PRELIMINARY
STOCK ASSESSMENT AND FISHERY EVALUATION REPORT FOR THE GROUNDFISH RESOURCES OF THE BERING SEA/ALEUTIAN ISLANDS REGIONS AS PROJECTED FOR 1995

by the

Plan Team for the Groundfish Fisheries
for the
Bering Sea and Aleutian Islands
of the
North Pacific Fishery Management Council

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STOCK ASSESSMENT AND FISHERY EVALUATION REPORT FOR THE GROUNDFISH RESOURCES OF THE BERING SEA/ALEUTIAN ISLANDS REGIONS AS PROJECTED FOR 1995

ABSTRACT

The Bering Sea/Aleutians Groundfish Plan Team of the North Pacific Fishery Management Council has assessed the status of the groundfish resources in the Bering Sea/Aleutians regions through August 1994 and estimated their acceptable biological catches (ABCs) for 1995. The estimates are preliminary since new data from the 1994 summer surveys of the resources and the fisheries are just becoming available for analysis. This preliminary SAFE report has been prepared for discussion by the Council at its September Council meeting. Since the status of the stocks has not been updated, the ABC values are essentially the same as adopted by the Council last year , except for two instances when the Plan Team's assessments of the ABC are different from those of the Council. These exceptions are for pollock in Area 518 (127,000 t Plan Team estimate versus 31,750 t adopted by the Council) and for Greenland turbot (17,200 Plan Team estimate versus 7,000 t adopted by the Council).

Overall, the ABCs for the Bering Sea/Aleutians groundfish resources total 2.76 million t for 1995; slightly under the maximum sustainable yield of 2.86 million t. The resources are relative high and stable in abundance; except for Greenland turbot whose abundance is expected to remain low through the 1990s. By major species groups, the preliminary 1995 ABC estimates and their percentage composition of the total groundfish complex ABC are as follows: Pollock (1,513,600 t or 54.8%), Rock Sole (313,000 t or 11.3%), Yellowfin Sole (230,000 t or 8.3%), Other flatfishes (335,600 t or 12.2%), Pacific cod (191,000 t or 6.9%), Atka mackerel (122,500 t or 4.4%), rockfish complex (22,235 t or 0.8%), sablefish (2,800 t or 0.1%), and all other species (30,610 t or 1.1%).

The Plan Team will be updating the stock assessments again in November for review by the Council at its December meeting. The SAFE report of the Plan Team that will be prepared for the December Council meeting will form the biological basis for management of the resources in 1995.

SUMMARY

by

The Plan Team for the Groundfish Fisheries
of the Bering Sea and Aleutian Islands

INTRODUCTION

The *Guidelines for Fishery Management Plans (602 Guidelines)* published by the National Marine Fisheries Service (NMFS) require that a stock assessment and fishery evaluation (SAFE) report be prepared and reviewed annually for each fishery management plan (FMP). The SAFE reports are intended to summarize the best available scientific information concerning the past, present, and possible future condition of the stocks and fisheries under federal management.

The SAFE reports for the groundfish fisheries managed by the North Pacific Fishery Management Council (Council) are compiled by the respective Plan Teams from chapters contributed by scientists at NMFS' Alaska Fisheries Science Center (AFSC) and the Alaska Department of Fish and Game. These SAFE reports include separate stock assessment and fishery evaluation sections. The stock assessment section includes recommended acceptable biological catch (ABC) levels for each stock and stock complex managed under the FMP. The ABC recommendations, together with social and economic factors, are considered by the Council in determining total allowable catches (TACs) and other management strategies for the fisheries.

The FMPs for the groundfish fisheries managed by the Council require that drafts of the SAFE reports be produced each year in time for the September and December meetings of the Council. Since critical stock assessment data often do not become available until after the September draft has been completed, many chapters undergo substantial revision in preparation for the December Council meeting. Only those chapters with substantive changes have been attached to this SAFE summary. Other chapters remain unchanged from the December 1993 SAFE.

Members of the Plan Team who compiled this SAFE report were Loh-Lee Low (chairman), David Witherell (plan coordinator), David Ackley, David Colpo, Richard Merrick, Grant Thompson, Ellen Varosi, Gregg Williams, and Sam Wright.

BACKGROUND INFORMATION

Management Areas and Species

The Bering Sea/Aleutian Islands (BS/AI) management area lies within the 200-mile U.S. Exclusive Economic Zone (EEZ) of the United States (Figure 1). International North Pacific Fisheries Commission (INPFC) statistical areas 1 and 2 make up the EBS. The Aleutian Islands (AI) region is INPFC area 5. Four categories of finfishes and invertebrates have been designated for management purposes (Table 1). They are (a) prohibited species, (b) target species, (c) other species, and (d) non-specified species. This SAFE report describes the status of the stocks in categories (b) and (c) only.

Historical Catch Statistics

Catch statistics since 1954 are shown for the EBS subarea in Table 2. The initial target species was yellowfin sole. During the early period of these fisheries, total catches of groundfish reached a peak of 674,000 metric tons (t) in 1961. Following a decline in abundance of yellowfin sole, other species (principally pollock) were targeted upon, and total catches rose to 2.2 million t in 1972. Catches have since varied from one to two million t as catch restrictions and other management measures were placed on the fishery.

Catches in the Aleutian region have always been much smaller than those in the EBS. Target species have also been different (Table 3): In the Aleutians, Pacific ocean perch (POP) was the initial target species. During the early years of exploitation, overall catches of Aleutian groundfish reached a peak of 112,000 t in 1965. As POP abundance declined, the fishery diversified to other species. Total catches from the Aleutians in recent years have been about 100,000 t annually.

Recent Total Allowable Catches

Amendment 1 to the BS/AI Groundfish FMP provides the framework to manage the groundfish resources as a complex. Maximum sustainable yield (MSY) for this complex was originally estimated at 1.8 to 2.4 million t. The optimum yield (OY) range was set at 85% of the MSY range, or 1.4 to 2.0 million t.

Total allowable catches established by the Council since implementation of extended jurisdiction under the Magnuson Fishery Conservation and Management Act (MFCMA) in 1977 are given in Table 4, and are broken down by fishery sector in Table 5. The sum of the TACs equals OY for the groundfish complex, which is currently constrained by the 2.0 million t cap. Optimum yield for all species combined increased steadily from 1.4 million t in 1977 to 2.0 million t in 1984-94.

Biological Reference Points

A number of biological reference points are used in this SAFE report. Among these are the fishing mortality rate (F) and stock biomass level (B) associated with MSY (F_{MSY} and B_{MSY} respectively). Also used are the fishing mortality rates which reduce the level of spawning per recruit to some percentage P of the pristine level ($F_{P\%}$), and the fishing mortality rate which reduces the slope of the yield per recruit curve (plotted against F) to 10% of the slope at the origin ($F_{0.1}$). The fishing mortality rate used to compute ABC is designated F_{ABC}, and the fishing mortality rate used to compute the overfishing level (OFL) is designated F_{OFL}.

Plan Team Policy on Acceptable Biological Catch

In computing ABC, the Plan Team is guided by the MFCMA, the *602 Guidelines*, the BS/AI Groundfish FMP, and two policy statements adopted jointly by the Plan Team and its Gulf of Alaska counterpart. The first policy statement, adopted in September, 1990, addresses the overall process of setting ABC, and reiterates the definition of overfishing given in Amendment 16 to the BS/AI Groundfish FMP:

1) The Teams endorse the definition of ABC contained in the *602 Guidelines*, which states, "ABC is a preliminary description of the acceptable harvest (or range of harvests) for a given stock or

stock complex. Its derivation focuses on the status and dynamics of the stock, environmental conditions, other ecological factors, and prevailing technological characteristics of the fishery."

2) ABC values are chosen after consulting with individual scientists responsible for conducting assessments on the various stocks. The Teams would like to make clear that these guidelines are in no way intended to constrain the assessment scientists in their efforts to apply new and innovative techniques; rather, the Teams encourage creativity in stock assessment research. In particular, the Teams would like to encourage assessment scientists to explore new methods of incorporating uncertainty, recruitment variability, and multispecies considerations into their assessments.

3) The ABC values recommended by the Plan Teams must not exceed the catch levels obtained by applying the overfishing definition selected by the Council in Amendment 21/16. Whether or not ABC is set at the limit of overfishing or at some lower value will depend on factors such as recruitment trends, multispecies interactions, and the degree of uncertainty in data or parameter estimates. The overfishing definition adopted by the Council defines a maximum fishing mortality rate that declines at low stock sizes. Because data availability varies between stocks, the definition contains some flexibility, as shown below:

a) Data available: stock-recruitment, fecundity, maturity, growth, and mortality parameters. The maximum allowable fishing mortality rate will be set at F_{MSY} for all biomass levels in excess of B_{MSY}. For lower biomass levels, the maximum allowable fishing mortality rate will vary linearly with biomass, starting from a value of zero at the origin and increasing to a value of F_{MSY} at B_{MSY}.

b) Data available: fecundity, maturity, growth, and mortality parameters. The maximum allowable fishing mortality rate will be set at the value that results in the biomass-per-recruit ratio (measured in terms of spawning biomass) falling to 30% of its pristine level.

c) Data available: growth and mortality parameters. The maximum fishing mortality rate will be set at the value that results in the biomass-per-recruit ratio (measured in terms of exploitable biomass) falling to 30% of its pristine level.

d) Data available: natural mortality rate. The maximum allowable fishing mortality rate will be set equal to the natural mortality rate.

In cases where a biomass estimate is unavailable, overfishing is defined as exceeding the average catch since implementation of the MFCMA.

The second policy statement, adopted in November, 1992, constrains the computation of ABC so as to insure a buffer between ABC and OFL for all stocks in categories (a-c) above, and places a limit on admissible estimates of F_{MSY}:

Case I: Estimates of F_{MSY} and B_{MSY} are available.

