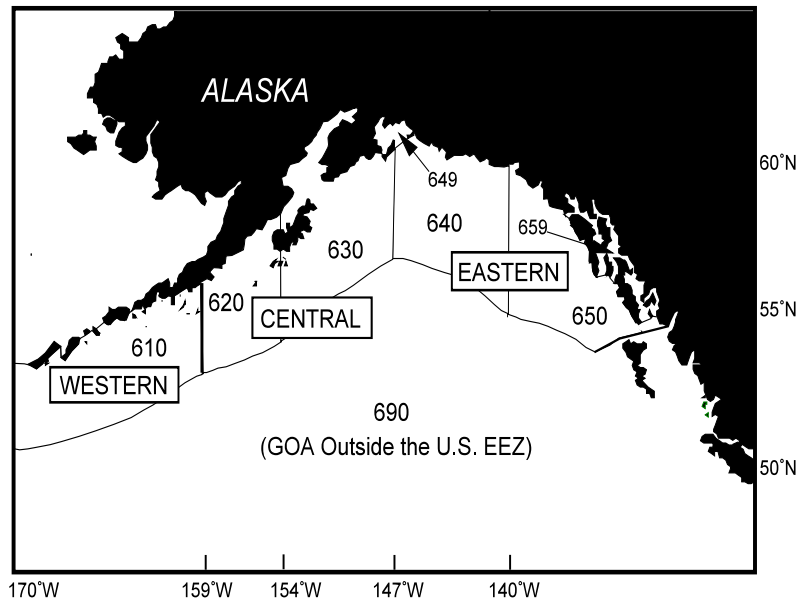


Groundfish of the Gulf of Alaska: A Species Profile



by

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Acronyms and Definitions

ABC	= acceptable biological catch
BSAI	= Bering Sea/Aleutian Islands
DSR	= demersal shelf rockfish
EEZ	= exclusive economic zone
F	= instantaneous fishing mortality rate
FMP	= fishery management plan
GOA	= Gulf of Alaska
IFQ	= individual fishing quota
M	= instantaneous natural mortality rate
m	= meters
mt	= metric tons
OFL	= overfishing level
OY	= optimum yield
POP	= Pacific ocean perch
PSR	= pelagic shelf rockfish
TAC	= total allowable catch

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Walleye Pollock

Biology: Pollock (*Theragra chalcogramma*) in the Gulf of Alaska (GOA) are managed as a single stock that is separate from the Bering Sea and Aleutian Island pollock stocks. Pollock begin to recruit to the fishery at age 2 and many survive 10 years or more. Seasonal migrations occur from overwintering areas along the outer shelf to shallow waters (90-140 m) to spawn. Pollock are found throughout the water column from near the surface down to 500 m. Females reach 50% maturity at 30-34 cm (3- 4 years old) and produce about 140,000 - 300,000 pelagic eggs at this size. Spawning occurs in late winter/early spring in major spawning concentrations of pollock which have been observed in Shelikof Strait and the Shumagin Islands. Annual natural mortality of adults has been estimated to be about 25% per year ($M = 0.30$). Pollock feed on copepods, euphausiids, and fish (primarily capelin), and are in turn prey for other fish, marine mammals, and seabirds.

Stock Assessment: The current assessment is based on a length-based stock synthesis model for the Western and Central regulatory areas. The model incorporates fishery data and fishery independent data from triennial bottom trawl surveys and an annual hydroacoustic survey of spawning concentrations in Shelikof Strait. Beginning in 1997, OFL and ABC rates are based on tiers defined under Amendment 44. In 1997, pollock fell under tier 3b of the ABC/OFL guidelines, thus the overfishing mortality rate is $F_{30\%}$ adjusted by the ratio of current female spawner biomass (0.258 million mt) to $B_{40\%}$ (0.267 million mt). F_{ABC} cannot exceed the $F_{40\%}$ fishing mortality rate adjusted by the ratio of current spawner biomass to $F_{40\%}$ (0.34). The adjusted harvest rate resulted in a projected yield of 120,800 mt in 1998. B_{MSY} and F_{MSY} have not been estimated for the GOA stock.

Population Status: For 1998, exploitable biomass (age 3+) in the GOA was estimated at 1.16 million mt. Catch specifications were the following: OFL=170,500 mt, ABC=130,000 mt (includes Western Central and Eastern Gulf ABC), TAC=124,730 mt. Pollock are of medium relative abundance and are harvested at 100% of ABC. The 1988, 1989, and 1994 year-classes are forecast to be above average. Preliminary information suggests that the 1995 year class is weak and the 1996 and 1997 year-classes are predicted to be weak or average. Under these recruitment scenarios of year class strength, the spawner biomass will peak in either 1999 or 2000.

Fishery: Major exploitable concentrations are found primarily in the Western/ Central areas. Pollock are targeted only by trawl gear, with 96 trawl vessels participating in the 1996 GOA pollock fishery, all delivering onshore. The trawl season opens on January 20. In 1997, the fishery closed on January 26 in Area 610, February 7 in Area 620, February 4 in Area 630, and March 2 in Areas 640 and 650. The fishery went on prohibited status in Areas 640 and 650 on March 31 and did not reopen. The fishery reopened in Areas 610-630 on June 1 and closed on June 2 in Area 610, June 8 in Area 620, and June 9 in Area 630. The fishery reopened on September 1 and closed on September 7 in Area 610, September 21 in Area 620, and September 12 in Area 630.

Management: The pollock fishery is regulated under the GOA Groundfish FMP. In 1993, the Council apportioned 100% of GOA pollock to the inshore sector. The FMP controls the fishery through a moratorium permit and limited entry, catch quotas (TACs), seasons, in-season adjustments, gear restrictions, bycatch limits and rates, allocations, regulatory areas, record keeping and reporting requirements, and observer monitoring. The Western and Central subarea TACs are divided into three fishing periods, beginning January 1 (January 20 for trawl gear), June 1, and September 1. The trimester apportionments for 1998 are 25:35:40 percent. In 1998, trawl gear was prohibited east of 140° W. longitude and 100% retention was required for pollock.

Economics: In 1996, 51,000 mt of pollock was caught in the GOA, of which about 90% was retained. The rate of pollock discard was 3.7% in the pollock target fishery (153 mt). The onshore fleet took 96% of total harvest. Average ex-vessel price was about \$0.10/lb. Primary products produced are surimi, minced product, fillets, meal, oil and roe.

Catch History: The commercial fishery started as a foreign fishery in the early 1970s. Catches increased rapidly

Exploitable biomass (from 1998 stock synthesis model), catch specifications and total catches (including discards) of age 2+ walleye pollock in the GOA, 1978-98 (in mt).

<u>Year</u>	<u>Biomass</u>	<u>ABC</u>	<u>TAC</u>	<u>Catch</u>
1978	1,906,000	--	--	90,820
1979	2,180,000	--	--	98,510
1980	2,587,000	--	--	110,100
1981	2,905,000	--	--	139,170
1982	2,937,000	--	--	168,690
1983	2,714,000	--	--	215,570
1984	2,293,000	--	234,960	307,400
1985	1,786,000	--	293,250	284,820
1986	1,535,000	116,600	133,280	93,570
1987	1,525,000	112,000	108,000	69,540
1988	1,473,000	93,000	93,000	65,625
1989	1,359,000	75,375	72,200	78,220
1990	1,353,000	73,400	73,400	90,490
1991	1,378,000	133,400	133,400	107,500
1992	1,344,000	99,400	87,400	93,900
1993	1,249,000	160,400	114,400	108,600
1994	1,071,000	109,300	109,300	110,890
1995	881,000	65,360	65,360	73,250
1996	965,000	54,810	54,810	50,200
1997	1,046,000	79,980	79,980	89,800
1998	1,156,000	130,000	124,730	*

during the late 1970s and early 1980s. The pollock fishery experienced a short period of joint venture operations in the mid-1980s and was fully U.S. fishery by 1988.

Pacific Cod

Biology: Pacific cod (*Gadus macrocephalus*), also known as grey cod, are moderately fast-growing and short-lived fish. Females reach 50% maturity of about 67 cm, corresponding to an age of about 6.7 years and are highly fecund. A 67 cm female cod will produce > 1 million eggs. Annual natural mortality of adults has been estimated to be about 0.37. In the GOA, they are most abundant in the Central area, where large schools are encountered at varying depths. Cod are demersal and concentrate on the shelf edge and upper slope (100-200 m) in the winter and spring where they overwinter and spawn from January through April. and move to shallower waters (<100 m) in the summer. Cod begin to recruit to trawl fisheries at age 3, but are not fully recruited to all gear types until about age 7. Maximum age has been estimated at 19 years. Cod prey on polychaetes, amphipods, shrimp, and fish. In turn, they are eaten by halibut, sharks, seabirds, and marine mammals.

Stock Assessment: The current assessment is based on a risk-averse, length-based synthesis model. B_{MSY} and F_{MSY} Estimates are not available for this stock. Beginning in 1997, OFL and ABC rates are based on tiers defined under Amendment 44. P. cod OFL is based on a tier 3a fishing mortality rate where $F_{OFL} = F_{30\%}$ (=0.50), estimated at 141,000 mt for 1998. ABC is based on a tier 3a harvest strategy where $F_{ABC} = F_{40\%}$ (=0.34), resulting in a yield of 77,900 mt for 1998.

Population Status: The 1998 exploitable biomass (age 3+) was estimated at 785,000 mt. The 1998 quota was set at 66,060 mt, reduced by 15% from the ABC. This amount (11,840 mt) was set aside as the guideline harvest level for State of Alaska pot and jig fisheries. Pacific cod are of medium relative abundance and are harvested at 100% of ABC. The last above average year class was spawned in 1989. Year class strengths for 1991-94 are classified as below average. Preliminary indications of the 1995 year class indicate it may be exceptionally large.

