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PRELIMINARY
STOCK ASSESSMENT AND FISHERY EVALUATION REPORT FOR THE GROUNDFISH RESOURCES OF THE GULF OF ALASKA AS PROJECTED FOR 1995

by the

Plan Team for the Groundfish Fisheries
of the
Gulf of Alaska
of the
North Pacific Fishery Management Council

Submitted to the

NORTH PACIFIC ANADROMOUS FISH COMMISSION

by the

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STOCK ASSESSMENT AND FISHERY EVALUATION REPORT FOR THE GROUNDFISH RESOURCES OF THE GULF OF ALASKA AS PROJECTED FOR 1995

ABSTRACT

The Gulf of Alaska Groundfish Plan Team of the North Pacific Fishery Management Council has assessed the status of the groundfish resources in the Gulf of Alaska through August 1994 and estimated their acceptable biological catches (ABCs) for 1995. The recommendations will form the biological basis for management of the resources by the Council in 1995. The ABC for the Gulf of Alaska groundfish resources total 535,110 t, down 17,940 t from 1994. By species groups, the preliminary ABCs are: Pollock (65,360 t), Pacific cod (103,000 t), Deep water flatfish (14,590 t), Rex sole (11,210 t), Shallow water flatfish (52,270 t), Flathead sole (28,790 t), Arrowtooth flounder (198,130 t), sablefish (25,500 t), Pacific ocean perch (6,800 t), Shortraker/Rougheye rockfish (1,910 t), Nothern rockfish (5,270 t), Other slope rockfish (6,930 t), Pelagic shelf rockfish (5,190 t), Black rockfish (400 t), Demersal shelf rockfish (960 t), Atka mackerel (6,480 t), and Thornyhead rockfish (2,320 t). The Plan Team will update the stock assessments again in November for review by the Council at its December meeting when the ABC levels will be finalized.

SUMMARY

by

The Plan Team for the Groundfish Fisheries
of the Gulf of Alaska

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 Plan Team for the Fishery Management Plan for Groundfish of the Gulf of Alaska met in Seattle on August 29 through September 2, 1994 to review the status of stocks of fifteen species or species groups that are managed under the FMP. The Plan Team review was based on presentations by Alaska Department of Fish and Game and Alaska Fisheries Science Center scientists, results from the NMFS 1993 Gulf of Alaska trawl surveys, the 1992 longline surveys, the 1993 Shelikof Strait hydroacoustic survey. Members of the Plan Team who compiled the SAFE report were Sandra Lowe, (chair), Jane DiCosimo (plan coordinator), Kaja Brix, Sam Wright, Tory O'Connell for Barry Bracken, Rich Ferrero, Lew Haldorsen, Jeff Fujioka, Gregg Williams, Jim Ianelli, and Jim Hastie.

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.

The FMP recognizes single species and species complex management strategies. Single species management is recommended for stocks which are easily targeted by the harvesting sector, and for which minimal mixing of other species occurs in the targeted catch. In the Gulf of Alaska, Pacific cod, pollock, sablefish, Pacific ocean perch, northern rockfish, flathead sole and arrowtooth flounder have been managed as single species. Other groundfish species that are usually caught in groups have been managed as complex assemblages. For example, shortraker and rougheye rockfish, other slope rockfish, pelagic shelf rockfish, demersal shelf rockfish, thornyhead rockfish, deepwater flatfish, shallow water flatfish, and other groundfish have been managed as complexes. The FMP, however, authorizes splitting species, or groups of species, from the complexes for purposes of promoting the goals and objectives of the FMP. Atka mackerel was split out from "other species" beginning in 1994. The Plan Team is recommending separating out black rockfish from the pelagic shelf rockfish group for 1995.

Fishermen do not always catch species in a complex in proportion to the species composition, i.e., certain segments of the complex may be more easily harvested than others, or they may be more valuable. Consequently, the implicit risk in species complex management is that one or more of the species in the complex may be over or underharvested. Recognition of this risk is important. Alternative management strategies can be imposed to limit the risk including removing a species from a complex and managing as a single species, or reducing the quota of the complex to protect the more vulnerable species. The Plan Team gave close scrutiny to the species composition of the catch from the species complex management units and made recommendations for adjustments as required.

Except where the State of Alaska manages separate groundfish harvests quotas specified in 5 Alaska Administrative Code (AAC) 28.160, all groundfish catches in waters of the State of Alaska, including internal waters, are managed against TAC specifications. The exceptions pertain to guideline harvest ranges for sablefish and demersal shelf rockfish in the inside subdistricts of the southeast subdistrict as defined at 5 AAC 28.105 Description of Districts, Subdistricts, and Sections.