Case IA: Estimate of F_{MSY} does not exceed $F_{30\%}$.

Case IA1: Projected biomass (B_{t+1}) exceeds B_{MSY}.

Then,

$$F_{OFL} = F_{MSY}$$

$$F_{ABC} \leq \left(\frac{F_{35\%}}{F_{30\%}}\right) F_{MSY}$$

Case IA2: Projected biomass does not exceed B_{MSY}.

Then,

$$F_{OFL} = \left(\frac{B_{t+1}}{B_{MSY}}\right) F_{MSY}$$

$$F_{ABC} \leq \left(\frac{F_{35\%}}{F_{30\%}}\right)\left(\frac{B_{t+1}}{B_{MSY}}\right) F_{MSY}$$

Case IB: Estimate of F_{MSY} exceeds $F_{30\%}$.

Then, the estimate of F_{MSY} is unreliable and

$$F_{OFL} = F_{30\%}$$

$$F_{ABC} \leq F_{35\%}$$

Case II: Estimates of F_{MSY} and B_{MSY} are unavailable.

Then, see Case IB.

Most species assessed in the present SAFE report fall under Case II above, and for most of these species, the recommended F_{ABC} was set at the upper limit of the allowable range (i.e., at $F_{35\%}$).

OVERVIEW OF "STOCK ASSESSMENT" SECTION

Preliminary Plan Team recommendations for 1995 ABCs are summarized in Tables 6-8. The sum of the preliminary recommended ABCs for 1995 is about 2.66 million t, about 7% higher than the total of the 1993 ABCs (2.48 million t) and close to the current total MSY estimate of 2.86 million t. Overall, the status of the stocks continues to appear relatively favorable. Stock status is summarized on a species-by-species basis below, with the following conventions observed:

1) "Fishing mortality rate" refers to the full-selection F (i.e., the rate that applies to fish of fully selected sizes or ages). It is important to remember that a full-selection F should be interpreted in the context of the selectivity schedule to which it applies. Use of full-selection Fs in this SAFE report represents a change since 1993, when knife-edge equivalent rates were reported (exceptions are those models which assume knife-edge recruitment, since the full-selection and knife-edge equivalent rates are identical in such cases).

2) "Exploitable biomass" refers to the total biomass of all age or size groups covered by the respective assessment model. This definition differs from that used by the chapter authors, where exploitable biomass is computed by multiplying biomass at age by selectivity at age and summing over all ages (again, in those models assuming knife-edge recruitment, the two definitions are equivalent).

3) "Exploitation rate" refers to the ratio between catch (in numbers) and start-of-year stock size (also in numbers). Where information is lacking, the exploitation rate is sometimes multiplied by start-of-year biomass to compute ABC.

4) Projected ABC and biomass levels are reported to three significant digits. Fishing mortality rates are reported to two significant digits.

5) The abbreviations "t" and "mt" represent metric tons.

6) The figures listed as 1994 ABCs correspond to the values approved last year by the Council. The figures listed as 1995 ABCs correspond to the Plan Team's recommended values for next year.

WALLEYE POLLOCK

EBS	1994 ABC = 1,330,000 t	1995 ABC = 1,330,000 t
	1994 TAC = 1,330,000 t	
Aleutians	1994 ABC = 56,600 t	1995 ABC = 56,600 t
	1994 TAC = 56,600 t	
Bogoslof	1994 ABC = 31,750 t	1995 ABC = 127,000 t
	1994 TAC = 1,000 t	
	(1995 Bogoslof ABC is recommended to be bycatch only)	

EBS	exploitable biomass = 8,020,000 t
Aleutians	exploitable biomass = 189,000 t
Bogoslof	exploitable biomass = 490,000 t

The current assessment includes several separate estimators of pollock abundance, including the EBS bottom trawl survey, two tunings of the standard cohort analysis (subjective and least squares), CAGEAN, and Synthesis. All methods indicate a total biomass (age 3+) in the neighborhood of 5-10 million t for the EBS portion of the stock. In particular, the assessment focuses on two projection scenarios (here labeled "A" and "B") taken from the least squares tuning of the cohort analysis, which differ primarily in their estimates of the strength of the 1989 year class. Scenario A assumes that the total biomass of fish in the 37-47 cm size range estimated by the 1993 bottom trawl survey (2,450,000 t) is an accurate estimate of the total biomass of the 1989 year class. When tuned to fit this estimate, cohort analysis gives a 1993 age 4 biomass of 2,620,000 t. Scenario B assumes that the survey estimate should be adjusted upward by dividing by a survey selectivity factor (estimated by Synthesis) of 0.45, giving a figure of 5,440,000 t for the biomass of the 1989 year class at age 4. Scenario A projects a total population biomass (age 3+) of 5,370,000 t, while Scenario B projects a value of 8,020,000 t.

The Plan Team feels that the 1994 age 3+ biomass used in Scenario A (2,620,000 t) is too low. As has been noted in previous assessments, it is unlikely that the trawl survey has a selectivity of 1.0 at age 4. Furthermore, the 1993 hydroacoustic survey estimated a biomass of 2,290,000 t for fish in the 35-43 cm size range, even though this survey covered only about half of the area assessed by the trawl survey. Finally, the 1994 age 3+ biomass of 8,020,000 t projected under Scenario B seems more consistent with the Synthesis model's estimate of 9,110,000 t for 1992 (Synthesis' projection of 1994 biomass is not available). For these reasons, the Plan Team accepts the projections resulting from Scenario B. However, the Plan Team notes that the dependence of these projections on a single strong (and tentatively estimated) year class requires that a cautious approach be used to set ABC.

The Plan Team also accepts the estimates of B_{MSY} (6,000,000 t) and F_{MSY} (0.38) presented in the chapter. Given Scenario B, projected biomass exceeds B_{MSY}, meaning that F_{ABC} is capped by the product of ($F_{35\%}/F_{30\%}$) and F_{MSY}, or (0.38/0.46)x0.38 = 0.31. Coincidentally, 0.31 is also the value of $F_{0.1}$ for this species. Harvesting EBS pollock at the $F_{0.1}$ rate under Scenario B gives an ABC of 1,330,000 t. Given the uncertainty associated with Scenario B, the Plan Team feels that the $F_{0.1}$ strategy is suitably conservative, and notes that the resulting catch lies at the approximate mid-point of the range corresponding to a straight F_{MSY} (or $F_{35\%}$) harvest strategy (1,020,000 t - 1,590,000 t).

The OFL for EBS pollock is defined by the F_{MSY} harvest strategy, which corresponds to a catch of 1,590,000 t under Scenario B.

For the Aleutian Islands component of the stock, the chapter author estimates a 1993 biomass of 189,000 t (a 1995 projection is not given). Using an $F_{35\%}$ exploitation rate of 0.30, the 1995 Aleutian ABC is set at 56,600 t. The 1995 OFL for the Aleutian component is calculated from an $F_{30\%}$ exploitation rate of 0.32, giving a value of 60,400 t.

The chapter also lists an estimate of 600,000 t for the 1993 total biomass in the Bogoslof region (Area 518). Assuming no growth, recruitment, or fishing mortality, the author projects a 1995 biomass of 490,000 t by applying a natural mortality rate of 0.2 to the 1993 biomass estimate. A 1995 Bogoslof ABC of 127,000 t is computed by multiplying estimated biomass by the $F_{35\%}$ exploitation rate of 0.26. Out of concern over recent declines in the Bogoslof population of Steller sea lions, however, the Plan Team recommends that the Bogoslof pollock fishery be managed on a bycatch-only basis. The 1995 OFL for the Bogoslof region is set at 147,000 t, based on an $F_{30\%}$ exploitation rate of 0.30.

PACIFIC COD

1994 ABC = 191,000 t 1995 ABC = 191,000 t
1994 TAC = 191,000 t
exploitable biomass = 925,000 t

The length-based Synthesis model described in the EA/RIR for Amendment 24 to the BS/AI Groundfish FMP and in the September 1993 SAFE report was retuned for the present assessment, incorporating additional length frequency information, revised catch estimates, and the 1993 trawl survey estimate of stock size. The new biomass and catch projections are slightly higher than in the September edition, but results are otherwise similar. In particular, it appears that the 1989 and 1990 year classes are well above average in size, and that the recent downward trend in stock biomass has been halted.

The Plan Team has opted for an $F_{35\%}$ strategy to remain consistent with its overall ABC policy. Using an $F_{35\%}$ (=0.35) harvest strategy, the new assessment model projects a 1995 ABC of 166,000 t for the EBS portion of the stock and 191,000 t for the EBS and Aleutians combined. An F=M (=0.37) harvest strategy results in a BS/AI ABC of 200,000 t. Reliable estimates of F_{MSY} and B_{MSY} are not available for this stock. The new assessment model projects a 1995 OFL (under an $F_{30\%}$=0.43 harvest strategy) of 198,000 t for the EBS portion of the stock, and 228,000 t for the EBS and Aleutians combined.

YELLOWFIN SOLE

1994 ABC = 230,000 t 1995 ABC = 230,000 t
1994 TAC = 150,325 t
exploitable biomass = 1,880,000 t

Three abundance estimators (trawl survey, virtual population analysis, and stock synthesis) all indicate that the yellowfin sole resource increased slowly during the 1970s and early 1980s to a peak during the mid-1980s and that the resource has remained abundant and stable until the present. This trend is indicative of a slow-growing species that is known to have been lightly exploited while experiencing average to strong recruitment during the past 15 years. Good recruitment from the 1981 and 1983 year-classes is expected to maintain the abundance of yellowfin sole at a high level in the near future.