Fishery: The P. cod stock is exploited by a multiple-gear fishery, principally by trawls and smaller amounts by longlines, jigs, and pots. Catches by pot gear have increased in recent years, facilitated in part by comparatively low halibut bycatch rates. Participants in the 1996 fishery included 348 hook-and-line, 148 pot, and 125 trawl vessels. The 1997 fishery opened on January 1 (fixed gear) and 20 (trawl gear) and closed on March 3 in the Western area and March 11 in the Central area for the inshore trawl fleet. The fishery reopened from July 1 to August 31 in all areas; and from October 1 to 27 for the inshore sector and through December 31 for the offshore sector in the Central area. A state water fishery for pot and jig gear began in 1997, with a guideline harvest level set at 15% of the federal quota. P. cod harvests have been constrained by halibut bycatch limits.

Management: The GOA P. cod fishery is regulated under the GOA Groundfish FMP. GOA, Bering Sea, and Aleutian Islands cod stocks are genetically indistinguishable, and tagging studies show that cod move between the Bering Sea and the GOA. However, the magnitude and regularity of such migrations are unknown and the stocks are managed as separate units. The FMP controls the fishery through a permit moratorium, limited entry, catch quotas (TACs), seasons, in-season adjustments, gear restrictions, bycatch limits and rates, allocations, regulatory areas, quota reserves, record keeping and reporting requirements, and observer monitoring. In 1993, the Council apportioned 90% of GOA pollock to the inshore sector and 10% to the offshore sector. In 1998, trawl gear was prohibited east of 140° W. longitude (East Yakutat/Southeast Outside subarea) and 100% retention was required for P. cod.

Economics: In 1996, 68,000 mt of P. cod was caught, of which about 89% was retained. The onshore sector harvested 55,000 mt, or 81% of total landings. The offshore sector landed the remaining 13,000 mt, or 19% of total landings. Approximately 10,000 m were landed with hook and line gear, 12,000 mt was landed with by pot gear, and 46,000 mt was landed with trawl gear. Total ex-vessel value was \$25.2 million in 1996. Average ex-vessel price was about \$0.23/lb for fixed gear and \$0.17/lb for trawl gear. Primary products

Exploitable biomass (from synthesis model), catch specifications, and total catches (including discards) of age 3+ Pacific cod in the GOA, 1980-1998 (in mt).

Year	Biomass	ABC	TAC	Catch
1980	737,000	—	60,000	35,345
1981	790,000	—	70,000	36,130
1982	849,000	—	60,000	29,465
1983	903,000	—	60,000	36,540
1984	926,000	—	60,000	23,900
1985	936,000	—	60,000	14,430
1986	941,000	—	75,000	25,010
1987	978,000	125,000	50,000	32,940
1988	983,000	99,000	80,000	33,800
1989	965,000	71,200	71,200	43,290
1990	968,000	90,000	90,000	72,520
1991	923,000	77,900	77,900	76,980
1992	912,000	63,500	63,500	80,100
1993	880,000	56,700	56,700	55,990
1994	848,000	50,400	50,400	47,990
1995	799,000	69,200	69,200	69,050
1996	729,000	65,000	65,000	68,280
1997	650,000	81,500	69,115	62,260
1998	785,000	77,900	66,060	*

produced are headed and gutted product and fillets, and to a lesser extent salted, whole fish, roe, and mince.

Catch History: Pacific cod catches increased through most of the 1980s in response to a large year class which recruited around 1980. Historically, the majority of landings came from the Shumagin and Chirikof areas. Foreign trawl catches of cod were usually incidental to directed fisheries for other species.

Deep Water Flatfish

Biology: The deep water flatfish group is comprised of Dover sole (*Microstomus pacificus*), Greenland turbot (*Reinhardtius hippoglossoides*), and deep-sea sole (*Embassichthys bathybius*). All flatfish are demersal. Dover sole are found among the soft bottom community of benthic animals at depths up to about 1400 m. Flatfish all spawn on or near the bottom at various depths. Dover sole spawn off the Oregon coast from winter to early spring. Maturity information is not available for Dover sole in the GOA, however, female Dover sole off Oregon reach 50% maturity at about 34 cm (about 6 to 9 years old). Dover sole recruit to the fishery from 7 to 10 years old and have a maximum age of about 45 years. Natural mortality is assumed to be 0.10, estimated for Dover sole off the Oregon coast. Dover sole feed on small invertebrates that live on or in the seafloor sediments. With their small-mouths, they are especially adapted to feeding on small detrital-consuming invertebrates that live within the sediment (polychaete worms and clams) or at the sediment surface (amphipods and other small crustaceans, shrimp, snails, and brittlestars).

Stock Assessment: Due to the lack of a time series of size and age data, and the lack of maturity information for flatfish, no population dynamics models have been used in the assessment for this assemblage. Estimates of B_{MSY} and F_{MSY} are not available for this stock. Beginning in 1997, OFL and ABC rates are based on tiers defined under Amendment 44. Under this definition, OFL for deep water flatfish are based on a tier 5 and tier 6 fishing mortality rate. For Dover sole F_{OFL} is equal to the estimate of natural mortality, for Greenland turbot and Deep sea sole, where no survey biomass estimates are available, F_{OFL} is the average catch from 1978-95. The ABC is = 0.75 x OFL.

Population Status: For 1998, exploitable biomass was estimated at 101,430 mt for Dover sole. Catch specifications were the following: OFL = 9,440 mt, ABC = 7,170 mt, TAC = 7,170 mt. Relative abundance for deep water flatfish is unknown. Fishing is severely constrained by halibut bycatch limits (catch < 50 %ABC). Biomass estimates for Dover sole have a high degree of uncertainty due to the lack of deep water sampling in the triennial GOA trawl survey.

Fishery: Dover sole is the primary target species in this assemblage. Nearly all flatfish were landed by 70 trawlers in 1996. In 1997, only half the TAC was harvested due to trawl closures on March 14, April 11 and July 17, to prevent exceeding quarterly halibut bycatch limits. In the ongoing 1998 fishery, closures occurred on March 10, April 21, and November 26 due to the halibut cap.

Management: The Council divided the flatfish assemblage into four categories for management in 1990 because of a significant difference in halibut bycatch rates in directed fisheries for shallow and deep water flatfish species: “deep water flatfish,” “shallow water flatfish,” flathead sole, and arrowtooth flounder. Flathead sole was assigned a separate ABC in 1991 since it overlaps the depth distributions of the both shallow and deep water groups. In 1993, rex sole was split out of the deep water assemblage because of concerns regarding Pacific ocean perch bycatch. In 1998, trawling was prohibited in the Eastern area east of 140° W. longitude. The FMP controls the fishery through permits and limited entry, catch quotas (TACs), seasons, in-season adjustments, gear restrictions, bycatch limits and rates, allocations, regulatory areas, record keeping and reporting requirements, and observer monitoring. Harvests have also been constrained by halibut bycatch limits.

Economics: All flatfish species produced a total ex-vessel value of \$8.2 million in 1996 on landings of 43,000 mt, of which 23,100 mt was retained. Average ex-vessel price for flatfish was about \$0.16/lb. Deep water flatfish landings totaled 3,622 mt in 1996, with an approximate value of \$1.28 million. Primary products produced are whole fish, H&G, and kirmi.

Catch History: Until 1981, flatfish was chiefly a foreign fishery targeting non-flatfish species. With the cessation of foreign fishing in 1986, joint venture fishing began to account for the majority of the catch. In 1987, the gulf-wide flatfish catch increased nearly

Exploitable biomass (from triennial trawl surveys), catch specifications and total catches (including discards) of deep water flatfish in the GOA, 1990-98 (in mt).

<u>Year</u>	<u>Biomass</u>	<u>ABC</u>	<u>TAC</u>	<u>Catch</u>
1990	131,890	108,400	22,000	2,380
1991	131,890	50,500	15,000	10,190
1992	131,890	39,280	19,740	8,370
1993	116,570	45,530	19,740	6,110
1994	116,570	16,510	11,080	5,060
1995	116,570	14,590	11,080	2,210
1996	101,430	14,590	11,080	2,200
1997	101,430	7,170	7,170	3,620
1998	101,430	7,170	7,170	*

fourfold to 10,000 mt with the joint venture fisheries accounting for nearly 73% of the gulf-wide catch. After 1988, only domestic fleets harvested flatfish. The Central area has produced the majority of the flatfish catches, with most of the harvest on the continental shelf and slope east of Kodiak Island. The fishery primarily targets on Dover sole with 72% of landings retained in 1996. Greenland turbot catch has been variable in recent years.

Rex Sole

Biology: Rex sole (*Glyptocephalus zachirus*) are closely associated with the soft bottom community of benthic animals that occur in the deep water portions of submarine canyons. They are found throughout the northeastern Pacific and in the Bering Sea at depths usually less than 275 m. Rex sole feed on small invertebrates that live on or in the sea floor sediments. The small-mouthed sole is especially adapted to feeding on small detrital-consuming invertebrates that live within the sediment (polychaete worms and clams) or at the sediment surface (amphipods and other small crustaceans, shrimp, snails, and brittlestars).

Stock Assessment: The current assessment for rex sole uses the 1996 triennial trawl survey biomass to calculate ABC. Estimates of B_{MSY} and F_{MSY} are not available for this stock. Beginning in 1997, OFL and ABC rates are based on tiers defined under Amendment 44. Under this definition, OFL for rex sole is based on a tier 5 fishing mortality rate where $F_{OFL} = M$ and ABC for rex sole was estimated using $F = 0.75 M$.

