, late maturity, and low reproductive rates, information such as a skate's longevity and growth rates is critical in developing sustainable management plans. At least 15 species of skates (3 *Raja* and 12 *Bathyraja*) are found in Alaskan waters and are common from shallow inshore waters to very deep benthic habitats. From 2003 to 2005, over half of all Gulf of Alaska directed skate catch was comprised of only two species, the big skate (*Raja binoculata)* and the longnose skate, *R. rhina*. This report focuses on these two species.

Life History

The big skate, *Raja binoculata,* and longnose skate *R. rhina* are members of the family Rajidae. Generally found at depths of less than 300 feet in continental shelf waters ranging from the Bering Sea to southern Baja, California, the big skate is the largest skate in the eastern north Pacific, reaching maximum reported total lengths of nearly nine feet. Unlike most skate species which produce only one embryo per egg case, big skates may produce up to eight embryos per egg case. The longnose skate is smaller with observed lengths of five feet. NOAA reports that age information on these skates is very limited. However, what is known suggests male big skates are fully mature at three feet in length, around ten years old; and females at the same length two years later. Male longnose skates mature at a length of two feet when they are around seven years old and females of three feet mature at ten to twelve years.[30] Longnose skate are typically found on mud-cobble bottoms often near boulders, rock ledges, and other areas with vertical relief whereas big skate are found in shallower waters on sandy-muddy bottoms.

[30] Gburski, C.:Age and Growth Program Alaska, Fisheries Science Center 7600 Sand Point Way NE Seattle, WA 98115 (*http://www.afsc.noaa.gov/REFM/age/Docs/Skate_Age_Man.pdf*)

Commercial Fishery

Skate is commercially taken in Alaska primarily as bycatch in groundfish trawls throughout its range but has become a target species in the last decade. In 2002, as a result of improved market prices for skate, a state directed skate fishery developed in the Gulf of Alaska near Kodiak, paralleling a targeted federal fishery. At the time, skate deliveries increased from 20 tons in 2002 to 1,700 tons in 2003, mostly as a result of the targeted fishery in state waters. The directed fishery in Kodiak was discontinued because of concerns about stocks and lack of data.[31]

During March 2009, a directed fishery targeting big and longnose skates in the Outside District of Prince William Sound opened with guideline harvest levels of 30,000 pounds of big skate, and 150,000 pounds of longnose skate. By the first part of April, the harvest levels for big skate where achieved and the fishery closed. Currently, big skate may be retained as bycatch at a level of up to 20 percent of the directed groundfish and IFQ halibut on vessels.[32]

In 2003, vessels began retaining and delivering skates as a target species in federal waters partly because the market for skates had improved and partly because catch of Pacific cod could be retained as bycatch in a skate target fishery, even though directed fishing for cod was seasonally closed. The result was a dramatic increase in skate landings.[33] In 2005 and for the first time in federal waters, big and longnose skates were managed as a single species group in the Gulf of Alaska, a management response to growing commercial interest in these species. Their status was previously listed under NOAA management as part of the Other Skates Complex.[34]

North Pacific Stock Status

Current research on skate biology and fisheries suggests that large skate species with late sexual maturation, like big and longnose skates, are extremely vulnerable to overfishing, and if overfished are slow to recover.[35] However, NOAA Fisheries reporting recently on the status of the U.S. fisheries for 2005 states the Alaska Region Gulf of Alaska longnose and big skate are not subject to overfishing.

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[31] NOAA Fisheries

[32] ADF&G correspondence.

[33] For an excellent analysis of skate stock assessment work see: Gulf of Alaska Skates 2005: http://www.afsc.noaa.gov/refm/docs/2005/GOAskates.pdf

[34] NOAA's National Marine Fisheries Service's report on the status of the U.S. fisheries for 2005 – Message from the assistant administrator: http://www.nmfs.noaa.gov/sfa/domes_fish/ReportsToCongress/finalSOS/Report_text_FINAL3.pdf

[35] Gertseva, G. 2008. The population dynamics of the longnose skate, *Raja rhina*, in the northeast Pacific Ocean. Cooperative Institute for Marine Resources Studies, Oregon State University, 2030 SE Marine Science Drive, Newport, OR 97365, USA