The recommended ABC for 1995 was calculated by applying the $F_{35\%}$ fishing mortality rate from the stock synthesis model to the 1994 projection of exploitable biomass. The $F_{35\%}$ rate was considered appropriate because it makes use of the available information regarding age-specific fishing selectivities and maturity. As with most North Pacific flatfish species, sexual maturity in yellowfin sole occurs well after the age of entry into the fishery. Yellowfin sole are fully selected to the fishery by age 11 but only about 50% of the females are mature by this age. The $F_{35\%}$ rate of 0.12 corresponds to a 1995 ABC of 230,000 t. This catch is below the level of 269,000 t corresponding to the Council's overfishing definition, computed under an $F_{30\%}$ value of 0.14. The Plan Team does not feel that reliable estimates of F_{MSY} or B_{MSY} exist for this stock.

GREENLAND TURBOT

1994 ABC = 7,000 t 1995 ABC = 17,200 t
1994 TAC = 7,000 t (2/3 in BS, 1/3 in AI)
Recommended 1995 TAC = 7,000 t
exploitable biomass = 165,000 t

A length-based Synthesis model was employed for the Greenland turbot assessment. The chapter authors describe nine versions of the model, differing in terms of the slope survey catchability coefficient (0.25, 0.50, and 0.75) and the trawl:longline catch allocation (20:80, 50:50, and 80:20). The Plan Team, along with the chapter authors, feels that Model 3b (a slope survey catchability of 0.75 and a trawl:longline catch ratio of 50:50) is the most appropriate. Using an $F_{40\%}$ (=0.23) harvest strategy, Model 3b gives an ABC of 17,200 t. The same model gives an OFL of 24,800 t (at $F_{30\%}$=0.34) and an exploitable biomass of 165,000 t. Reliable estimates of F_{MSY} and B_{MSY} are not available for this stock.

Continuous poor recruitment has been observed for this resource since the early 1980s and there is no evidence that this pattern has changed or will change in the foreseeable future. All forecasts for a variety of possible fishery management strategies, including no fishing at all, project continued declines in biomass for the near-term future. The available evidence indicates that this stock is not capable of replacing itself under present conditions. Since no threshold level has been determined for this species, a prudent course for management would be to minimize fishery impacts. Therefore, the Plan Team recommends that the 1995 TAC for this species be kept at the current level of 7,000 t.

ARROWTOOTH FLOUNDER

1994 ABC = 93,400 t 1995 ABC = 93,400 t
1994 TAC = 10,000 t
exploitable biomass = 519,000 t

The resource continues to be in excellent condition as a result of minimal exploitation and steady increases in biomass throughout the 1980s. Estimates from 1990-93 indicate that about 86% of the arrowtooth flounder caught were discarded. In the absence of a stock-recruitment relationship for this species, a harvest strategy based on $F_{35\%}$ (which in this case happens to be identical to the $F_{0.1}$ estimate of 0.18) was used to recommend a 1995 ABC of 93,300 t. Although estimates of B_{MSY} and F_{MSY} for this stock are becoming more rigorous, the Plan Team views them as still too preliminary to be used reliably.

Therefore, the OFL for this stock is defined by the $F_{30\%}$ (=0.25) fishing mortality rate, which corresponds to a 1995 catch of 130,000 t.

ROCK SOLE

1994 ABC = 313,000 t 1995 ABC = 313,000 t
1994 TAC = 75,000 t
exploitable biomass = 1,790,000 t

Because of sustained good recruitment, rock sole biomass increased steadily throughout the 1980s and early 1990s to its present high level. Biomass estimates from stock synthesis, cohort analysis, and the trawl survey all indicate that the current stock size is well over 1.5 million t.

Prior to 1993 stock assessments computed ABC from estimates of F_{MSY} and $F_{0.1}$ obtained from a simple dynamic pool model. For last year's assessment, however, an $F_{35\%}$ strategy was developed from a Synthesis model. The $F_{35\%}$ rate was considered appropriate because it makes use of the available information regarding age-specific fishing selectivities and maturity. Rock sole attain sexual maturity well after the age of entry into the fishery (83% of the females are selected by the commercial gear by age 8, but only 50% are mature by that age). The $F_{35\%}$ fishing mortality rate (=0.18) gives a 1995 ABC of 313,000 t. This ABC is below the level corresponding to the Council's overfishing definition, which gives a 1995 catch of 363,000 t under an $F_{30\%}$ value of 0.22. The Plan Team feels that reliable estimates of F_{MSY} and B_{MSY} are not available for this stock.

FLATHEAD SOLE

1994 ABC = included with other flats 1995 ABC = 119,000 t
1994 TAC = included with other flats
exploitable biomass = 610,000 t

The Council requested the Plan Team break out flathead sole from the other flatfish complex for the 1995 fishing year. The exploitable biomass of flathead sole, from the 1993 Bering Sea trawl survey, was estimated to be 610,000 t.

Exploitation rates have been derived from the fishing mortality values that would reduce flathead sole exploitable biomass per recruit to 35% (ABC) and 30% (overfishing) of their unfished levels. These rates were calculated from the life history characteristics (von Bertalanffy parameters) for flathead sole. The Plan Team does not feel that reliable estimates of F_{MSY} and B_{MSY} exist for this species. The 1995 ABC and overfishing rates are $F_{35\%}$ = 0.19 and $F_{30\%}$ = 0.23, respectively. Projected 1995 catch under these rates are ABC = 119,000 t and OFL = 145,000 t.

OTHER FLATFISH COMPLEX

1994 ABC = 225,000 t (incl. flathead sole) 1995 ABC = 106,000 t
1994 TAC = 225,000 t (incl. flathead sole)
exploitable biomass = 630,000 t

Results of the 1993 Bering Sea trawl survey estimated the "other flatfish" species to be at a high level of abundance. The Alaska plaice estimate remained at a high and stable level of 515,000 t and the miscellaneous flatfish species estimate was 87,200 t.

Prior to 1992, assessments of "other flatfish" determined ABC by using the $F_{0.1}$ rate for rock sole as a proxy. For the present assessment, exploitation rates have been derived from the fishing mortality values that would reduce Alaska plaice exploitable biomass per recruit to 35% (ABC) and 30% (overfishing) of unfished levels. These rates were considered preferable to the rock sole proxies since they are calculated from the life history characteristics (von Bertalanffy parameters) of the species in question. The Plan Team does not feel that reliable estimates of F_{MSY} and B_{MSY} exist for this complex. The 1995 ABC and overfishing rates are as follows:

Species	$F_{35\%}$	$F_{30\%}$
Alaska Plaice	0.17	0.20
Miscellaneous species	0.19	0.23

Projected 1995 catch at these fishing levels is as follows:

Species	$F_{35\%}$	$F_{30\%}$
Alaska plaice	87,600 t	103,000 t
Miscellaneous species	18,250 t	22,100 t
Total	106,000 t	125,000 t

SABLEFISH

EBS 1994 ABC = 540 t 1995 ABC = 540 t
1994 TAC = 540 t
(1995 EBS ABC is recommended to be bycatch only)
Aleutians 1994 ABC = 2,800 t 1995 ABC = 2,800 t
1994 TAC = 2,800 t

EBS exploitable biomass = 4,600 t
Aleutians exploitable biomass = 23,900 t

The methodology for the present assessment is unchanged from previous years, using stock reduction analysis to model the combined population from the EBS, Aleutian Islands, and Gulf of Alaska. The most notable feature of the present assessment is that projected biomass in the EBS has decreased by approximately 65%. As in last year's assessment, the target fishing mortality rate for this stock

($F_{35\%}$=0.14) has been scaled by the ratio of projected biomass to $B_{35\%}$ (35% of pristine biomass), where projected biomass and $B_{35\%}$ are both pooled across areas (EBS, Aleutian Islands, and Gulf of Alaska). The current ratio of projected biomass to $B_{35\%}$ is 0.94, resulting in a reduction of the target fishing mortality rate to 0.13. This fishing mortality rate corresponds to 1995 ABCs of 540 t in the EBS and 2,800 t in the Aleutian Islands. The OFL is computed at the $F_{30\%}$ (=0.17) rate, giving 1995 values of 670 t in the EBS and 3,490 t in the Aleutian Islands. The Plan Team does not feel that reliable estimates of F_{MSY} and B_{MSY} exist for this stock.

Because the ABC for the EBS portion of the stock is so low, the Plan Team recommends that the 1995 EBS sablefish fishery be conducted on a bycatch-only basis. Furthermore, since sablefish in the EBS and Aleutians are believed to belong to the same stock, the Plan Team recommends combining the OFLs for the these two subareas, giving a total OFL of 4,160 t.

PACIFIC OCEAN PERCH COMPLEX

EBS

True POP	1994 ABC = 1,910 t	1995 ABC = 1,910 t
	1994 TAC = 1,910 t	
OR Rock.	1994 ABC = 1,400 t	1995 ABC = 1,400 t
	1994 TAC = 1,400 t	

True POP exploitable biomass = 48,400 t
OR Rock. exploitable biomass = 29,700 t

Aleutian Islands

True POP	1994 ABC = 10,900 t	1995 ABC = 10,900 t
	1994 TAC = 10,900 t	(W=6,104 t, C=3,052 t, E=1,744 t)
NO and SC	1994 ABC = 5,670 t	1995 ABC = 5,670 t
	1994 TAC = 5,670 t	
RE and SR	1994 ABC = 1,220 t	1995 ABC = 1,220 t
	1994 TAC = 1,220 t	

True POP exploitable biomass = 244,000 t
NO and SC exploitable biomass = 94,500 t
RE and SR exploitable biomass = 45,000 t

The POP complex consists of true POP (*Sebastes alutus*) and four other red rockfish (OR Rock.) species (northern rockfish [NO], rougheye rockfish [RE], sharpchin rockfish [SC], and shortraker rockfish [SR]). Prior to 1991, the complex was managed as a unit in each of the two management areas. In 1991, 1992, and 1993, however, the Council managed *S. alutus* separately from the other species in both areas, and also split out rougheye and shortraker in the Aleutians. This was done to avoid excessive catches of the less abundant members of the complex, particularly shortraker and rougheye. For the 1995 harvest year, the Plan Team recommends that the Council retain the 1991-1993 approach of splitting out rougheye and shortraker in the Aleutians but not in the Bering Sea.

the Plan Team recommends that the Council retain the 1991-1993 approach of splitting out rougheye and shortraker in the Aleutians but not in the Bering Sea.