Population Status: In 1998, the exploitable biomass of rex sole was estimated at 72,330 mt. Catch specifications were the following: OFL = 11,920 mt, ABC = 9,150 mt, TAC = 9,150 mt. Relative abundance for rex sole is unknown. Fishing is severely constrained by halibut bycatch limits (catch < 50 %ABC).

Fishery: The Central area has produced the majority of flatfish catches with most of the harvest on the continental shelf and slope east of Kodiak Island. Nearly all flatfish were landed by 70 trawlers in 1996. In 1997, roughly one-third of the TAC was landed due to trawl closures on March 14, April 11 and July 17 to prevent exceeding the quarterly halibut bycatch limits. In the ongoing 1998 fishery, closures occurred on March 10, April 21, and November 26 due to the halibut cap.

Management: The rex sole fishery is regulated under the GOA Groundfish FMP. In 1993, rex sole was split out of the deep water management category because of concerns regarding the Pacific ocean perch bycatch in this target fishery. In 1998, trawling was prohibited in the Eastern area east of 140° W. longitude. The FMP controls the fishery through permits and limited entry, catch quotas (TACs), seasons, in-season adjustments, gear restrictions, closed waters, bycatch limits and rates, allocations, regulatory areas, record keeping and reporting requirements, and observer monitoring. Harvests have been constrained by halibut and crab bycatch limits.

Economics: Rex sole is a valuable target species, with 95% retained by the commercial fleet in 1996. This fishery was worth somewhat less than \$2 million. Primary products produced are H&G with roe-in, and to a lesser extent kiriti.

Catch History: Until 1981, flatfish was chiefly a foreign fishery targeting non-flatfish species. With the cessation of foreign fishing in 1986, joint venture fishing began to account for the majority of the catch. In 1987 the gulf-wide flatfish catch increased nearly fourfold to 10,000 mt with the joint venture fisheries accounting for nearly 73% of the gulf-wide catch. After 1988, only domestic fleets harvested flatfish.

Exploitable biomass (from triennial trawl surveys), catch specifications and total catches (including discards) of rex sole in the GOA, 1994-98 (in mt).

Year	Biomass	ABC	TAC	Catch
1994	89,700	11,950	10,140	3,660
1995	89,700	11,210	9,690	4,030
1996	72,300	11,210	9,690	5,850
1997	72,300	9,150	9,150	3,265
1998	72,300	9,150	9,150	*

Shallow Water Flatfish

Biology: The shallow water flatfish group is primarily comprised of: northern rock sole (*Lepidopsetta perarcuata*), southern rock sole (*Pleuronectes bilineatus*), yellowfin sole (*Pleuronectes asper*), starry flounder (*Platichthys stellatus*), butter sole (*Pleuronectes isolepis*), English sole (*Pleuronectes vetulus*), Alaska plaice (*Pleuronectes quadrituberculatus*), and sand sole (*Psettiichthys melanostictus*). All flatfish are demersal, but have varying depth ranges. Most marine occurrences of starry flounder in the trawl surveys have occurred at depths less than 150 m, but have also been harvested in rivers 120 km upstream and in the ocean to depths of 375 m. Rock sole are most abundant in the Kodiak and Shumagin areas. Spawning season, fecundity, and size at age at 50% maturity vary by species. Starry flounder spawn in late winter/early summer. Rock sole spawn from winter to spring. Rock sole attain 50% maturity at 9 years for females in the Bering sea. The maximum age of sampled rock sole was 21 years.

Although yellowfin sole are only an incidentally caught species in the GOA, they are the second most abundant demersal fish (after pollock) in Cook Inlet and are also found in Prince William Sound. They are a relatively slow growing and long-lived. They concentrate on the outer shelf in the winter, and move to very shallow waters (<30 m) to spawn and feed in the early summer. They begin to recruit to trawl fisheries at age 6, but are not fully recruited to all gear types until about age 13. Maximum age in the Bering sea for this species is 31 years. In the Bering sea, females reach 50% maturity at 30 cm (about 10.5 years old) and are highly fecund, producing 1 - 3 million eggs. Natural mortality is estimated to be 0.2. Prey includes benthic infauna and epifauna, euphausiids, and fish.

Stock Assessment: Due to the lack of a time series of size, age, and maturity data for flatfish, no population dynamics models have been used for this assemblage. Estimates of B_{MSY} and F_{MSY} are not available for this stock. Beginning in 1997, OFL and ABC rates are based on tiers defined under Amendment 44. Therefore, the OFL for rock sole is based on a tier 4 fishing mortality rate where $F_{OFL} = F_{30\%}$ and $F_{ABC} \leq F_{40\%}$. The OFLs for yellowfin and other shallow water species are based on a tier 5 fishing mortality rate where $F_{OFL} = M$ and $F_{ABC} \leq 0.75 \times M$.

Population Status: In 1996, exploitable biomass shallow water flatfish in the GOA was estimated at 314,960 mt. Catch specifications were the following: OFL = 59,540 mt, ABC = 43,150 mt, TAC = 18,630 mt. Relative abundance for shallow water flatfish is unknown. Fishing is severely constrained by halibut bycatch limits (catch < 50 %ABC).

Fishery: The flatfish resource has been lightly to moderately harvested. Nearly all flatfish were landed by 70 trawlers in 1996. The Central area has produced the majority of flatfish catches, with most of the harvest on the continental shelf and slope east of Kodiak Island. Rock sole is the predominant target species in this assemblage. The 1997 shallow-water flatfish directed fishery was closed on May 1, August 5, and November 26 because quarterly bycatch allowances of Pacific halibut were attained. In the current 1998 fishery, the second quarter was closed on May 2 due to the halibut cap. Harvests have also been severely constrained by halibut bycatch limits.

Management: The shallow water flatfish fishery is regulated under the GOA Groundfish FMP. The FMP controls the fishery through permits and limited entry, catch quotas (TACs), seasons, in-season adjustments, gear restrictions, closed waters, bycatch limits and rates, allocations, regulatory areas, record keeping and reporting requirements, and observer monitoring. In 1998, trawling was prohibited in the Eastern area east of 140° W. longitude.

Economics: Shallow water flatfish landings totaled 7,700 mt in 1996, worth approximately \$2.7 million. Roughly 86% of landings were retained. Primary products produced are whole fish, H&G, and kiritimi.

Catch History: Until 1981, flatfish was chiefly a foreign fishery targeting non-flatfish species. With the cessation of foreign fishing in 1986, joint venture fishing began to account for the majority of the catch. In 1987 the gulf-wide flatfish catch increased nearly fourfold to 10,000 mt with the joint venture fisheries accounting for nearly 73% of the gulf-wide catch. After 1988, only domestic fleets harvested flatfish. The Central area has produced the majority of the flatfish catches, with the most of the harvest on the continental shelf and slope east of Kodiak Island.

Exploitable biomass (from triennial trawl surveys), catch specifications and total catches (including discards) of shallow water flatfish in the GOA, 1990-98 (in mt).

Year	Biomass	ABC	TAC	Catch
1990	249,000	84,500	10,000	NA
1991	249,000	74,000	12,000	5,300
1992	249,000	50,480	11,740	8,780
1993	355,590	50,480	16,240	9,720
1994	355,590	34,420	18,630	3,890
1995	355,590	52,270	18,630	5,430
1996	315,590	52,270	18,630	9,335
1997	315,590	43,150	18,630	7,690
1998	315,590	43,150	18,630	*

Flathead Sole

Biology: Flathead sole (*Hippoglossoides ellassodon*) are distributed from northern California northward throughout Alaska. They are most abundant at depths less than 250 m. Flathead sole spawn from February-April at depths of 50-300 m. Flathead sole are also bottom feeders but will feed on small nektonic animals such as shrimp, krill, herring, and smelt when the opportunity arises. Flathead sole attain maximum ages of 17 years for males and 21 years for females. Natural mortality is estimated at 0.2.

Stock Assessment: The current assessment for flathead sole is based on NMFS trawl survey abundance estimates. Estimates of B_{MSY} and F_{MSY} are not available for this stock. Beginning in 1997, OFL and ABC rates are based on tiers defined under Amendment 44. Under this definition, OFL for flathead sole is based on a tier 5 fishing mortality rate where $F_{OFL} = M$ and ABC for rex sole was estimated using $F = 0.75 M$.

Population Status: For 1998, exploitable biomass of flathead sole was 206,340 mt. Catch specifications were the following: OFL = 34,010 mt, ABC = 26,110 mt, TAC = 9,040 mt. Relative abundance for flathead sole is unknown. Fishing is severely constrained by halibut bycatch limits (catch < 50 %ABC).

Fishery: The flatfish resource has been lightly to moderately harvested. Nearly all flatfish were landed by 70 trawlers in 1996. The 1997 fishery was closed on May 13, August 5, and November 26 because quarterly bycatch allowances of Pacific halibut were attained. Only about 25% of the TAC was taken as a result of the trawl closures. In the current 1998 fishery, the second quarter was closed on May 2 due to the halibut cap.

Management: The flathead sole fishery is regulated under the GOA Groundfish FMP. The FMP controls the fishery through permits and limited entry, catch quotas (TACs), seasons, in-season adjustments, gear restrictions, closed waters, bycatch limits and rates, allocations, regulatory areas, record keeping and reporting requirements, and observer monitoring. Harvests have been constrained by halibut bycatch limits. Flathead sole was assigned a separate ABC from the deep water complex in 1991 since it overlaps the depth distributions of the both shallow and deep water groups. In 1998, trawling was prohibited in the Eastern area east of 140° W. longitude. Harvests have also been severely constrained by halibut bycatch limits.

Economics: In 1996, 3,080 mt of flathead sole was caught, of which about 2,370 mt was retained. This fishery was worth roughly \$835,000. Primary products produced are H&G with roe-in, and to a lesser extent kirimi.