Markets

In 2008, 65 million pounds of skates worth $11 million were commercially landed in the U.S.[36] Big and longnose skate are marketed under the general term 'skate." Both species of skate are captured year round as bycatch in Alaska's groundfish fisheries. A relative of the shark family, skate's wings are considered a delicacy and are used in many forms of Asian recipes calling for shark, especially in such popular dishes as shark fin soup. In 1997, Korea lifted restrictions on skate imports. Today, companies that process skate sell them as fresh or frozen wings and most of the landings of big and longnose skate are exported to South Korea. The Korean government does, however, apply a 20% tariff on most fresh or chilled fish species, and a 10% tariff on most frozen fish species. Frozen skate is also a popular item, as Korean importers perceive these forms to be of very high quality. In fact, skates are so popular in Korea that some stores in Seoul's Noryangjin market specialize exclusively in skates.

Skate wings are exported frozen to Spain and France as well. Demand is especially strong in France where until recently, a single company based in New Bedford Massachusetts annually exported 1,750 tons of skate wings.[37] In 2006, the Massachusetts skate fishery was valued at $5.5 million with landings totaling 25 million pounds. A crash in commercially targeted skates in that region of the country currently presents market opportunities for Alaska skate fishermen to meet continuing demand for skate meat and co-products in France.

Permits and Regulations

A Commissioner's permit (ADF&G) is needed prior to commercial fishing for skates in waters managed by the State of Alaska. In addition to the conditions of this permit, to qualify to participate in a test fishery for skates in State of Alaska waters, commercial fishermen must present a current gear-appropriate, miscellaneous finfish interim-use permit card issued by the Commercial Fisheries Entry Commission (CFEC). Other terms and conditions will likely apply. Skates may be retained as bycatch at a level of up to 20 percent of the directed groundfish and IFQ halibut on vessels.

Summary

Studies indicate the importance of conducting species-specific identification in the skate fishery and closely monitoring discards of big and longnose skates to improve the accuracy of fishery catch data. This effort is currently underway and is intended to assess stock vulnerability.[38]

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[36] Fisheries of the United States, 2008, page 11.

[37] Seatrade International Company Inc, New Bedford, Mass. Walter Barrett, General Manager.

[38] NOAA Fisheries defines *vulnerability* as a combination of a stock's productivity, which depends upon its life history characteristics, and its susceptibility to the fishery. *Productivity* refers to the capacity of the stock to produce at maximum sustainable yield and to recover if the population is depleted. *Susceptibility* is the potential for the stock to be impacted by the fishery, which includes direct captures, as well as indirect impacts to the fishery (e.g., loss of habitat quality).

Arrowtooth Flounder (Atheresthes stomias**)**

Life History

NOAA Fisheries estimates that when fish are ranked by weight, arrowtooth flounder is fist among marine species with the most biomass in the Gulf of Alaska. While the numbers of crab and other fish species have dropped in the past several decades, the arrowtooth flounder population has increased six fold.

Many basic aspects of arrowtooth flounder life history such as size and age of sexual maturity are lacking. However, in Alaska waters, arrowtooth flounder are distributed over the continental shelf through age four and then at older ages disperse to occupy both the continental shelf and the slope. Arrowtooth flounder range from central California to the eastern Bering Sea. The huge increase in biomass observed in the 1990s resulted from strong year-classes produced in the 1980s. Arrowtooth flounder are known to be voracious predators of juvenile walleye pollock.

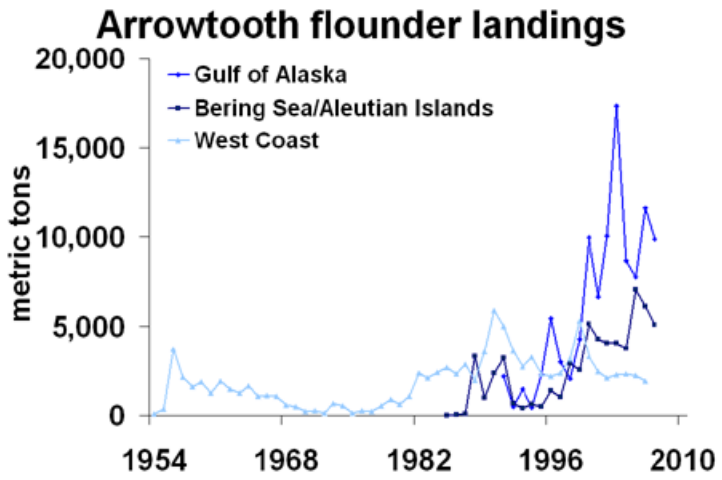
Arrowtooth are most commonly found on sandy gravel substrates and occasionally over low-relief rock-sponge bottoms at depths of 160 feet in the summer to more than 1,640 feet in the winter. Females grow slightly faster than males, up to three feet in length; males can grow up to two feet in length and mature at three to seven years. Females mature at four to eight years.