The Plan Team suggests that the ABC and TAC for true POP be subdivided within the AI area. Based on the 1991 survey biomass distribution, a majority (56%) of the biomass occurs in the western Aleutians, but most of the fishing is thought to occur in the eastern area. Only 16% of the biomass was found in the eastern AI, and 28% in the central area. The team is concerned about localized depletion of this stock in the eastern AI area, in particular. Studies of POP and other rockfish species indicate that adult movements and larvae dispersal are limited.

The stock assessment for this complex is based mainly on *S. alutus*, which has the most data and is the most abundant species in the complex. An age-based Synthesis model has been used as the primary analytic tool for the last two assessments. Since last year, otoliths collected in 1990 have been aged and the results incorporated into the Synthesis model. The 1992 harvest results were fully incorporated into the model, as were the 1993 harvest results through October. An alternative index of abundance is being analyzed using NMFS domestic observer data and the results may be available in a future SAFE report.

Synthesis results indicate that the *S. alutus* stocks in both areas underwent declines in abundance during the 1960s and early 1970s, and remained low in abundance through the early 1980s. For several years, the Council set TAC well below (normally at 50% of) ABC to promote rebuilding of the stocks. Through a combination of these management actions and improved recruitment, the stocks have been recovering slowly, although the most recent survey from the EBS region indicated some downturn in that portion of the stock.

The chapter authors and the Plan Team believe that reliable estimates of F_{MSY} and B_{MSY} for *S. alutus* are not available. Therefore, the recommended 1995 ABC is based on a harvest strategy that reduces the equilibrium level of spawning biomass per recruit to 44% of the pristine level ($F_{44\%}$). The $F_{44\%}$ (=0.06) level was chosen over an $F_{35\%}$ (=0.08) level because an analysis of *S. alutus* in the Gulf of Alaska showed that the $F_{44\%}$ level produces the best harvest policy given uncertainty in the stock-recruitment relationship and life-history characteristics for this species. When applied to the projected age 9+ biomass levels of 48,400 t in the EBS and 244,000 t in the AI region, the resulting 1995 ABCs for *S. alutus* are 1,910 t and 10,900 t, respectively. The 1995 OFL for *S. alutus* is based on $F_{30\%}$ (=0.10), resulting in catches of 2,920 t and 16,600 t for the EBS and AI regions, respectively.

For the other subcomplexes ("others" in the EBS and northern/sharpchin and shortraker/rougheye in the AI), 1995 ABC is calculated as the product of the natural mortality rate (0.06 for northern and sharpchin, 0.025 for rougheye, and 0.03 for shortraker) and exploitable biomass. Since estimates of other biological parameters are unavailable, harvesting at the $F=M$ strategy also corresponds to the OFL.

OTHER ROCKFISH COMPLEX

EBS	1994 ABC = 365 t	1995 ABC = 365 t
	1994 TAC = 365 t	
Aleutians	1994 ABC = 770 t	1995 ABC = 770 t
	1994 TAC = 770 t	

EBS exploitable biomass = 7,300 t

Aleutians exploitable biomass = 15,500 t

The "other rockfish" complex consists primarily of thornyhead (*Sebastolobus*) species, along with all *Sebastes* species not included in the Pacific ocean perch complex. U.S. observers have identified 15 confirmed species within this complex, and another 14 species have been tentatively identified. The complex is managed as two separate stocks, one in the EBS and one in the Aleutian Islands.

Little is known about the species in this complex. Commercial catch and effort data are of little use in examining abundance trends for these species since most of the catch is probably incidental. The species in this complex are primarily located on the EBS slope (with a slope component and an Aleutian Islands component) and in the Aleutian Islands region. Both of these areas were surveyed in 1991, and the biomass estimates for the species in this complex were estimated by averaging the results of previous surveys. Six years of survey information since 1979 were used in calculating the mean biomass in the EBS slope component; four surveys since 1980 were included in the Aleutians Islands portion of the EBS; and the same four years were used to calculate the mean biomass for the Aleutian Islands region

The natural mortality rate for species in this complex has been estimated at 0.05, which was used as the target fishing mortality rate in calculating 1995 ABC. Lacking estimates of other biological parameters, the resulting ABC values also correspond to the respective OFLs. The Plan Team does not feel that reliable estimates of F_{MSY} or B_{MSY} exist for this complex.

ATKA MACKEREL

1994 BSAI ABC = 122,500 t 1995 ABC = 245,000 t
1994 BSAI TAC = 68,000 t
Western BSAI ABC = 53,900 t, TAC = 10,000 t
Central BSAI ABC = 55,125 t, TAC = 44,525 t
Eastern BSAI ABC = 13,475 t, TAC = 13,475 t

exploitable biomass = 816,000 t

This is the third year in which the Synthesis approach has been used to assess the status of Atka mackerel. For this year's assessment, the Synthesis model was rerun with the updated 1992 catch data, the 1993 catch data (as of 8/14/93), and the 1992 commercial fishery length frequency data. Relative to last year, the only change in the configuration of the model was that both the 1989 and 1992 fishery length frequency data were used directly in stock synthesis and fitted simultaneously with the time series of catch-age data.

The exploitable biomass estimate for Atka mackerel in 1995 is 816,000 t. This estimate is lower than either the 1992 or 1993 estimates (1,293,500 t and 1,171,000 t, respectively). The reduction is due to a significant downward revision in the estimated strength of the 1989 year class. The estimated level of recruitment from this year class is still tenuous, however.

Because the stock-recruitment data generated by Synthesis do not indicate the presence of a definable stock-recruitment relationship, reliable estimates of F_{MSY} and B_{MSY} are not available. As an alternative, the chapter author uses a catch level corresponding to 30% of the projected biomass as a starting point for computing ABC. A factor of 0.3 is supportable in several ways: 1) it provides consistency with the

past two years' procedure; 2) the natural mortality rate is also 0.3; and 3) simulation studies cited in the chapter indicate that $F_{0.1}$ and $F_{35\%}$ strategies may be too aggressive for Atka mackerel, given the level of uncertainty involved in survey estimates of biomass for this stock. Multiplying the natural mortality rate of 0.3 by the projected biomass of 816,000 t gives an overall 1995 ABC of 245,000 t. This corresponds to a fishing mortality rate of 0.37. The OFL for this stock is based on $F_{30\%}$ (=0.88), corresponding to a 1995 catch of 484,000 t.

Because of the possibility of local depletion, Amendment 28 of the BS/AI Groundfish Fishery Management Plan divided the Aleutian subarea into three districts at 177° E and 177° W longitude, thereby providing a mechanism to apportion Aleutian TACs. Based on the biomass distribution for Atka mackerel from the 1991 Aleutian survey, a potential apportionment for the 1995 TAC would be 44.48% Western district, 44.70% Central district, and 10.82% Eastern district. The associated ABCs are provided at the top of this summary.

In setting ABC for the 1992 and 1993 seasons, both the Plan Team and SSC began with catches equal to 30% of the respective projected biomasses. Because these catch levels were far above those observed in previous years, the SSC recommended reducing these catches by factors of 5/6 and 2/3 for the 1992 and 1993 seasons, respectively, with the understanding that the adjustment factor would be 1/2 for the 1994 season. The Plan Team is unconvinced that making such reductions at the ABC stage is mandated by the best available scientific information. However, since the resulting catch for 1995 is obviously more conservative than the Plan Team's recommended ABC, the Plan Team has no objection to making such an adjustment at the TAC stage.

OTHER SPECIES COMPLEX

Squid	1994 ABC = 3,110 t exploitable biomass not available	
Other Species	1994 ABC = 27,500 t 1994 TAC = 26,390 t	1995 ABC = 30,611 t (incl. squid)
	exploitable biomass = 706,000 t	

The Plan Team recommends that squid be included with the other species complex, rather than assigned a separate ABC as has been done in past years. Squid has been taken as incidental bycatch in other groundfish fisheries, and has not been a target species in the domestic groundfish fisheries. Recent catches have been in the order of 600 tons per year since 1985. Biomass estimates for squid are not available, because squid are mainly pelagic over deep water, and not generally available to the bottom trawl survey.

In recent years, catches of squid and "other species" have represented 1% or less of the total catch of all groundfish. Biomass estimates for "other species" were derived from demersal trawl surveys. The survey data suggest that sculpins and skates constitute most of the "other species" biomass but it is recognized that the abundance of pelagic species such as smelts and sharks may be substantially underestimated by demersal trawls. Recent increases in the exploitable biomass of this category are largely attributable to the substantially increased biomass of skates. Biomass for 1995 was computed by averaging the biomass estimates from the 1991-93 EBS surveys and adding the 1991 Aleutians survey biomass.

The Plan Team does not feel that reliable estimates of F_{MSY} and B_{MSY} exist for these stocks. Because of the scarcity of data regarding these species, the recommended ABCs for 1995 were set at the average catch levels observed since 1977, which was 30,611 t for other species (27,500 t for 1994 other species, plus 3,111 t from squid). In the absence of information needed to estimate F_{MSY} or $F_{30\%}$, overfishing for "other species" is defined by fishing at $F=M$. Since M is roughly estimated at a value of 0.2, the OFL for "other species" is set at 141,000 t (0.2 X 706,000 t).