Catch History: Until 1981, flatfish was chiefly a foreign fishery targeting non-flatfish species. With the cessation of foreign fishing in 1986, joint venture fishing began to account for the majority of the catch. In 1987, the gulf-wide flatfish catch increased nearly fourfold to 10,000 mt with the joint venture fisheries accounting for nearly 73% of the gulf-wide catch. After 1988, only domestic fleets harvested flatfish.

Exploitable biomass (from triennial trawl surveys), catch specifications and total catches (including discards) of flathead sole in the GOA, 1990-98 (in mt).

<u>Year</u>	<u>Biomass</u>	<u>ABC</u>	<u>TAC</u>	<u>Catch</u>
1991	247,000	50,300	10,000	1,360
1992	247,000	48,280	10,000	2,460
1993	199,000	49,450	10,000	2,450
1994	199,000	35,850	10,000	2,550
1995	199,000	28,790	10,000	2,170
1996	206,000	28,790	9,740	3,070
1997	206,000	26,110	9,040	2,460
1998	206,000	26,110	9,040	*

Arrowtooth Flounder

Biology: Arrowtooth flounder (*Atheresthes stomias*) spawn during December-February at depths of 100-360 m. Spawning of arrowtooth flounder occurs in the Gulf of Alaska from Kodiak Island to Yakutat Bay. Arrowtooth flounder are abundant over a depth range of 100-500 m. During the winter months they aggregate in the deeper portion of their range. High densities of arrowtooth flounder, as indicated from resource assessment surveys, have also been found in waters off southeastern Alaska at depths of 200-400 m. The maximum age for arrowtooth flounder is 21 years. The instantaneous rate of natural mortality is estimated at 0.2. Arrowtooth flounder are 50% mature at 47 cm (about 8.5 years) for females. The fecundity of this species is unknown. Arrowtooth flounder 15 to 30 cm feed predominantly on shrimp, euphausiids, capelin and herring, while fish over 40 cm eat mostly pollock.

Stock Assessment: The current assessment for arrowtooth flounder uses a length-based assessment model. Arrowtooth flounder is in tier 3a of the overfishing definitions. The $F_{40\%}$ fishing mortality rate is 0.189, based on tier 3a harvest strategy of $F_{ABC} = F_{40\%}$. A separate stock assessment for arrowtooth flounder was begun for 1996.

Population Status: Arrowtooth flounder are currently the most abundant groundfish species in the Gulf of Alaska. Exploitable biomass of arrowtooth flounder was estimated to be 2,062,740 mt in 1998. Catch specifications were the following: OFL= 295,970 mt, ABC=208,340 mt, TAC=35,000 mt. Arrowtooth flounder biomass in the GOA appear to be at peak levels, but is lightly exploited.

Fishery: Arrowtooth flounder are presently of limited economic importance. Little to no effort is directed at catching this species, although commercial interest is growing. Nearly all flatfish were landed by 70 trawlers in 1996. In 1997, trawl closures occurred on March 14, April 11, July 17, and November 26 to prevent exceeding the quarterly halibut bycatch limits. In the ongoing 1998 fishery, quarterly closures occurred on March 10 and April 21 due to the halibut cap. Arrowtooth are taken as bycatch by trawl and longline gear in pursuit of other high valued species. Prior to 1996, they frequently served as "ballast" against allowable retainable bycatch of other species.

Management: Arrowtooth flounder are regulated under the GOA Groundfish FMP. They were separated from the flatfish assemblage in 1990 and managed under a separate acceptable biological catch (ABC), because of its present high abundance and low commercial value. The FMP controls the fishery through permits and limited entry, catch quotas (TACs), seasons, in-season adjustments, gear restrictions, closed waters, bycatch limits and rates, allocations, regulatory areas, record keeping and reporting requirements, and observer monitoring.

Economics: Arrowtooth is a very low valued species. In 1996, 22,580 mt of arrowtooth flounder were landed in the GOA, of which all but 5,440 mt was discarded. Average ex-vessel price was about \$0.02 per pound, for a total ex-vessel value of around \$240,000, compared with about \$20,000 in 1994. The primary product produced from arrowtooth is meal, although a process has been developed to make surimi.

Catch History: Under current fishing practices, arrowtooth flounder are mostly discarded when caught, although the percent retained has increased from 2% in 1992 and 1994 to 24% in 1996. Higher catches in more recent years are a result of higher biomass levels, corresponding incidental catch in other target fisheries, and increased marketing efforts for arrowtooth meal and surimi.

Exploitable biomass (from triennial trawl surveys), catch specifications and total catches (including discards) of arrowtooth flounder in the GOA, 1990-98 (in mt).				
Year	Biomass	ABC	TAC	Catch
1990	1,922,000	194,600	32,000	7,710
1991	1,922,000	340,100	20,000	10,030
1992	1,922,000	303,800	25,000	15,970
1993	1,585,000	321,290	30,000	15,560
1994	1,585,000	236,240	30,000	23,560
1995	1,585,000	198,130	35,000	18,430
1996	1,640,000	198,130	35,000	22,180
1997	1,640,000	197,840	35,000	16,410
1998	2,063,000	208,340	35,000	*

Sablefish

Biology: Sablefish (*Anoplopoma fimbria*), also known as black cod, is a long lived fish, with a reported maximum age of 62 years in Alaska, 55 years in Canada. They occur over a wide range of depths, with their center of abundance at 400-1,000 m along the continental slope. Sablefish are found within gullies crossing the continental shelf like Spencer Gully. Sablefish move deeper as they age. Sablefish spawn during late winter to early spring. Female fecundity ranges from 60,000-200,000 eggs up to one million eggs for 58-71 cm to 102 cm fish. Larvae have been reported near the surface throughout the Gulf, Aleutian Islands and southeastern Bering Sea. Sizes at maturity are 52-61 cm (5 years) for males and 58-71 cm (5-7 years) for females. Sablefish growth appears to be rapid for the first 3-5 years and slows asymptotically thereafter. The current estimate of natural mortality is 0.10-0.11. Older juveniles and adults feed primarily on fishes, crustaceans, and cephalopods. Juvenile sablefish are eaten by a wide variety of finfishes, sea birds, and pinnipeds. Predators include hagfishes, sharks, Pacific cod, lingcod, Pacific halibut, and killer whales.

Stock Assessment: Sablefish are thought to belong to a single population. A combined GOA and BSAI assessment is based on an age structured model. Estimates of B_{MSY} and F_{MSY} are not available for this stock. Beginning in 1997, OFL and ABC rates are based on tiers defined under Amendment 44. Under this definition, the 1998 OFL for sablefish is based on a tier 3b adjusted $F_{30\%}$ (= .145) fishing rate. ABC is based on an "equilibrium adjusted" yield equivalent to $F = 0.085$ in 1998.

Population Status: For 1998, exploitable biomass was estimated at 166,000 mt in the GOA. Catch specifications were the following: OFL =23,450 mt, ABC =14,120 mt, TAC =14,120 mt. Sablefish are at a low relative abundance and fully exploited (100% of ABC). The stock is expected to continue to decline due to poor recruitment since 1982. The 1992 and 1993 year-classes are the lowest observed. No strong year classes are expected to recruit to the fishery during the next three to four years, with the possible exception of an above average 1995 year class whose strength estimate is based on only one year of survey data.

Fishery: Sablefish are taken mostly by longline gear in a directed fishery (88%), and as bycatch by trawls (12%). In 1996, 16,200 mt of sablefish was caught, 98% of which was retained. Discards have occurred in the hook-and-line sablefish and trawl fisheries targeting flatfish and rockfish. An individual fishing quota (IFQ) program for the fixed gear fishery was implemented in 1995. In 1997, 1,029 persons held sablefish quota shares, fishing on 504 catcher vessels. The season runs from March 15-November 15, concurrent with the halibut IFQ fishery. State fisheries in Prince William Sound, Chatham Strait and Clarence Strait also land sablefish outside the IFQ program.

Management: The GOA sablefish fishery is regulated under the GOA Groundfish FMP. The FMP controls the fishery through permits, an IFQ program, catch quotas (TACs), seasons, in-season adjustments, gear restrictions, closed waters, bycatch limits and rates, allocations, regulatory areas, record keeping and reporting requirements, and observer monitoring. There are four management areas in the Gulf of Alaska: Western, Central, West Yakutat, and East Yakutat/Southeast Outside (SEO). The sablefish TAC is allocated among gear types (80% of the Western and Central area and 95% of the Eastern area TAC to fixed gear; the remaining to trawl gear). It is on bycatch status year round for trawl gear.

Economics: Sablefish is the highest valued groundfish resource in the GOA, worth \$74 million ex-vessel in 1996. Average ex-vessel price was about \$1.96/lb round weight for fixed gear fisheries, and \$1.70/lb for trawl fisheries. The primary product produced is H&G for Japanese markets, with small amounts going to specialty domestic markets.

Catch History: Annual catches averaged about 1,500 mt during 1930-50, and exploitation rates remained low until the Japanese longline fleet expanded into the GOA around 1959. Catches rapidly escalated during the mid-1960s. The record all-nation catch reached 37,500 mt in 1972 and averaged about 28,000 mt during 1973-76. Evidence of declining stock abundance led to significant fishery restrictions during 1977-85, and catches were reduced substantially. Catches during 1978-83 averaged 9,200 mt, increased steadily to 29,900 mt in 1988, and

Exploitable biomass (from age-structured analysis of longline survey and catch data), catch specifications and total catches (including discards) of sablefish (mt) in the GOA, 1979-98.