Commercial Fishery

Arrowtooth flounder populations are very healthy, and no overfishing is occurring. In the Gulf of Alaska and Bering Sea Aleutian Islands, biomass is nearly 200 percent over maximum sustainable yield value.[39] With the exception of the longline fishery for halibut, the majority of the arrowtooth catch in Alaska is taken with trawl gear. Arrowtooth were typically only caught incidentally in fisheries targeting other species, but in recent years, a directed fishery has developed (Figure 4). Catch is limited by market demand and halibut bycatch limits.

[39] 2008 BSAI Arrowtooth Flounder Stock Assessment, 2008 GOA Arrowtooth Flounder Stock Assessment

Figure. 5



Arrowtooth flounder are currently of low value in the GOA. However, the percent retained has increased from below 10% in the early 1990s to about 70% in 2008. Higher catches in recent years are a result of higher biomass levels and subsequently higher incidental catch in other target fisheries and increased marketing efforts for arrowtooth fish meal and surimi.

In the BSAI, little effort has been directed to catching arrowtooth flounder, and they are taken as bycatch by trawl and longline gear in pursuit of higher valued species and often discarded. However, as new markets open up fishermen are expected to retain more of this species in coming years.

North Pacific Stock Status

Arrowtooth flounder are currently the most abundant fish in the Gulf of Alaska where over the past decade a directed fishery has developed. Arrowtooth is managed under the Gulf of Alaska (GOA) Groundfish Fishery Management Plan (FMP) and Bering Sea Aleutian Islands (BSAI) Groundfish Fishery Management Plan (FMP) because of its importance to both ecosystems and growing commercial interest. Arrowtooth flounder catches have been averaging 12,789 tons from 1977 to 2008. Total catch for 2008 was only 21,856 tons, well below the allowable biological catch of 243,900 tons.[40]

Markets

When compared with the pollock and cod fisheries, little effort has been directed to catching arrowtooth flounder due to the reduced intrinsic quality of their flesh. Upon landing, a proteolytic enzyme is released that causes softening of the flesh that further limits arrowtooth marketability. Recently, several food grade additives have been successfully introduced that inhibit this enzymatic reaction enabling a targeted fishery to

[40] Ibid.

occur in the Gulf of Alaska for marketable arrowtooth products including a protein powder, surimi, and frozen fillets.[41]

Due to the large number of flatfish available from Alaska, the marketplace does not always distinguish between flatfish species and therefore arrowtooth flounder may also be sold as sole or flounder making it difficult to identify specific arrowtooth markets. Instead, with improved species differention targeting consumers, niche markets for flounders should be examined as potential opportunities for this flatfish. Current product forms include surimi, protein powder concentrates, and when sold frozen, as round, j-cut, and as skinless fillets.

The United State and China are two of the largest consumers of available arrowtooth flounder, and the list of international importers is growing as word of increasing supply spreads. Presently, a lack of pollock available for surimi products due to demand for pollock fillets has the current surimi market, valued at $10 billion, scrambling for new supplies of raw material. Arrowtooth flounder offers excellent potential as a supply source, but issues of halibut bycatch first need to be addressed.[42]

Permits and Regulations

Along with over a dozen species of flatfish managed by the State of Alaska, arrowtooth are caught as target or bycatch species in federally-managed fisheries in the GOA and BSAI. For management purposes all flatfish are included in species groups that differ between the GOA and BSAI and with an overlap of arrowtooth and halibut habitats, arrowtooth catches are limited by halibut bycatch quota. A Total Allowable Catch (TAC) is established for arrowtooth flounder and the commercial fishery is managed primarily through the actions taken by the North Pacific Fisheries Management Council.[43]

Summary

Arrowtooth flounder in the GOA and BSAI is a species of high abundance but currently low commercial value. For example, the ex-vessel value of all flatfish in the GOA in 2002 was $3.5 million for 34,100 metric tons; of which 21,200 metric tons was arrowtooth flounder. Until new ways can be devised to reduce halibut bycatch, the arrowtooth fishery is likely to continue to be limited by the potential for high bycatch of Pacific halibut, which results in closure of the halibut fishery prior to achieving the target species TAC.