MARINE MAMMAL/ECOSYSTEM CONSIDERATIONS SUMMARY

The marine mammal and ecosystem considerations sections have been combined and placed as a separate chapter. In the future, as this chapter evolves, the ecosystem considerations portion may be enlarged and appear separately.

The marine mammal portion contains a summary of research results for Steller sea lions, and updates status of research activities for northern fur seal, harbor seal, killer whale and harbor porpoise.

Steller sea lions

New information on Steller sea lions includes March 1993 aerial survey results, the first comprehensive aerial survey conducted for sea lions in Alaska outside the breeding season. There were 41% fewer animals hauled out in March 1993 than in June 1992; numbers of animals on haul-outs were somewhat greater in March than in June, but rookery numbers were much lower in March; some rookery sites were empty or nearly so in March and a larger proportion of animals were observed in the western GOA and central Aleutian Islands in March than in June.

Summer pup surveys showed a 25.8% decline on eight Kenai-Eastern Aleutian Island rookeries between 1991 and 1993. Addition of three SE Alaska sites counted in 1991-93 results in a decline of 20.4%. An update on foraging studies is also provided.

Northern fur seals

The northern fur seal population trends on the Pribilof Islands, assessed through biennial pup counts suggest no significant change in the number of pups between 1990 and 1992. Overall, the Alaskan population is considered to be depleted but stable.

Pacific harbor seals

The 1993 harbor seal surveys were conducted in Southeast Alaska. Results are expected in December. Previous counts in 1991 and 1992 suggest relatively stable numbers in Bristol Bay and west along the Alaska Peninsula, but a significant decline in the central and western Gulf of Alaska and in Prince william Sound.

Killer whales and harbor porpoise

Summer surveys were conducted for both species; results are expected in early 1994.

OVERVIEW OF "FISHERY EVALUATION" SECTION

There were no changes made to the December version of the Economic SAFE. An update will be provided in the final SAFE in December.

OVERVIEW OF APPENDICES

Appendix A: Pacific Halibut SAFE Report

A separate SAFE report on the Pacific halibut (*Hippoglossus stenolepis*) population and fishery has been prepared by the staff of the International Pacific Halibut Commission, and is included with this SAFE report as Appendix A.

Coastwide, Pacific halibut exploitable biomass was estimated at 300.4 million pounds (dressed weight, or 181,200 mt *rd. wgt.*) in 1993, a decline of 12% from the 1992 estimate. Exploitable biomass was estimated at 219.6 million pounds (dressed weight, or 132,500 mt *rd. wgt.*) for the Gulf areas (Areas 2C, 3A, and 3B) and 28.8 million pounds (dressed weight, or 17,400 mt *rd. wgt.*) for the Bering Sea areas (Area 4A, 4B, 4C, 4D, and 4E). The trends in the estimated exploitable biomass indicate a decrease of 13% for the Gulf and 11% Area 4 with respect to the corresponding estimated 1992 biomass levels. The decline is expected to continue over the next few years as a consequence of reduced recruitment. Recruitment, measured as the abundance of 8-year-olds, continued to decline in all areas. An exploitation rate of 0.30 was used to determine yield by area.

Coastwide commercial fishery catches in 1993 totalled 59.27 million pounds (dressed weight, or 35,750 mt *rd. wgt.*). For the IPHC areas in the Gulf of Alaska (GOA), the commercial catch was 41.9 million pounds (dressed weight, or 25,300 mt *rd. wgt.*). Catches in the BSA areas totalled 6.3 million pounds (dressed weight, or 3,800 mt *rd. wgt.*). Preliminary data for 1992 shows the recreational catch of halibut off Alaska was relatively unchanged from 1991, at 6.6 million pounds (dressed weight, or 4,000 mt *rd. wgt.*). The number of sport charter licenses issued by IPHC continued to increase in 1992 and 1993, however. Coastwide halibut bycatch mortality continued to decrease from a peak in 1990, to 15.2 million pounds (dressed weight, or 9,200 mt *rd. wgt.*) in 1993. The largest decrease was noted in the BSA, which was offset somewhat by an increase in the GOA.

Appendix B: Pacific Halibut Bycatch Discard Mortality Rates

The Team reviewed a report by IPHC staff (Appendix B) on the results of recent analysis of 1993 observer data examining halibut discard mortality rates. Discard mortality rates are determined from the distribution of the release condition of halibut caught as bycatch. Condition, or viability, was determined by the observer on the basis of a physical examination of the fish against certain criteria which focus on body and opercular movements and extent of external injuries. The criteria are different for trawls, pots, and hook & line bycatch.

The IPHC analysis continued the same procedures used in previous analyses. Discard mortality rates were calculated for each target fishery and gear in the BSA and GOA. For most fisheries, the 1993 rates were quite similar to 1992 values, the exceptions being BSA and GOA trawl rockfish, GOA hook & line cod, and BSA pot cod.

Since halibut bycatch is managed with PSC limits in terms of mortality, NMFS needs a discard mortality rate to apply to the estimated bycatch in order to manage bycatch mortality inseason. Pre-season assumed rates provided by past analyses and were based on data from the most recent years. At the December, 1993 Council meeting, discussions with the AP, SSC, and IPHC staff concluded that an average of the rates for the 2 most recent years would serve as an appropriate preseason assumed rate. Accordingly, the IPHC report presented an average of the 1992-1993 data, shown on the next page, as a recommendation for 1995 bycatch monitoring.

The Team discussed these results and concurred with the IPHC recommendation that these are the most appropriate rates to use in 1995.

The Team also discussed the 2 issues raised in the report seeking industry input: the first being separate discard mortality rates for at-sea and shore-based trawl operations, and the second being a continuation of different rates for observed and unobserved hook & line vessels. Regarding the first, the Team noted that the only fisheries with significant differences occurred in the GOA: BT pollock and shallow water flatfish. Industry representatives in attendance informed the Team that at-sea effort for BT pollock in the GOA was a consequence of "ballasting", which the Council has prohibited in a recent action. Hence, there should be little, if any, BT pollock fishing by at-sea processing vessels in the future. However, because of the significant difference in rates between the two fishery components, the GOA Team recommends that at-sea and shore-based delivery vessels be assigned unique discard mortality rates. **IPHC staff will provide a similar breakdown in mortality rate data for the 1992 fishery in order that an appropriate 2-year average can be calculated.** For shallow water flatfish, the amount of data for at-sea processors was quite small and industry representatives confirmed that there is no effort by at-sea processors for this target. On this basis, the GOA Team concurred with the use of a single rate of 64% for this fishery, as recommended by the IPHC report.

The Team also discussed the issue of separate rates for observed and unobserved hook & line vessels in 1995. The data presented in the IPHC report for 1993 (Table 4) represented fisheries that occurred before and after the Careful Release requirement went into effect in mid-May. The major fisheries which occurred following implementation both showed increases in discard mortality rates from 1992. In addition, the rates were much higher than had been assumed would occur. Careful Release compliance by an unobserved vessel is unknown. Without an observer, a vessel may have little incentive to carefully release the halihut hycatch, but applying a higher discard mortality rate offers little, if any, disincentive to carefully release halibut. Applying the same mortality rate to the unobserved vessel as is applied to the observed vessel means that the unobserved fisherman gets credit for the actions taken by the observed fisherman. While seeing that unobserved fishermen may be getting undue credit, the Team did not believe that sufficient information exists in which to base a different rate for unobserved vessels.

Noting that the recommendations for hook & line fisheries were derived in the same manner as for pots and trawls, the Team concurred with the use of a single discard mortality rate for all hook & line fisheries.

Representatives from the GOA trawl industry requested that IPHC break out rex and flathead sole targets in the discard mortality rate analysis to see if these fisheries exhibit rates unique from other flatfish trawl fisheries in the area. These data will be provided for the November Team meetings.

Pacific halibut bycatch discard mortality rates recommended for 1995, from IPHC report.

Region/Target	1993	1992-93 Average	Recommendation for 1995
BSAI TRAWL			
MWT Pollock	90	89	89
Atka mackerel	56	59	59
Rock sole/Oflats	72	75	75
Pacific cod	62	65	65
BT Pollock	78	77	77
Rockfish	78	69	69
Yellowfin sole	75	76	76
Arrowtooth	-	-	49[1]
Grnld. turbot	-	-	48[1]
GOA TRAWL			
MWT Pollock	63	66	66
Rockfish	62	66	66
BT Pollock	81/54[2]	--	--
Shallwtr. flatfish	66	64	64
Pacific cod	56	58	58
Deepwtr. flatfish	59	59	59
BSAI H&L			
Pacific cod	18	18	18
Sablefish	14	17	17
Rockfish	-	-	24[1]
Grnld. turbot	21	19	19
GOA H&L			
Pacific cod	9	20	20
Sablefish	26	25	25
Rockfish	-	-	18[1]
BSAI POT			
Pacific cod	4	8	8
GOA POT			
Pacific cod	20	18	18

[1]Average of 1990 and 1991, the two most recent years.
[2]The first value is for at-sea processors, the second is for shore-based delivery vessels.

Appendix C: Seasonal Allocation of the Pollock TAC

Amendment 14 to the BS/AI Groundfish FMP provides for the allocation of the pollock TAC between a roe season (Jan. 1 - April 15) and a non-roe season (June 1 - Dec. 31). The Plan Team's report on this topic is attached as Appendix C.

Appendix D: Seasonal Allocation Prohibited Species (PSC) Apportionments

Amendments 16, 19 and 21 to the BS/AI Groundfish FMP provide for the allocation of bycatch apportionments to designated PSC fishery categories and on a seasonal basis. The Plan Team's report on this topic is attached as Appendix D.

Appendix E: Definitions of Common Acronyms

Although a conscientious attempt has been made to see that each acronym used in this SAFE report is defined at the point of its first occurrence, a collection of such definitions has also been included as Appendix E.