Year	Biomass	ABC	TAC	Catch
1979	133,000	13,000	13,000	10,350
1980	143,000	13,000	13,000	8,540
1981	172,000	14,350	14,350	9,920
1982	211,000	12,300	12,300	8,560
1983	246,000	9,480	9,480	9,000
1984	282,000	8,980	8,980	10,230
1985	310,000	8,980	8,980	12,480
1986	313,000	18,800	15,000	21,610
1987	312,000	25,000	20,000	26,320
1988	314,000	35,000	28,000	29,900
1989	308,000	30,900	26,000	29,840
1990	266,000	26,200	26,000	26,600
1991	232,000	22,500	22,500	23,130
1992	231,000	20,800	20,800	23,380
1993	224,000	20,900	20,900	22,690
1994	228,000	25,500	25,500	21,340
1995	214,000	21,500	21,500	18,630
1996	194,000	17,080	17,080	15,980
1997	180,000	14,520	14,520	13,215
1998	166,000	14,120	14,120	*

have since declined to about 14,000 mt in 1998.

Other Slope Rockfish

Biology: At least 30 rockfish species of the genus *Sebastes* inhabit the Gulf. Since 1988, rockfish have been divided into three management assemblages based on their habitat and distribution: slope, pelagic shelf, and demersal shelf rockfish. Slope rockfish are those species that, as adults, inhabit waters of the outer continental shelf and continental slope in depths greater than 150-200 m. In 1991, the slope assemblage was divided into three management subgroups: Pacific ocean perch (POP), shortraker/rougheye rockfish, and all other species of slope rockfish. In 1993, a fourth management subgroup, northern rockfish, was also created. These subgroups were established to protect the subgroups from possible overfishing. Each is now assigned an individual TAC and is profiled separately. Little information exists for the other slope assemblage. Harlequin, sharpchin, redstripe, and silvergrey rockfish are the predominant species caught in the commercial fishery. For sharpchin rockfish, size at 50% maturity is 25.5 cm, age at 50% maturity occurs at about 10 years, and $M = 0.05$. For yellowmouth rockfish, maximum age is 71 years and $M = 0.06$. Darkblotched rockfish maximum age is 48 years, and $M = 0.07$. Silvergray rockfish maximum age is 80 years, and $M = 0.01-0.07$. Harlequin rockfish maximum age is 43 years.

Stock Assessment: Estimates of B_{MSY} and F_{MSY} are not available for this stock complex. Beginning in 1997, OFL and ABC rates are based on tiers defined under Amendment 44. The ABC for this group is based on a harvest rate set equal to natural mortality (M) applied to exploitable biomass. Exploitable biomass is determined from the average of the three most recent trawl surveys. Applying the new definitions for ABC and OFL places sharpchin rockfish in tier 4 where $F_{ABC} \leq F_{40\%}$, and the other species of other slope rockfish in tier 5 where $F_{ABC} \leq 0.75M$. For sharpchin rockfish, $F_{ABC} = M = 0.05$ is less than $F_{40\%} = 0.055$. Overfishing is defined to occur at the $F_{30\%}$ of 0.08 for sharpchin rockfish and $F=M$ for the other species.

Population Status: For 1998, the exploitable biomass is 103,710 mt. Catch specifications based on tier 4 were the following: OFL = 7,560 mt, ABC = 5,260 mt, TAC = 2,170 mt. Relative abundance for other slope rockfish is unknown. Harvest is constrained by halibut bycatch and overfishing concerns for other species taken as bycatch.

Fishery: Between half and three quarters of the catch have been discarded since 1993, after northern rockfish were separated out. Harlequin and sharpchin rockfish are small in size and of lower economic value, and there may be less incentive for fishermen to retain these fish. Other slope rockfish went on bycatch status on January 1 for the Western and Central areas, and went on prohibited status on July 25 when the TACs were reached. A fixed gear (jig) fishery opened July 1 in the Eastern area, and lasted one week when it went on prohibited status.

Management: The fishery is regulated under the GOA Groundfish FMP. The FMP controls the fishery through permits and limited entry, catch quotas (TACs), seasons, in-season adjustments, gear restrictions, closed waters, bycatch limits and rates, allocations, regulatory areas, record keeping and reporting requirements, and observer monitoring. Management actions include: (1) establishment of the management subgroups in 1991, which limited harvest of the more desired species and (2) conservative in-season management practices in which fisheries have sometimes been closed although substantial unharvested TAC remained. In 1993, northern rockfish were separated from the assemblage. In 1998, trawling was prohibited east of 140° W. longitude.

Economics: Total rockfish (slope, POP, shortraker/rougheye, and northern) landings were worth \$6.8 million. Forty-six trawlers landed nearly 90% of all rockfish in 1996. Trawl gear landed 16,000 mt, of which 12,800 mt (80%) were retained. Rockfish totaling 2,200 mt were landed by 620 hook-and-line vessels, of which 1,800 mt (82%) were retained. Average ex-vessel price was about \$0.15/lb (estimated) for trawl gear and \$0.62/lb for fixed gear.

Catch History: Foreign, primarily Japanese, fishing dominated the fishery during 1977-84. Catches declined to a minimum in 1985 when foreign trawling was prohibited. The domestic fishery expanded each year until 1991. Overall catches of slope rockfish have continued to diminish as a result of lowered TACs. Landings for remaining species surged in 1993 when northern rockfish were removed from the subgroup. Catches declined considerably since 1994 due, in part, to lower TACs. Before 1996, more than 90% of the slope rockfish trawl catch was taken by large at-sea factory trawlers. Smaller shore-based trawlers began taking sizeable catches for delivery to processing plants in Kodiak since 1996.

Exploitable biomass (from triennial trawl surveys), catch specifications and total catches (including discards) of other slope rockfish in the GOA, 1991-98 (in mt).

<u>Year</u>	<u>Biomass</u>	<u>ABC</u>	<u>TAC</u>	<u>Catch</u>
1991	97,460	10,100	10,100	6,500
1992	97,460	14,060	14,060	9,150
1993	82,330	8,300	5,380	2,810
1994	82,330	8,300	2,235	1,610
1995	82,330	7,110	2,235	1,480
1996	131,330	7,110	2,020	880
1997	131,330	5,260	2,170	1,210
1998	131,330	5,260	2,170	*

Factory trawlers continued to take almost all the catch in the Western and Eastern areas.

Pacific Ocean Perch

Biology: Pacific Ocean perch (*Sebastes alutus*), commonly known as POP are broadly distributed around the northeast Pacific. They are found over a wide range of depths but most commonly occur at depths of 100-450 m. Adult POP migrate into deep water during fall and winter to spawn and then move to shallower depths to feed during spring and summer. Separate schools of males and females have been observed on feeding grounds at depths of 150-185 m in the Unimak Pass region. Spawning concentrations have been observed at depths of 350-400 m off Prince William Sound and Yakutat Bay. Adults also perform diel migrations off the sea bottom to feed. For management purposes, the Gulf of Alaska stock is considered to be separate from those of the eastern Bering Sea, Aleutian, and British Columbia-California. The extent operational subpopulations within these regions is uncertain.

Average adult maximum size is around 45 cm. Maximum age for POP ranges from 30 to 77 years. They are ovoviviparous, with mating occurring during September-November. Fertilization is internal and the eggs are released as larvae during March-June. Known spawning areas are southeast of the Pribilof Islands in the Bering Sea and in the Gulf of Alaska near Yakutat. Males mature at 4-13 years and females mature at 5-15 years. Mean survey ages for POP were 9.3 and 15.0 years in the Western/Central and Eastern areas, respectively. Size at 50% maturity is 36 cm and age at 50% maturity occurs at about 10 years. Estimated fecundity of females ranges from 10,000-300,000 eggs at 23-45 cm. POP are planktivorous. Small juveniles feed on calanoid copepods; large juveniles and adults feed on euphausiids. Large adults may feed on pandalid shrimps and squids. Major feeding areas are found off Unimak and Kodiak islands. Predators of POP, sablefish, Pacific halibut, and sperm whales. Estimates of natural mortality is 0.05.

Stock Assessment: The current POP assessment is based on an age-structured model. Estimates of B_{MSY} and F_{MSY} are not available for this stock complex. Beginning in 1997, OFL and ABC rates are based on tiers defined under Amendment 44. Under this definition, POP rates are based on a tier 3 fishing mortality rate where $F_{ABC} = 0.055$ and $F_{OFL} = 0.079$.

Population Status: For 1998, the current spawning biomass is 107,200 mt; exploitable biomass is 243,170 mt. Catch specifications based on tier 3b were the following: OFL = 18,090 mt, ABC = 12,820 mt, TAC = 10,776 mt. POP are at low relative abundance and are constrained in some areas by halibut bycatch and overfishing concerns for other species taken as bycatch. A rebuilding plan was implemented in 1995, and the stock was considered rebuilt in 1997. POP ranged up to 78 years in survey samples, but the mean population age was 10 years during 1987-90. Relatively strong recent year-classes appear to have contributed to increased abundance.

Fishery: POP have been taken primarily by catcher processors in a directed fishery, although shore-based trawlers accounted for 49% of the catch in the Central area in 1996, and 28% in 1997. Discard rates for POP are very low, 14% in 1997 compared with a peak of 79% in 1993. In 1997, the fishery was on bycatch status from January 1 - July 25, and then on prohibited status from July 25 - December 31 in the Western and Central areas. In the Eastern area, the fishery was on bycatch status from January 1 - July 1, open from July 1- July 7, and on prohibited status until the end of the year.

Management: The fishery is regulated under the GOA Groundfish FMP. The FMP controls the fishery through permits and limited entry, catch quotas (TACs), seasons, in-season adjustments, gear restrictions, closed waters, bycatch limits and rates, allocations, regulatory areas, record keeping and reporting requirements in 1991, and observer monitoring. In 1991, POP and shortraker/rougheye rockfish were separated from the slope rockfish assemblage to prevent possible overfishing. A reduction in TACs to promote rebuilding of stocks achieved success after only 3 years. In 1998, trawling was prohibited east of 140° W. longitude.