[41] Alaska Fisheries Science Center, NOAA Fisheries
http://www.afsc.noaa.gov/species/Arrowtooth_flounder.php
[42] For more information go here: http://surimischool.org/sur-or.html
[43] Fishery Management Plan for the BSAI: http://www.fakr.noaa.gov/npfmc/fmp/bsai/BSAI.pdf
and Fishery Management Plan for GOA: http://www.fakr.noaa.gov/npfmc/fmp/goa/GOA.pdf

Bering Cisco (*Coregonus Laurettae*)

Life History

The Bering Cisco is a soft-finned freshwater whitefish found in northwestern Arctic drainages, and is anadromous, migrating from salt-water to fresh-water to spawn. Bering Cisco spawn in the fall in fast-flowing water near beds of loose gravel. Whether they spawn more than once in their life is unknown; reaching sexual maturity between four and nine years of age. The average age of spawning females is seven; whereas, males average six years of age. Bering Ciscos have been observed 1,200 miles up the Yukon River and 600 miles up the Kuskokwim River. Bering Cisco found in the Yukon River average about fifteen inches (males) to 20 inches (females) in length. Fry migrate out of the river during their first summer and do not return until they mature.[44]

In Alaska, the Bering Cisco is found in coastal waters of the Beaufort, Bering and Chukchi seas. Major spawning migrations occur in the Yukon and Kuskokwim rivers. While scientists' understanding of population dynamics, migrations, and demographics is relatively poor, work started in the late1990's by ADF&G and continuing today with USFWS is beginning to answer some of these unknowns. For example, major spawning habitats for whitefish, including Bering Cisco, have been identified in gravel bed, braided areas of the Yukon Flats, and in large tributaries of the upper Tanana, Koyukuk, and Nowitna rivers.[45] In the Yukon River, primary spawning areas occur between Circle and Fort Yukon, and some Bering Cisco migrate up the Yukon River into Canadian waters, occasionally observed as far upstream as Dawson City, Yukon Territory.

Commercial Fishery

In Alaska, Bering Cisco is targeted by coastal subsistence fishers who value these whitefish for their high oil content, and more recently by commercial fishermen participating in test fisheries Although during the summer they are the most abundant whitefish species in the lower Yukon River in Alaska, Bering Cisco are not fished heavily in the river since they migrate at the same time as Yukon Chinook and Chum salmon and fishermen are targeting the salmon. Recently, new market opportunities in East Coast markets for Yukon River Bering Cisco are being pioneered by Kwik'Pak Fisheries. Now in its fourth year of effort, commercial fishermen in Emmonak working

[44] USFW Service, Fairbanks, Alaska.
[45] Oncorhynchus, Spring 2007: *Coregonid Research in the Yukon River Drainage*, R. Brown.

with Kwik'Pak Fisheries have been conducting test fisheries aimed at developing a full scale commercial fishery for Bering Cisco.

Permits issued by ADF&G allow fishermen to especially target Bering Cisco during the fall and early winter months due to its local abundance and marketability in East Coast smoked fish markets. Fishermen use gillnets in open river waters, and later under the ice to harvest the whitefish. During 2008, 10,000 pounds of Yukon River whitefish shipped to smokers on the East Coast were well received by customers.

Stock Status

Alaska fisheries biologists working the lower Yukon River, report Bering Cisco spawners far outnumbering any other salmonid species during the late summer and fall. However, complete stock assessment data on Cisco genetics, total run strength and timing of adult runs needs to be collected for informed management decisions needed to direct a sustainable commercial fishery. State fisheries biologist and the local CDQ are working cooperatively to answer these and other questions needed to manage a potential future commercial fishery on Bering Cisco. Until then, test fisheries will be conducted in the fall and spring that will provide some fish for the market as well as valuable data on the Bering Cisco stocks to managers.

Markets

Whitefish is considered one of the best-eating freshwater fish available. Whitefish occupy cold northern waters resulting in meat with high flavorful oil content. The meat is medium-firm with a large flake and a mild flavor that is more like salmon than trout.