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Table 1-- Species categories established for management of the Bering Sea/Aleutian Islands groundfish fishery.

Prohibited Species[a]	Target Species[b]	Other Species[c]
FINFISHES		
Salmon	Walleye pollock	Sculpins
Pacific halibut	Pacific cod	Sharks
Pacific herring	Yellowfin sole	Skates
	Greenland turbot	Smelt
	Arrowtooth flounder	
	Rock sole	
	Other flatfish	
	Sablefish	
	Pacific ocean perch	
	Other rockfish	
	Atka mackerel	
INVERTEBRATES		
King crab	Squid	Octopus
Snow (Tanner) crab		

a. Species which must be returned to the sea when caught.
b. Species for which an individual TAC is established.
c. Species for which an aggregate TAC is established.

A nonspecified species category is also established to cover all species not listed above.

Table 2. Groundfish and squid catches (metric tons) in the eastern Bering Sea, 1954-1994.

Year	Pollock	Pacific Cod	Sable Fish	Pacific Ocean Perch	Other Rock Fish	Yellow Fin Sole	Greenland Turbot
1954						12,562	
1955						14,690	
1956						24,697	
1957						24,145	
1958	6,924	171	6			44,153	
1959	32,793	2,864	289			185,321	
1960			1,861	6,100		456,103	36,843
1961			15,627	47,000		553,742	57,348
1962			25,989	19,900		420,703	58,226
1963			13,706	24,500		85,810	31,565
1964	174,792	13,408	3,545	25,900		111,177	33,729
1965	230,551	14,719	4,838	16,800		53,810	9,747
1966	261,678	18,200	9,505	20,200		102,353	13,042
1967	550,362	32,064	11,698	19,600		162,228	23,869
1968	702,181	57,902	4,374	31,500		84,189	35,232
1969	862,789	50,351	16,009	14,500		167,134	36,029
1970	1,256,565	70,094	11,737	9,900		133,079	19,691
1971	1,743,763	43,054	15,106	9,800		160,399	40,464
1972	1,874,534	42,905	12,758	5,700		47,856	64,510
1973	1,758,919	53,386	5,957	3,700		78,240	55,280
1974	1,588,390	62,462	4,258	14,000		42,235	69,650
1975	1,356,736	51,551	2,766	8,600		64,690	64,819
1976	1,177,822	50,481	2,923	14,900		56,221	60,523
1977	978,370	33,335	2,718	2,654	311	58,373	27,708
1978	979,431	42,543	1,192	2,221	2,614	138,433	37,423
1979	913,881	33,761	1,376	1,723	2,108	99,017	34,998
1980	958,279	45,861	2,206	1,097	459	87,391	48,856
1981	973,505	51,996	2,604	1,222	356	97,301	52,921
1982	955,964	55,040	3,184	224	276	95,712	45,805
1983	982,363	83,212	2,695	221	220	108,385	43,443
1984	1,098,783	110,944	2,329	1,569	176	159,526	21,317
1985	1,179,759	132,736	2,348	784	92	227,107	14,698
1986	1,188,449	130,555	3,518	560	102	208,597	7,710
1987	1,237,597	144,539	4,178	930	474	181,429	6,533
1988	1,228,000	192,726	3,193	1,047	341	223,156	6,064
1989	1,230,000	164,800	1,252	2,017	192	153,165	4,061
1990	1,353,000	162,927	2,329	5,639	384	80,584	7,267
1991	1,268,360	165,444	1,128	4,744	396	94,755	3,704
1992	1,384,376	163,240	558	3,309	675	146,942	1,875
1993	1,301,574	133,156	669	3,763	190	105,809	6,330
1994 /c	642,785	127,826	637	359	122	54,603	6,474

Table 2. (continued)

Year	Arrow Tooth Flounder	Other Flat Fish	Rock Sole/b	Atka Mackerel	Squid	Other Species	Total (All Species)
1954							12,562
1955							14,690
1956							24,697
1957							24,145
1958						147	51,401
1959						380	221,647
1960	a						500,907
1961	a						673,717
1962	a						524,818
1963	a	35,643					191,224
1964	a	30,604				736	393,891
1965	a	11,686				2,218	344,369
1966	a	24,864				2,239	452,081
1967	a	32,109				4,378	836,308
1968	a	29,647				22,058	967,083
1969	a	34,749				10,459	1,192,020
1970	12,598	64,690				15,295	1,593,649
1971	18,792	92,452				13,496	2,137,326
1972	13,123	76,813				10,893	2,149,092
1973	9,217	43,919				55,826	2,064,444
1974	21,473	37,357				60,263	1,900,092
1975	20,832	20,393				54,845	1,645,232
1976	17,806	21,746				26,143	1,428,565
1977	9,454	14,393			4,926	35,902	1,168,144
1978	8,358	21,040		831	6,886	61,537	1,302,509
1979	7,921	19,724		1,985	4,286	38,767	1,159,547
1980	13,761	20,406		4,955	4,040	34,633	1,221,944
1981	13,473	23,428		3,027	4,182	35,651	1,259,666
1982	9,103	23,809		328	3,838	18,200	1,211,483
1983	10,216	30,454		141	3,470	15,465	1,280,285
1984	7,980	44,286		57	2,824	8,508	1,458,299
1985	7,288	71,179		4	1,611	11,503	1,649,109
1986	6,761	76,328		12	848	10,471	1,633,911
1987	4,380	50,372		12	108	8,569	1,639,121
1988	5,477	137,418		428	414	12,206	1,810,470
1989	3,024	63,452		3,126	300	4,993	1,630,382
1990	2,773	22,568		480	460	5,698	1,644,109
1991	12,748	30,401	46,681	2,265	544	16,285	1,647,455
1992	11,080	34,757	51,720	2,610	819	29,993	1,831,954
1993	7,950	28,812	63,942	201	597	21,413	1,674,406
1994 /c	8,637	17,108	56,421	1,244	124	16,274	932,614

a/ Included in Greenland turbot catch statistics.
b/ Rocksole prior to 1991 is included in other flatfish catch statistics.
c/ Data through August 6, 1994.

Table 3. Groundfish and squid catches (metric tons) in the Aleutian Islands region, 1962-1994.

Year	Pollock	Pacific Cod	Sable Fish	Pacific Ocean Perch /b	Other Rock Fish	Greenland Turbot	Yellow Fin Sole
1962				200			
1963			664	20,800		7	
1964		241	1,541	90,300		504	
1965		451	1,249	109,100		300	
1966		154	1,341	85,900		63	
1967		293	1,652	55,900		394	
1968		289	1,673	44,900		213	
1969		220	1,673	38,800		228	
1970		283	1,248	66,900		285	
1971		2,078	2,936	21,800		1,750	
1972		435	3,531	33,200		12,874	
1973		977	2,902	11,800		8,666	
1974		1,379	2,477	22,400		8,788	
1975		2,838	1,747	16,600		2,970	
1976		4,190	1,659	14,000		2,067	
1977	7,625	3,262	1,897	8,080	3,043	2,453	
1978	6,282	3,295	821	5,286	921	4,766	
1979	9,504	5,593	782	5,487	4,517	6,411	
1980	58,156	5,788	274	4,700	420	3,697	
1981	55,516	10,462	533	3,622	328	4,400	
1982	57,978	1,526	955	1,014	2,114	6,317	
1983	59,026	9,955	673	280	1,045	4,115	
1984	81,834	22,216	999	631	56	1,803	
1985	58,730	12,690	1,448	308	99	33	
1986	46,641	10,332	3,028	286	169	2,154	
1987	28,720	13,207	3,834	1,004	147	3,066	
1988	43,000	5,165	3,415	1,979	278	1,044	
1989	156,000	4,118	3,248	2,706	481	4,761	
1990	73,000	8,081	2,116	14,650	864	2,353	
1991	78,104	6,714	2,071	2,545	549	3,174	1,380
1992	54,036	42,889	1,546	10,277	3,689	895	4
1993	57,184	34,234	2,078	13,375	495	2,138	0
1994 /c	46,734	20,821	1,310	10,995	241	2,461	0

Table 3. (continued)

Year	Rock Sole	Other Flat Fish	Arrow Tooth Flounder	Atka Mackerel	Squid	Other Species	Total (All Species)
1962							200
1963			a				21,471
1964			a			66	92,652
1965			a			768	111,868
1966			a			131	87,589
1967			a			8,542	66,781
1968			a			8,948	56,023
1969			a			3,088	44,009
1970			274	949		10,671	80,610
1971			581			2,973	32,118
1972			1,323	5,907		22,447	79,717
1973			3,705	1,712		4,244	34,006
1974			3,195	1,377		9,724	49,340
1975			784	13,326		8,288	46,553
1976			1,370	13,126		7,053	43,465
1977			2,035	20,975	1,808	16,170	67,348
1978			1,782	23,418	2,085	12,436	61,092
1979			6,436	21,279	2,252	12,934	75,195
1980			4,603	15,533	2,332	13,028	108,531
1981			3,640	16,661	1,763	7,274	104,199
1982			2,415	19,546	1,201	5,167	98,233
1983			3,753	11,585	510	3,675	94,617
1984			1,472	35,998	343	1,670	147,022
1985			87	37,856	9	2,050	113,310
1986			142	31,978	20	1,509	96,259
1987			159	30,049	23	1,155	81,364
1988			406	21,656	3	437	77,383
1989			198	14,868	6	108	186,494
1990			1,459	21,725	11	627	124,886
1991	n/a	88	938	22,258	30	91	117,942
1992	236	68	900	46,831	61	3,081	164,513
1993	318	59	1,348	65,805	85	2,540	179,659
1994	308	52	1,213	70,662	86	1,038	155,921

a/ Included in Greenland turbot catch statistics.
b/ Includes POP shortraker, rougheye, northern and sharpchin rocksole.
c/ Data through August 6, 1994.