Economics: Total rockfish (slope, POP, shortraker/rougheye, and northern) landings were worth \$6.8 million. Forty-six trawlers landed nearly 90% of all rockfish in 1996. Trawl gear landed 16,000 mt, of which 12,800 mt (80%) were retained. Rockfish totaling 2,200 mt were landed by 620 hook-and-line vessels, of which 1,800 mt (82%) were retained. Average ex-vessel price was about \$0.15/lb (estimated) for trawl gear and \$0.62/lb for fixed gear.

Exploitable biomass (from the 1998 Stock Synthesis model), catch specifications and total catches (including discards) of Pacific ocean perch in the GOA, 1991-98 (in mt).

Year	1998	Biomass	773,620	ABC
1991		135,400		5,800
1992		135,400		5,730
1993		453,600		5,560
1994		453,600		3,030
1995		453,600		6,530
1996		773,620		8,060
1997		773,620		12,990

Catch History: A foreign POP trawl fishery began in the early 1960s. This fishery developed rapidly, with massive efforts by the Soviet and Japanese fleets. Catches peaked in 1965 with landings of 350,000 mt. This apparent overfishing resulted in a precipitous decline in catches in the late 1960s. Catches continued to decline in the 1970s, and by 1978 were only 8,000 mt. Landings declined again to very low levels in the early 1990s, but have recovered under the rebuilding plan.

Shortraker/Rougheye Rockfish

Biology: As with most rockfish, shortraker (*Sebastes borealis*) and rougheye (*S. aleutianus*) rockfish are slow growing and long-lived. They inhabit waters of the outer continental shelf and continental slope. Shortraker rockfish are consistently most abundant in the Yakutat area, and rougheye rockfish, except during 1992-95, are most abundant in the Southeastern area. Estimates of maximum age of shortraker rockfish is 120 years. Estimates for maximum age of rougheye rockfish are 95 and 140 years. The estimate of M for rougheye rockfish is 0.025; there is no estimate of M or Z for shortraker rockfish, but a ratio of maximum age of rougheye to shortraker (140/120) multiplied by 0.025 was used to estimate an M of 0.03.

Stock Assessment: Estimates of B_{MSY} and F_{MSY} are not available for this stock complex. Applying the new definitions for ABC and OFL based on Amendment 44 places shortraker rockfish in tier 5 where $F_{ABC} \leq 0.75M$. Thus, the recommended F_{ABC} for shortraker rockfish is 0.023. Applying tier 4 to rougheye rockfish ($F_{ABC} \leq F_{40\%}$) results in an $F_{ABC} = M = 0.025$.

Population Status: Applying the F_{ABC} rates to the estimates of exploitable biomass of 16,670 mt for shortraker rockfish and 48,710 mt for rougheye rockfish results in ABCs of 370 mt for shortraker rockfish and 1,220 mt for rougheye rockfish and a recommended ABC for the subgroup of 1,590 mt. The TAC for 1998 is set equal to ABC. Total exploitable biomass in 1998 for this group is 65,380 mt. Overfishing is defined to occur at the harvest rate set equal to $F_{30\%} = 0.046$ for rougheye rockfish. The $F = M$ rate of 0.03 is used to define the overfishing level for shortraker rockfish because data are not available to determine $F_{30\%}$ for shortraker rockfish. The overfishing catch limit equals 2,740 mt for the shortraker/rougheye subgroup. The relative abundance for this complex is unknown and the population is highly exploited. Roughly 17.5 - 26.3% during 1993-96 of the rougheye rockfish population was <30 cm in length, suggesting a moderate level of recruitment. Mean survey lengths for rougheye rockfish were 37.4 and 36.6 cm in 1993 and 1996.

Fishery: Historically, bottom trawls have accounted for nearly all the reported commercial harvest. Since 1993, longline catches have ranged from 30% to 48% of the total Gulf-wide harvest of shortraker/rougheye, harvested in a directed fishery and as bycatch in the sablefish and halibut longline fisheries. The entire TAC is needed for bycatch in other directed hook-and-line fisheries. Shortraker rockfish have predominated in the commercial catch of this subgroup, especially since 1993. Discards of shortraker/rougheye rockfish generally have been low or moderate over the years, dropping from a peak of 45% in 1994 to 22% in 1997. The shortraker/rougheye fishery was placed on bycatch status for all areas of the Gulf on January 1. It went on prohibited species status on September 23, 1997, in the Eastern area when the TAC was reached.

Management: The fishery is regulated under the GOA Groundfish FMP. The FMP controls the fishery through permits and limited entry, catch quotas (TACs), seasons, in-season adjustments, gear restrictions, closed waters, bycatch limits and rates, allocations, regulatory areas, record keeping and reporting requirements in 1991, and observer monitoring. Management actions include: (1) establishment of the management subgroups in 1991, which limited harvest of the more desired species, and (2) conservative in-season management practices in which fisheries have sometimes been closed although substantial unharvested TAC remained. In 1998, trawling was prohibited in the Eastern area east of 140° W. longitude.

Economics: Economic information for rockfish are not broken out by subgroup. This information is provided for total rockfish landings in the profile for other slope rockfish.

Catch History: The shortraker/rougheye fishery was separated from the slope rockfish fishery in 1991. Landings since then have been low and relatively stable, and is harvested primarily in a directed fixed gear fishery and as bycatch in other trawl fisheries.

Exploitable biomass (from triennial trawl surveys), catch specifications and total catches (including discards) of shortraker/rougheye in the GOA, 1991-98 (in mt).

Year	Biomass	ABC	TAC	Catch
1991	48,900	2,000	2,000	1,350
1992	48,900	1,960	1,960	2,150
1993	82,400	1,960	1,760	1,860
1994	82,400	1,960	1,960	1,590
1995	82,400	1,910	1,910	2,290
1996	64,900	1,910	1,910	1,670
1997	64,900	1,590	1,590	1,620
1998	64,900	1,590	1,590	*

Northern Rockfish

Biology: As with most rockfish, northern rockfish (*Sebastes polyspinus*) are slow growing and long-lived. Maximum age for northern rockfish is estimated at 49 years. Mean age of northern rockfish was roughly 15 years for 1987-93. Size at 50% maturity is 36 cm and age at 50% maturity occurs at about 12.8 years. Natural mortality for northern rockfish is 0.06.

Stock Assessment: Estimates of B_{MSY} and F_{MSY} are not available for this stock complex. The recommended ABC for northern rockfish is based on a harvest rate set equal to natural mortality M (0.06). Applying the new definitions for ABC and OFL based on Amendment 44, places northern rockfish in tier 4 where $F_{ABC} \leq F_{40\%}$. This results an $F_{ABC} = M = 0.06$ which is less than $F_{40\%} = 0.075$.

Population Status: For 1998, applying the $F_{40\%}$ rate to the estimated exploitable biomass (83,367 mt) results in an ABC of 5,000 mt. The TAC for 1998 is set equal to ABC. Overfishing is defined to occur at $F_{30\%} = 0.113$ for northern rockfish and 0.080 for sharpchin rockfish. Applying these F rates, results in an overfishing limit of 9,420 mt for northern rockfish. The relative abundance for northern rockfish is unknown and the population is exploited at 50-90% of ABC. Strong year classes occurred during 1968-70, 1975-77, 1982 and 1984. Recruitment is highly variable.

Fishery: Historically, bottom trawls have accounted for nearly all the commercial harvest. The trawl fishery opens on July 1. Northern rockfish were placed on bycatch status in the Eastern Gulf on January 1 and on prohibited status on July 23. The trawl fishery in the Western area closed on July 3 and on July 10 in the Central area. Discards of northern rockfish generally have been low to moderate over the years, with a low of 13% in 1995 and a high of 28% in 1997.

Management: The fishery is regulated under the GOA Groundfish FMP. The FMP controls the fishery through permits and limited entry, catch quotas (TACs), seasons, in-season adjustments, gear restrictions, closed waters, bycatch limits and rates, allocations, regulatory areas, record keeping and reporting requirements, and observer monitoring. Management actions include: (1) establishment of the management subgroups in 1991, which limited harvest of the more desired species and (2) conservative in-season management practices in which fisheries have sometimes been closed although substantial unharvested TAC remained. Northern rockfish were separated from the other slope rockfish assemblage in 1993. In 1998, trawling was prohibited in the Eastern area east of 140° W. longitude.

Economics: Economic information for rockfish are not broken out by subgroup. This information is provided for total rockfish landings in the profile for other slope rockfish.

Catch History: The northern rockfish fishery was separated from the slope rockfish fishery in 1993 to prevent overfishing. ABCs and TACs have declined slightly, while landings have declined by less than half. Northern rockfish are caught in a directed fixed gear fishery and as bycatch in other trawl fisheries. Shore-based trawlers accounted for 32% of the 1996 and 1997 northern rockfish catch.

Exploitable biomass (from triennial trawl surveys), catch specifications and total catches (including discards) of northern rockfish in the GOA, 1993-98 (in mt).