Test fishing and marketing are currently taking place on Yukon River Bering Cisco. Through the efforts of Yukon Delta Fisheries Development Association's Kwik'Pak Fisheries and fourteen commercial fishermen operating in the lower Yukon River, 10,000 pounds of test quota were harvested in 2008. Management staff at Kwik'Pak working closely with ADF&G is hoping to see the fishery increase to a 40,000 – 100,000 pound commercial harvest over time. Interest in fresh, frozen and smoked product forms is strong in domestic markets from Hawaii to New York City, and prospects in Asian markets are improving.[46]

In a 2006 report by the EU Fish processor's Association the authors cite the decline of the whitefish harvests in EU waters and an underserved European market.[47] While this report mainly addresses marine whitefish markets for pollock and cod, the potential for entering

[46] Sylvia Beaudoin, Kwik'Pak Fisheries Manager of Sales & Marketing.

[47] EU dependency on third-country fish imports is increasing: AIPCE study on white fish, 2006 http://www.globefish.org/files/White%20Fish%20Study%202006_432.pdf

similar markets with freshwater whitefish are good, especially smoked markets in Scandinavian countries, Germany, Spain and France.

Permits and Regulations

Permits used in the Bering Cisco test fishery are obtained through a Commissioner's permit issued by the ADF&G for an annual harvest of 10,000 pounds of whitefish.

Summary

Two primary challenges currently confront the development of a Bering Cisco commercial fishery. The first is a need for more resource management data on Cisco stocks to be able to manage a sustainable commercial fishery. The collection of this information is currently underway. The second needs to address concerns expressed by some of the local population who traditionally target fresh water whitefish as an important subsistence food and do not want a commercial fishery on these stocks. The solution to the second challenge might be found in answering the first.

State of Oregon's Developmental Fisheries Program

Some like to point out that Alaska is not in the seafood business; it's in the asset management business. Arguably, sustainable economic development of its commercial fisheries is best approached by taking the long view and through successfully harnessing market forces. To understand how this approach might be applied to underdeveloped commercial fishing opportunities, the State of Oregon's Developmental Fisheries Program (DFP) is reviewed.

Instituted in 1993 by the Oregon State Legislature, the DFP is tasked with bringing underdeveloped commercial fisheries into full development status. It attempts to do this by establishing operational program guidelines, allocating asset rights, choosing measurable targets establish in statute, and financing developmental fisheries management practices.[48] However, since its inception the program has only been able to bring two underdeveloped commercial fisheries into full developmental status: the bay clam and sardine fisheries. Reasons cited for the program's poor performance include: (a). Too few fishermen willing to invest in the development of underdeveloped fisheries from a lack of incentives offered by the state; (b). Insufficient biological data collected and required to establish stock biomass, growth rates, and optimal yields for the fishery; and (c). Lack of established markets and potential new markets.

[48] M. Harte, P. Endreny et al November 2007. Developing Underutilized Fisheries: Oregon's Developmental Fisheries Program. Marine Policy 32 (2008) 643-652.

Following a 2007 review of Oregon's Developmental Fisheries Program, analysts identified six recommendations intended to make the program more effective in bringing underdeveloped commercial fisheries into full utilization.[49]

1. Set defined operational guidelines to take the fisheries through the development process, and establish measurable program goals and objectives to benchmark progress.
2. Establish a mandatory time frame for moving a developing fishery into a developed status.
3. Secure sufficient funding and staff support. Agency funding must be a priority.
4. Provide an economic incentive to fishermen and processors participating in the development of a new fishery intended to safeguard the investment of those who assume the risk of new fishing ventures. But require participants to provide evidence that they are in fact, contributing to the development of the emerging fishery.
5. Before transitioning to a developed status, the fishery must meet scientific and management standards.
6. Dedicated access programs such as Individual Fishing Quotas should be strongly considered for encouraging the development of underutilized commercial fisheries.

Strategies to implement the six recommendations are found in the report. While the DFP continues to be well received by commercial fishermen and seafood processors alike, criticisms of the program's slow progress and especially weak access rights contribute to inefficiencies, stifle economic innovation, and raise questions concerning resource sustainability of the fisheries. Despite the often small–scale size of many of the underdeveloped fisheries, their management and scientific requirements are complex and expensive. For this reason it is recommended that cost estimates of the underdeveloped fishery be made before the decision is made to move it into a fully developed status. As the authors' of the DFP report state: *"At a minimum, development responsibilities should be assigned to every developmental permit. In return, higher qualifying landings and fewer permits would create greater competition between fishermen and be a driver of resource and industry development."*

[49] Ibid