Table 4- Apportionments of total allowable catches (t) for groundfish of the eastern Bering Sea and Aleutian Islands region, 1977-1993.

	1977	1978	1979	1980	1981
Eastern Bering Sea[a]					
Walleye pollock	950,000	950,000	950,000	1,000,000	1,000,000
Yellowfin sole	106,000	126,000	126,000	117,000	117,000
Greenland turbot	-	-	-	90,000	90,000
Arrowtooth flounder[b]	-	-	-	-	-
Other flatfish[c]	100,000	159,000	159,000	61,000	61,000
Pacific cod	58,000	70,500	70,500	70,700	78,700
Sablefish	5,000	3,000	3,000	3,500	3,500
Pacific ocean perch	6,500	6,500	6,500	3,250	3,250
Other rockfish	-	-	-	7,727	7,727
Squid	10,000	10,800	10,000	10,000	10,000
Other species	59,600	66,600	66,600	74,249	74,249
Aleutians[a]					
Walleye pollock	-	-	-	100,000	100,000
Sablefish	2,400	1,500	1,500	1,500	1,500
Pacific ocean perch	15,000	15,000	15,000	7,500	7,500
Other rockfish	-	-	-	-	-
Atka mackerel	-	24,800	24,800	24,800	24,800
Other species	34,000	34,000	34,000	-	-
Optimum yield	1,346,500	1,467,700	1,466,900	1,571,226	1,579,226

a/ Total allowable catches are for the eastern Bering Sea and Aleutian Islands areas combined for pollock in 1977-79, other rockfish in 1980-83, other species in 1980-85, and in all years for yellowfin sole, turbot, other flounders, Pacific cod, and squid.
b/ Combined with Greenland turbot until 1986.
c/ Excludes halibut but includes turbot until 1980.
d/ Optimum yield = sum of total allowable catches.

Table 4-- Continued.

	1982	1983	1984	1985	1986
Eastern Bering Sea[a]					
Walleye pollock	1,000,000	1,000,000	1,200,000	1,200,000	1,200,000
Yellowfin sole	117,000	117,000	230,000	226,900	209,500
Greenland turbot	90,000	90,000	59,610	42,000	33,000
Arrowtooth flounder[b]	-	-	-	-	20,000
Other flatfish[c]	61,000	61,000	111,490	109,900	124,200
Pacific cod	78,700	120,000	210,000	220,000	229,000
Sablefish	3,500	3,500	3,740	2,625	2,250
Pacific ocean perch	3,250	3,250	1,780	1,000	825
Other rockfish	7,727	7,727	1,550	1,120	825
Squid	10,000	10,000	8,900	10,000	5,000
Other species	74,249	77,314	40,000	37,580	27,800
Aleutians[a]					
Walleye pollock	100,000	100,000	100,000	100,000	100,000
Sablefish	1,500	1,500	1,600	1,875	4,200
Pacific ocean perch	7,500	7,500	2,700	3,800	6,800
Other rockfish	-	-	5,500	5,500	5,800
Atka mackerel	24,800	24,800	23,130	37,700	30,800
Other species	-	-	-	-	-
Optimum yield[d]	1,579,226	1,623,591	2,000,000	2,000,000	2,000,000

a/ Total allowable catches are for the eastern Bering Sea and Aleutian Islands areas combined for pollock in 1977-79, other rockfish in 1980-83, other species in 1980-85, and in all years for yellowfin sole, turbot, other flounders, Pacific cod, and squid.
b/ Combined with Greenland turbot until 1986.
c/ Excludes halibut but includes turbot until 1980.
d/ Optimum yield = sum of total allowable catches.

Table 4-- Continued.

	1987	1988	1989	1990	1991
Eastern Bering Sea[a]					
Walleye pollock	1,200,000	1,300,000	1,340,000	1,319,039	1,300,000
Yellowfin sole	187,000	254,000	193,952	176,502	114,750
Greenland turbot	20,000	11,200	8,000	7,000	5,950
Arrowtooth flounder[b]	9,795	5,531	7,800	10,533	17,000
Other flatfish[c]	148,300	131,369	63,906	51,128	54,974
Rock Sole	-	-	77,148	67,359	76,500
Pacific cod	280,000	200,000	226,079	199,975	194,650
Sablefish	3,700	3,400	2,800	2,294	2,634
Pacific ocean perch	2,850	5,000	4,250	6,300	-
True POP	-	-	-	-	4,570
Other POP complex	-	-	-	-	1,420
Other rockfish	450	400	340	500	400
Squid	500	1,000	925	925	1,200
Other species	15,000	10,000	15,774	28,584	18,000
Aleutians[a]					
Walleye pollock	88,000	45,000	26,950	85,000	85,000
Sablefish	4,000	5,000	3,400	3,826	3,200
Pacific ocean perch	8,175	6,000	5,100	16,600	-
True POP	-	-	-	-	9,159
Other POP complex	-	-	-	-	3,982
Other rockfish	1,430	1,100	935	935	786
Atka mackerel	30,800	21,000	20,285	23,500	24,000
Other species	-	-	-	-	-
Optimum yield[d]	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000

a/ Total allowable catches are for the eastern Bering Sea and Aleutian Islands areas combined for pollock in 1977-79, other rockfish in 1980-83, other species in 1980-85, and in all years for yellowfin sole, turbot, other flounders, Pacific cod, and squid. 1992 pollock in EBS includes Bogoslof

b/ Combined with Greenland turbot until 1986.

c/ Excludes halibut but includes turbot until 1980, and includes rock sole until 1989.

d/ Optimum yield = sum of total allowable catches plus unallocated reserves.

e/ Through October 20.

Table 4-- Continued.

	1992	1993[e]
Eastern Bering Sea[a]		
Walleye pollock	1,241,000	1,330,000
Yellowfin sole	199,750	150,325
Greenland turbot	5,950	4,667
Arrowtooth flounder[b]	8,500	10,000
Other flatfish[c]	67,150	56,000
Rock Sole	40,000	75,000
Pacific cod	176,700	191,000
Sablefish	1,190	540
Pacific ocean perch	3,540	1,910
Other red rockfish	1,190	1,400
Other rockfish	400	365
Squid	1,700	3,110
Other species	27,200	26,390
Atka mackerel		13,475
Aleutians[a]		
Walleye pollock	48,580	57,600
Sablefish	2,550	2,800
Pacific ocean perch	9,945	10,900
Sharpchin/Northern	4,820	5,670
Shortraker/rougheye	1,220	1,220
Other rockfish	786	770
Atka mackerel	47,000	54,525[f]
Other species	-	-
Greenland Turbot		2,333
Optimum yield[d]	1,999,855	2,000,000

a/ Total allowable catches are for the eastern Bering Sea and Aleutian Islands areas combined for pollock in 1977-79, other rockfish in 1980-83, other species in 1980-85, and in all years for yellowfin sole, turbot, other flounders, Pacific cod, and squid. 1992 pollock in EBS includes Bogoslof.
b/ Combined with Greenland turbot until 1986.
c/ Excludes halibut but includes turbot until 1980, and includes rock sole until 1989.
d/ Optimum yield = sum of total allowable catches plus unallocated reserves.
e/ Thru October 31, 1993.
f/ 12,600 mt released from the non-specific reserve.

Table 5-- Bering Sea/Aleutian Islands groundfish apportionments and foreign allocations in metric tons, 1987-1994.

	1987	1988	1989	1990	1991	1992	1993	1994
ABC	2,245,780	2,876,100	2,700,700	2,938,500	2,932,485	2,773,355	2,476,245	2,656,435
TAC	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	1,999,855	1,998,620	2,000,000
DAP	336,723	708,520	1,341,387	1,742,008	1,918,175	1,889,171	1,864,445	1,700,000
JVP	1,484,110	1,282,784	656,257	257,992	0	0	0	0
CDQ	-	-	-	-	-	101,445	101,445	104,070
Reserve	46,471	8,696	2,356	0	81,825	110,684	32,730	300,000
TALFF	132,696	0	0	0	0	0	0	0
Japan	101,446	0	0	0	0	0	0	0
ROK	29,900	0	0	0	0	0	0	0
China	1,350	0	0	0	0	0	0	0

Table 6-- Summary of stock abundance, overfishing constraints, and fishing mortality rates for the eastern Bering Sea (EBS), Aleutian Islands (AI), and Bogoslof district (518) in 1995. Biomass and catch are in metric tons.

Species	Area	Biomass[a]	OFL[b]	F_{OFL}[c]	F_{ABC}[d]
Walleye pollock	EBS	8,020,000[e]	1,590,000	0.38	0.37
	AI	189,000	60,400	0.45	0.42
	518	490,000	147,000	0.40	0.33
Pacific cod		925,000	228,000	0.43	0.35
Yellowfin sole		1,880,000	269,000	0.14	0.12
Greenland turbot		165,000	24,800	0.34	0.23
Arrowtooth flounder		519,000	130,000	0.25	0.18
Rock sole		1,790,000	363,000	0.22	0.18
Other flatfishes		1,240,000	270,000	0.22[f]	0.18[f]
Sablefish	EBS	4,600	670	0.17	0.13
	AI	23,900	3,490	0.17	0.13
POP complex					
True POP	EBS	48,400	2,920	0.10	0.06
Other red rockfish[g]	EBS	29,700	1,400	0.05[f]	0.05[f]
True POP	AI	244,000	16,600	0.10	0.06
Sharp/Northern[h]	AI	94,500	5,670	0.06	0.06
Short/Rougheye[i]	AI	45,000	1,220	0.03	0.03
Other rockfish	EBS	7,300	365	0.05	0.05
	AI	15,500	770	0.05	0.05
Atka mackerel		816,000	484,000	0.88	0.37
Other species		706,000	141,000	0.20	0.04

a/ Projected exploitable biomass for January, 1994.
b/ Maximum 1994 catch level allowable under overfishing definition (the "overfishing level").
c/ Maximum fishing mortality rate allowable under overfishing definition.
d/ Fishing mortality rate corresponding to acceptable biological catch.
e/ B_{MSY} for walleye pollock is 6,000,000 t.
f/ Weighted average of species-specific rates.
g/ Sharpchin, northern, shortraker, and rougheye rockfish.
h/ Sharpchin and northern rockfish
i/ Shortraker and rougheye rockfish.