<u>Year</u>	<u>Biomass</u>	<u>ABC</u>	<u>TAC</u>	<u>Catch</u>
1993	76,800	5,760	5,760	4,880
1994	76,800	5,760	5,760	5,970
1995	76,800	5,270	5,270	5,690
1996	84,900	5,270	5,270	3,390
1997	84,900	5,000	5,000	2,950
1998	84,900	5,000	5,000	*

Pelagic Shelf Rockfish

Biology: The pelagic shelf rockfish (PSR) assemblage in the Gulf includes three species: dusky rockfish (*Sebastes ciliatus*), widow rockfish (*S. entomelas*), and yellowtail rockfish (*S. flavidus*). This assemblage was separated from slope rockfish in 1988. PSR are defined as those species of *Sebastes* that inhabit waters of the continental shelf of the Gulf, and that typically exhibit a midwater, schooling behavior. Gulfwide, dusky rockfish is the most important species in the assemblage; widow and yellowtail rockfish are minor species. The dusky rockfish natural mortality rate of 0.09 is an indication that dusky rockfish is a faster growing and shorter lived species than most other rockfish. The maximum age for dusky rockfish is 49 years; one specimen was aged to 59 years. Dusky rockfish appear to recruit at age 7 to the commercial fishery. Data on size at 50% maturity for females is estimated to be 42.8 cm fork length, or 13 years; there is no information on size at maturity for males. Dusky and yellowtail rockfish may be a latent, under-utilized resource in nearshore waters of Southeastern Alaska.

Stock Assessment: Estimates of B_{MSY} and F_{MSY} are not available for this assemblage. Applying the new definitions for ABC and OFL, based on Amendment 44, places pelagic shelf rockfish in tier 4. An $F=M = 0.09$, which is more conservative than $F_{40\%} = 0.10$, was used to assess dusky rockfish (the only assessed species in the assemblage).

Population Status: The PSR exploitable biomass for 1998 is 55,580 mt. An $F=M$ strategy is more conservative than the tier 4 maximum $F_{40\%} = 0.10$. Under a tier 4 assessment, $F_{OFL} = F_{30\%} = 0.15$ produces a gulf-wide OFL = 8,390 mt. The relative abundance for this complex is unknown and the population is exploited at 50-90% of ABC. Dusky rockfish recruitment is a relatively infrequent event. An estimated 92% of the population in 1996 was greater than or equal to 40 cm in length.

Fishery: The directed trawl fishery opens on July 1. During 1988-95, almost all the PSR trawl catch (>95%) was taken by large, at-sea factory trawlers. Smaller shore-based trawlers began taking a sizeable portion of the catch in the Central area in 1996 and 1997 for delivery to processing plants in Kodiak. These shore-based trawlers accounted for 27% of the Central area trawl catch in 1996, and 18% in 1997. Discard rates in the trawl fishery have been relatively low, less than 7% in 1997. Since 1991, PSR have also been harvested by jig and longline gear centered mostly near Kodiak and along the south shore of the Kenai Peninsula. In 1997, the Eastern area trawl fishery closed on July 15 after reaching the TAC.

Management: The fishery is regulated under the GOA Groundfish FMP. The FMP controls the fishery through permits and limited entry, catch quotas (TACs), seasons, in-season adjustments, gear restrictions, closed waters, bycatch limits and rates, allocations, regulatory areas, record keeping and reporting requirements, and observer monitoring. Management actions include: (1) establishment of the slope, PSR, and demersal shelf rockfish management subgroups in 1988, which limited harvest of the more desired species, and (2) conservative in-season management practices in which fisheries have sometimes been closed although substantial unharvested TAC remained. In 1997, black rockfish (*S. melanops*) and blue rockfish (*S. mystinus*) were separated into a "nearshore" component of PSR and managed under a separate ABC and TAC in the Central area, where a jig fishery for black rockfish occurs. In 1998, these two species were removed from the FMP. These species are now managed by the State of Alaska. In 1998, trawling was prohibited in the Eastern area east of 140° W. longitude.

Economics: Economic information for rockfish are not broken out by subgroup. This information is provided for total rockfish landings in the profile for other slope rockfish.

Catch History: Gulfwide PSR catches generally increased after the management groups were separated in 1988 to a maximum in 1992. Since then, catches have declined mostly due to in-season management regulations. In 1997, the Central and Eastern area were both closed with a substantial amount of unharvested TAC remaining. These closures occurred to avoid TAC overruns, and also to prevent bycatch of POP.

Exploitable biomass (from triennial trawl surveys), catch specifications and total catches (including discards) of pelagic shelf rockfish in the GOA, 1990-98 (in mt).

Year	Biomass	ABC	TAC	Catch
1988	83,000	3,300	3,300	1,090
1989	83,000	6,600	6,600	1,740
1990	30,000	8,200	8,200	1,650
1991	30,000	4,800	4,800	2,340
1992	30,000	6,890	6,890	3,440
1993	59,000	6,740	6,740	3,190
1994	59,000	6,890	6,890	2,990
1995	59,000	5,190	5,190	2,890
1996	78,000	5,190	5,190	2,300
1997	78,000	5,140	5,140	2,650
1998	78,000	4,880	4,880	*

Demersal Shelf Rockfish

Biology: The demersal shelf rockfishes (DSR) assemblage is comprised of seven species of shallow, nearshore, bottom-dwelling rockfishes: canary rockfish (*Sebastes pinniger*), China rockfish (*S. nebulosus*), copper rockfish (*S. caurinus*), quillback rockfish (*S. maliger*), rosethorn rockfish (*S. helvomaculatus*), tiger rockfish (*S. nigrocinctus*), and yelloweye rockfish (*S. ruberrimus*). Yelloweye rockfish accounts for 90% of all DSR landings. Quillback rockfish accounts for 8% of the catch. DSR exhibit slow growth and extreme longevity. They are ovoviviparous, with parturition occurring from February through September with the majority of species extruding larvae in late winter and spring. Yelloweye rockfish extrude larvae over an extended time period, with the peak period of parturition occurring in April and May. Estimated length and age at 50% maturity for yelloweye in central Southeast Outside are 45-52 cm and 21+ years for females and 50-57 cm and 23+ years for males. Individual growth levels off at about age 30. Natural mortality rate (M) = 0.02.

Stock Assessment: Density is estimated using line transect techniques in the Eastern Gulf. ABC/TAC recommendations for the entire assemblage are keyed to adult yelloweye abundance.

Population Status: The exploitable biomass estimate is based on the lower 90% confidence interval and is 25,031 mt for 1998 in Southeast Outside. The 1998 ABC is 560 mt, determined by applying $F=M=0.02$ to this biomass and adjusting for the 10% of other DSR species. This rate is more conservative than would be obtained by using Tier 4 under the new definitions for setting ABC, as $F_{40\%}=0.025$. The overfishing level was set at $F_{30\%} = 0.038 = 950$ mt. The relative abundance for this complex is unknown and the population is exploited at less than 50% of ABC.

Fishery: A directed longline fishery occurs in the Southeast Outside District and the internal State waters of Southeast Alaska. Much of the catch occurs as bycatch in the halibut fixed gear fishery. DSR may only be taken in directed fisheries by hook-and-line gear; trawl fisheries are limited to bycatch only. Discard rates in the trawl fishery have been relatively low, less than 7% in 1997. DSR mortality during the halibut longline fishery is estimated to be about 300 mt, using a 10% bycatch mortality in Area 2C and a 7% in Area 3A. The allowable bycatch limit in the halibut fishery is 10% of the halibut weight.

Management: Prior to 1987, this complex was grouped with the "other rockfish" complex in the GOA Fishery Management Plan (FMP). In 1987, the complex was split into three components for management purposes in the eastern Gulf. The DSR assemblage was recognized as an FMP assemblage only in the waters east of 137° W. longitude. In 1992, DSR was recognized in East Yakutat and management of DSR extended westward to 140° W. longitude. This area is referred to as the Southeast Outside (SEO) Subdistrict and is comprised of four management areas. In Southeast Outside, DSR are managed jointly by the State of Alaska (ADF&G) and the National Marine Fisheries Service. Two internal state water subdistricts are managed entirely by ADF&G and are not included in this stock assessment. The FMP controls the fishery through permits, catch quotas (TACs), seasons, in-season adjustments, gear restrictions, closed waters, bycatch limits and rates, allocations, regulatory areas, record keeping and reporting requirements, and observer monitoring. DSR were excluded from the Council license limitation program since the State has initiated an analysis for a separate DSR license limitation program. In 1998, trawling was prohibited in the Eastern area east of 140° W. longitude.

Economics: Economic information for rockfish are not broken out by subgroup. This information is provided for total rockfish landings in the profile for other slope rockfish.

Catch History: DSR have been landed incidental to other groundfish and halibut fisheries in Southeast Alaska since the turn of the century. Some bycatch was also landed by foreign longline and trawl vessels targeting on slope rockfish in the Eastern Gulf from the late 1960s through the mid-1970s. Beginning in 1979 a small, shore-based rockfish fishery began in Southeast Alaska and targeted primarily on the nearshore, bottom-dwelling component of the rockfish complex.

The directed DSR catch in SEO increased from 106 mt in 1982 to a peak of 900 mt in 1993. Directed fishery landings have been constrained by other fishery management actions. Since 1992, the DSR fishery there has been a separate PSC for the

Exploitable biomass (from line transect surveys), catch specifications and total catches (including discards) of demersal shelf rockfish (mt) in the GOA, 1994-98.

<u>Year</u>	<u>Biomass</u>	<u>ABC</u>	<u>TAC</u>	<u>Catch</u>
1994	30,450	960	960	540
1995	20,190	580	580	220
1996	29,290	950	950	400
1997	29,290	950	950	390
1998	25,030	560	560	*

DSR fishery.