Table 7-- Estimates of maximum sustainable yield (MSY) and acceptable biological catch (ABC) for 1994 (Council) and 1995 (Plan Team) for groundfish in the eastern Bering Sea (EBS), Aleutian Islands (AI), and Bogoslof district (518). Where current MSY estimates encompass a range of values, the midpoint has been listed. Figures are in metric tons. MSY total is reported to three significant digits.

Species	Area	MSY[a]	ABC(1994) Council	ABC(1995) Plan Team
Walleye pollock	EBS	1,880,000	1,330,000	1,330,000
	AI	145,000	56,600	56,600
	518	n/a[b]	31,750	127,000
Pacific cod		n/a[b]	191,000	191,000
Yellowfin sole		365,000	230,000	230,000
Greenland turbot		n/a[b]	7,000	17,200
Arrowtooth flounder		62,800	93,400	93,400
Rock sole		184,000	313,000	313,000
Other flatfish		151,000	225,000	225,000
Sablefish	EBS	n/a[b]	540	540
	AI	n/a[b]	2,800	2,800
POP complex				
True POP	EBS	n/a[b]	1,910	1,910
Other red rockfish[c]	EBS	n/a[b]	1,400	1,400
True POP	AI	n/a[b]	10,900	10,900
Sharp/Northern[d]	AI	n/a[b]	5,670	5,670
Short/Rougheye[e]	AI	n/a[b]	1,220	1,220
Other rockfish	EBS	n/a[b]	365	365
	AI	n/a[b]	770	770
Atka mackerel[f]		n/a[b]	122,500	122,500
Squid		10,000	3,110	g
Other species		61,900	27,500	30,610
Groundfish complex		2,860,000	2,656,435	2,761,885

a/ Maximum sustainable yield (note: numbers in this column correspond to MSY estimates given by chapter authors, and may or may not be endorsed by the Plan Team).
b/ Not available.
c/ Sharpchin, northern, shortraker, and rougheye rockfish.
d/ Sharpchin and northern rockfish.
e/ Shortraker and rougheye rockfish.
f/ The ABC for Atka mackerel was estimated by the author at 245,000 t, but the Plan Team adopted the Council estimate of 122,500 t. The Plan Team also recommends dividing the Atka mackerel ABC among three districts, as described in the text.
g/ Included in other species.

Table 8-- Summary of stock biomass, harvest strategy, 1995 acceptable biological catch (ABC), and stock condition for groundfish in the eastern Bering Sea (EBS), Aleutian Islands (AI), and Bogoslof district (518). Biomass and ABC are in metric tons.

Species	Area	Biomass[a]	Rate[b]	ABC	Relative abundance, trend
Walleye pollock	EBS	8,020,000	$F_{0.1}$	1,330,000	Average, stable
	AI	189,000	$F_{35\%}$	56,600	Average (?), stable (?)
	518	490,000	$F_{35\%}$	127,000	Low, stable
Pacific cod		925,000	$F_{35\%}$	191,000	Average, stable
Yellowfin sole		1,880,000	$F_{35\%}$	230,000	High, stable
Greenland turbot		165,000	$F_{35\%}$	17,200	Low, declining
Arrowtooth flounder		519,000	$F_{35\%}$	93,400	High, stable
Rock sole		1,790,000	$F_{35\%}$	313,000	High, stable
Other flatfish		1,240,000	$F_{35\%}$[c]	225,000	High, stable
Sablefish	EBS	4,600	$F_{35\%}$[d]	540	Low, declining
	AI	23,900	$F_{35\%}$[d]	2,800	Average, declining
POP complex					
True POP	EBS	48,400	$F_{44\%}$	1,910	Average, stable
Other red rockfish[e]	EBS	29,700	$F=M$[f]	1,400	Not available
True POP	AI	244,000	$F_{44\%}$	10,900	Average, stable
Sharp/Northern[f]	AI	94,500	$F=M$[f]	5,670	Not available
Short/Rougheye[g]	AI	45,000	$F=M$[f]	1,220	Not available
Other rockfish	EBS	7,300	$F=M$	365	Average, stable
	AI	15,500	$F=M$	770	Average, stable
Atka mackerel		816,000	$F=M$[h]	245,000	High, stable
Other species		706,000	$F=M$	30,610	High, increasing
Groundfish complex				2,884,385[1]	High, stable

a/ Projected exploitable biomass for January, 1994.
b/ Harvest strategy used to compute ABC.
c/ Weighted average of species-specific rates.
d/ Sablefish $F_{35\%}$ scaled by ratio of projected biomass to $B_{35\%}$.
e/ Sharpchin, northern, shortraker, and rougheye rockfish.
f/ Sharpchin and northern rockfish.
g/ Shortraker and rougheye rockfish.
h/ Ratio of catch to start-of-year biomass equals M (0.3); corresponding F is actually somewhat higher (about 0.37).
i/ Not available.
j/ Fishing mortality rate corresponding to the historic average catch.
k/ Includes squid.

[1] Total ABC in this Table uses the author's estimate of ABC for Atka mackerel (245,000 t) instead of the Council estimate of 122,500 t.

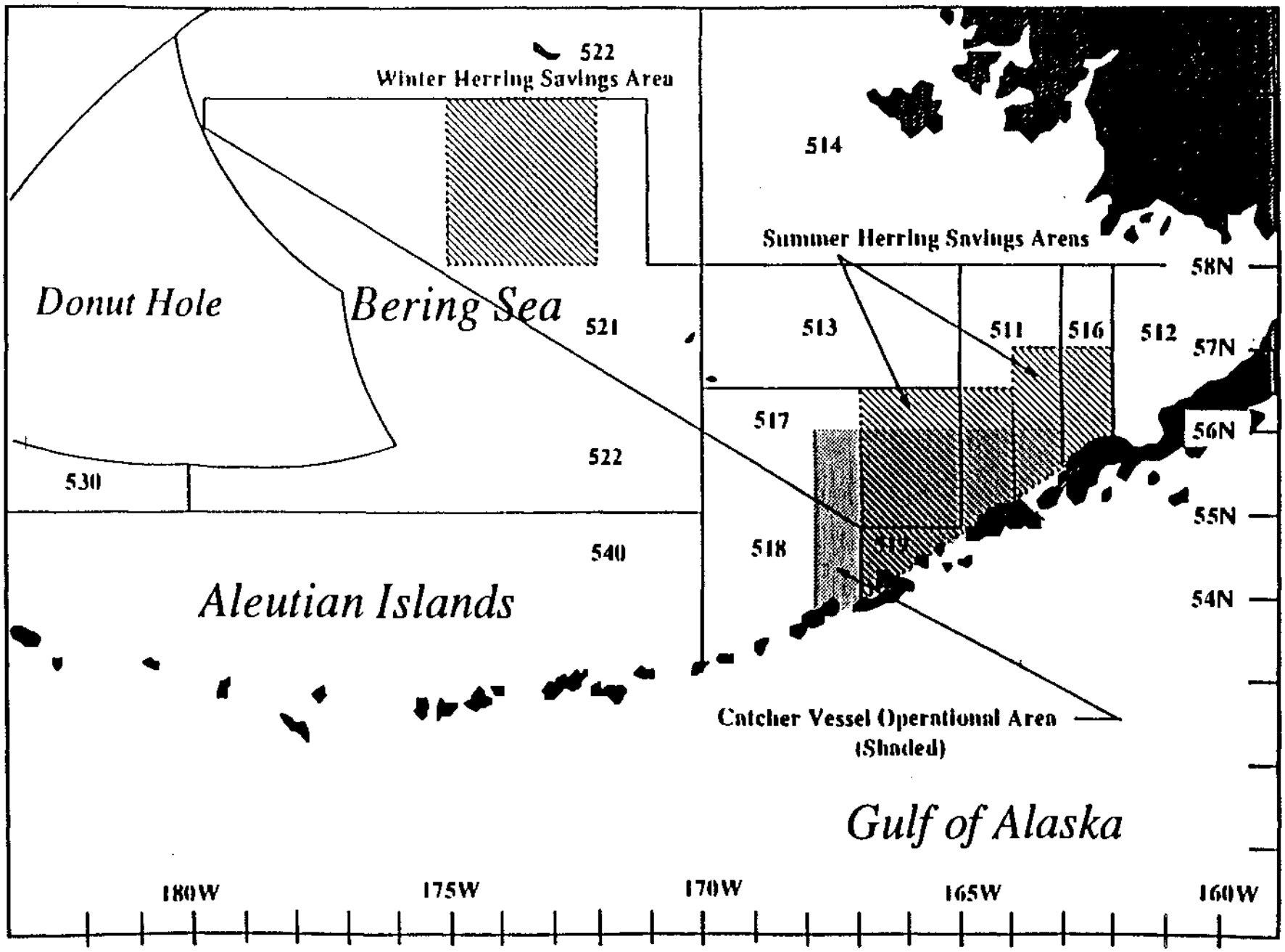
522
Winter Herring Savings Area
514
Summer Herring Savings Arens
58N
Donut Hole
Bering Sea
521
513
511
516
512
57N
517
56N
522
530
55N
540
518
519
Aleutian Islands
54N
Catcher Vessel Operational Aren
(Shaded)
Gulf of Alaska
180W
175W
170W
165W
160W

Figure 1