Thornyhead Rockfish

Biology: The thornyhead rockfish assemblage consists of two species: shortspine (*Sebastolobus alascanus*) and longspine (*Sebastolobus altivelis*) thornyheads. They inhabit the outer shelf and slope region throughout the northeastern Pacific and Bering Sea. Thornyheads are a deepwater demersal fish, inhabiting the continental shelf edge and slope and seldom swim far off the bottom. Unlike rockfish of the genus *Sebastes*, they do not generally form large schools. Shortspine thornyheads inhabit depths of 90-1,460 m and the longspine thornyheads inhabit depths of 370-1,600 m. Shortspine thornyheads are the most abundant of the two species. Longspine thornyheads have rarely occurred in resource assessment survey catches. Female thornyheads release a mass of eggs that are held together by a gelatinous material. This gelatinous mass rises to the surface where it becomes free-floating. It is not known if fertilization occurs internally or at the time the eggs are released. Shortspine thornyheads account for about 90% of the other rockfish complex biomass. Little is known about this species in the GOA. Females reach 50% maturity at about 22 cm. Maximum life span is thought to be about 60 years, but some individuals may be 100 years or older. Annual natural mortality of adults has been estimated to be about 5% ($M = 0.07$). Recruitment to longline fisheries starts at age 15, and are fully recruited at age 30. Recruitment to trawl fisheries occurs at smaller sizes reflecting the shallower depths where these fisheries typically occur. The population structure of shortspine thornyheads is not well defined. Thornyheads in the GOA have been managed as a single stock since 1980.

Stock Assessment: The current assessment for thornyheads is based on a sized based, age-structured model. B_{MSY} and F_{MSY} have not been estimated for this stock. Beginning in 1997, OFL and ABC rates are based on tiers defined under Amendment 44. Under this definition, OFL is based on a tier 4 fishing mortality rate where $F_{OFL} = F_{10\%} = 0.061$. ABC is based on a tier 4 harvest strategy where $F_{ABC} \leq F_{40\%} = 0.042$.

Population Status: The 1998 estimate of exploitable biomass for thornyheads is 52,270 mt. Assuming average recruitment when fished at the $F_{40\%}$ rate, thornyheads are expected to decline. For 1998, catch specifications were the following: OFL = 2,840 mt, ABC = 2,000 mt, TAC = 2,000 mt. The abundance of this complex is relatively high and recent harvests have been between 50-90% of the ABC. Due to the long-lived nature of this species, the overall harvest rate recommendation is low at about 4% of the total age 5+ biomass.

Fishery: Thornyheads are commonly taken as bycatch by bottom trawl and longline gear. They are one of the most valuable rockfish species, with most of the domestic harvest exported to Japan. The greatest foreign-reported harvest activities for thornyheads in the Gulf occurred during 1979-83. In 1985, the U.S. catch surpassed the foreign catch for the first time. U.S. catches peaked in 1989 with a total removal of 3,080 mt. The directed fishery for sablefish harvested the largest amount of thornyheads in 1994 and 1995, followed by rockfish, rex sole and other flatfish fisheries.

Management: The fishery is regulated under the GOA Groundfish FMP. The FMP controls the fishery through permits and limited entry, catch quotas (TACs), seasons, in-season adjustments, gear restrictions, closed waters, bycatch limits and rates, allocations, regulatory areas, record keeping and reporting requirements, and observer monitoring. In 1998, trawling was prohibited in the Eastern area east of 140° W. longitude. The low TAC is reserved for bycatch in other directed fisheries.

Economics: Economic information for rockfish are not broken out by subgroup. Information is provided for total rockfish landings in the profile for other slope rockfish.

Catch History: Thornyheads have been harvested since the late 19th century, when commercial trawling by U.S. and Canadian fishermen began. In the mid-1960s Soviet fleets arrived in the eastern Gulf, where they were soon joined by vessels from Japan and the Republic of Korea. The catches of thornyheads in the Gulf of Alaska declined markedly in 1984 and 1985 due primarily to restrictions on foreign fisheries imposed by U.S. management policies. The greatest foreign-reported harvest activities for thornyheads in the GOA occurred during the period 1979-83. In 1985, the U.S. catch surpassed the foreign catch for the first time. U.S. catches of thornyheads continued to increase,

Exploitable biomass (from sized based, age-structured model), catch specifications and total catches (including discards) of age 5+ thornyhead rockfish in the GOA, 1990-98 (in mt).

Year	Biomass	ABC	TAC	Catch
1984	58,330	3,750	3,750	210
1985	58,930	3,750	3,750	80
1986	59,750	3,750	3,750	860
1987	59,880	3,750	3,750	1,960
1988	58,990	3,750	3,750	2,790
1989	57,680	3,750	3,750	3,050
1990	56,080	3,800	3,800	1,650
1991	55,280	1,800	1,400	2,020
1992	54,800	1,800	1,800	2,020
1993	53,780	1,180	1,060	1,370
1994	53,410	1,180	1,180	1,320
1995	53,130	1,900	1,900	1,110
1996	52,660	1,560	1,250	1,100
1997	52,270	1,700	1,700	1,210
1998	52,270	2,000	2,000	*

reaching a peak in 1989 with a total removal of 3,080 mt. Catches have since averaged about 1,660 mt during the five year period from 1990-94.

Atka Mackerel

Biology: Atka mackerel (*Pleurogrammus monopterygius*) is a schooling, semi-demersal species distributed from the east coast of the Kamchatka Peninsula, throughout the Komandorskiye and Aleutian Islands, north to the Pribilof Islands in the eastern Bering Sea, and eastward through the GOA to southeast Alaska. Their center of abundance is in the Aleutian Islands. An Atka mackerel population existed in the GOA primarily in the Kodiak, Chirikof, and Shumagin areas and supported a large foreign fishery through the early 1980s. By the mid-1980s, this fishery and presumably the population, had all but disappeared. Recently, Atka mackerel have been detected by the summer trawl surveys only in the Shumagin (Western) area of the GOA. Genetic information suggests that the Aleutian Island and GOA populations could be managed as a unit stock, however, there are significant differences in population size, distribution, recruitment patterns, and resilience to fishing. Atka mackerel abundance in the GOA may be dependent on strong recruitment from the Aleutian Islands population.

Atka mackerel begin to recruit to the fishery at age 2 and may survive to 15 years, however most of the population is less than 10 years old. Annual natural mortality of adults has been estimated to be about 25% ($M = 0.30$). Females reach 50% maturity at about 38 cm or 3.6 years old. Atka mackerel migrate from the shelf edge to shallow coastal waters to spawn. Spawning occurs in July to October on restricted shelf areas with suitable bottom characteristics. Eggs are adhesive and deposited in rock crevices. These nests are guarded by the males until hatching, which occurs about 40-45 days later. Atka mackerel eat copepods and euphausiids, and in turn are prey for other fish, seabirds, Steller sea lions, and other marine mammals.

Stock Assessment: In 1996, an estimate of biomass could not be determined from trawl survey data due to extreme catch variances. Estimates of B_{MSY} and F_{MSY} are not available for this stock. Beginning in 1997, OFL and ABC rates are based on tiers defined under Amendment 44. Under this definition, OFL for Atka mackerel is based on tier 6 and is set equal to the average catch from 1978-1995. Due to the uncertainty about the status and trend of GOA Atka mackerel, the ABC is set below the maximum allowed under tier 6 ($0.75 \times OFL$), at a level sufficient only to satisfy the bycatch needs of other fisheries.

Population Status: Since 1997, an estimate of exploitable biomass in the Gulf of Alaska could not be determined from trawl survey data due to extreme catch variances. Using tier 6 criteria, the 1998 overfishing level equals 6,200 mt. The ABC was set equal to 600 mt to satisfy bycatch needs in other fisheries. Atka mackerel are considered to be at a low level of relative abundance and exploitation. There may be some evidence of localized depletion; this species has exhibited vulnerability to fishing pressure in the past. The dramatic decline of the Atka mackerel fishery in the Gulf of Alaska suggests that the area may be the edge of the species' range and be populated only during periods when recruitment, possibly as juveniles, from the Aleutian portion of the range is strong.

Fishery: Decreased Atka mackerel abundance may be due to a westward shift in their distribution, to excessive fishing mortality, or to successive years of poor recruitment. The population consists mostly of large fish. The absence of catches in the Eastern and Central Regulatory areas indicates stocks are not sufficiently abundant to support a commercial fishery, although small amounts are caught incidentally in other target fisheries. Schooling behavior makes them vulnerable to targeted fishing with bottom trawls. Due to its low availability the domestic groundfish industry showed little interest in targeting on this species, and Atka mackerel in the Western area resulted in establishment of that species as a target species category beginning with the 1994 fishing year. In 1997, Atka mackerel was a bycatch fishery only.

Management: The Atka mackerel fishery is regulated under the GOA Groundfish FMP. It was added to the "other species" category in 1988 due to low abundance. They were separated out from "other species" in 1994 after four years of targeted catch, primarily from the Western regulatory area. The FMP controls the fishery through permits and limited entry, catch quotas (TACs), seasons, in-season adjustments, gear restrictions, closed waters, bycatch limits and rates, allocations, regulatory areas, record keeping and reporting requirements, and observer monitoring.

Economics: In 1996, 1,585 mt of Atka mackerel was caught as trawl bycatch in the Gulf, nearly all of which was retained. Average ex-vessel price was about \$0.16/lb, totaling \$400,000. Primary products produced are H&G and whole fish.

Catch History: Atka mackerel stocks supported a targeted foreign fishery in the Central area in the 1970s through the early 1980s, under joint venture operations. Catches peaked in 1975 at about 27,000 mt and dropped to almost 0 in 1986. All landings since then have been taken by the domestic fishery.

Catch specifications and total catches (including discards) of Atka mackerel in the GOA, 1994-98 (in mt).

<u>Year</u>	<u>ABC</u>	<u>TAC</u>	<u>Catch</u>
1994	4,800	3,500	3,540
1995	3,240	3,240	700
1996	3,240	3,240	1,580
1997	1,000	1,000	330
1998	600	600	*

Abundance has declined to negligible quantities, except in the Western area.