NEW INFORMATION

Since the 1994 Stock Assessment and Fishery Evaluation Report (SAFE) was issued (NPFMC 1993), the following new information has become available:

1. For pollock: a) the 1993 bottom trawl survey biomass estimate; b) a revised egg production estimate of spawning biomass for 1991; c) the 1994 Shelikof Strait hydroacoustic biomass estimate; d) length-frequency data from the 1990-1994 hydroacoustic surveys; e) estimates of catch-at-age from the 1992 and 1993 fisheries; and f) updated estimates of discard and catch.

2. For Sablefish: data from the 1993 Cooperative and Domestic Longline Surveys were incorporated into the assessment.

3. For Pacific cod: the stock reduction analysis (SRA) used to model stock abundance and project future catches has been replaced with a length-based stock synthesis (SS) model, which accounts for fish not assessed by the NMFS longline survey.

4. For Flatfish: SRA model replaced by SS model for arrowtooth flounder.

5. For Slope rockfish: a) species composition data for the shortraker rougheye and "other slope rockfish" subgroups in the 1992 and 1993 commercial fishery; b) age composition data for Pacific ocean perch in the 1993 trawl survey; c) biomass estimates and age compositions from the 1993 survey and length data from the 1992 fishery.

6. For Pelagic shelf rockfish: a) biomass estimates from the 1993 survey; and b) revised biomass estimates for dusky rockfish in the 1984, 1987, and 1990 triennial trawl surveys.

7. For Thornyheads: a) the 1990 and 1993 trawl surveys did not extend into deeper waters (2,500m) where concentrations of larger thornyheads are known to exist; and b) natural mortality was revised from 0.05 to 0.07.

8. For groundfish, generally: a) harvest and discard data from the NMFS Observer Program Office for 1994 were available; and b) results of the 1993 triennial trawl survey.

BACKGROUND INFORMATION

Management Areas and Species

The Gulf of Alaska (GOA) management area lies within the 200-mile U.S. Exclusive Economic Zone (EEZ) of the United States (Figure 1). Four categories of finfishes and invertebrates have been designated for management purposes. They are prohibited species, target species, other species and non-specified species. Fish species or complexes included in each category are listed below.

Target Species	Other Species	Prohibited Species
Pollock	Octopus	Pacific halibut
Pacific cod	Squid	Pacific herring
Flounders	Sculpins	Pacific salmon
Rockfishes	Sharks	Steelhead trout
Sablefish	Skates	King crab
Atka mackerel	Eulachon	Tanner crab
	Smelts	
	Capelin	

All other species of fish and invertebrates taken incidentally that are not managed hy other FMPs and are associated with groundfish fisheries are designated as "non-specified species" and catch records need not be kept. A species or species group from within the target species category may be split out and assigned an appropriate harvest level. Similarly, species in the target species category may be combined and a single harvest level assigned to the new aggregate species group. The harvest level for demersal shelf rockfish in the Eastern Regulatory Area is specified by the Council each year. However, management of this fishery is deferred to the State of Alaska with Council oversight.

This SAFE report describes stock status of target species only.

Biological Reference Points

A number of biological reference points are used in this SAFE. 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 GOA Groundfish FMP, and two policy statements adopted jointly by the Plan Team and its Bering Sea/Aleutian Islands 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 21 to the GOA 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. 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 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 ASSESSMENTS

The current status of individual groundfish stocks managed under the FMP are summarized in this section. The abundance of Pacific cod and arrowtooth flounder is above target stock size. The abundance of sablefish is near target stock size. The abundance of pollock and Pacific ocean perch is below target stock size. The relative abundance of deep-water flatfish, shallow-water flatfish, flathead sole, demersal shelf rockfish, northern rockfish, pelagic shelf rockfish, other slope rockfish, and thornyheads and Atka mackerel is unknown.

Tables 1 and 2 provide a summary of the current status of the groundfish stocks, including estimated maximum sustainable yields, catch statistics, ABCs, and TACs for 1994, and recommendations for ABCs for 1995. Fishing mortality rates used to set these specifications are listed in Table 3. ABCs and TACs are specified for each of the Gulf of Alaska regulatory areas illustrated in Figure 1. Table 4 provides historical groundfish catches in the GOA, 1956-1994.

The sum of the preliminary 1995 ABCs for target species is 535,110 mt, which is within the FMP-approved optimum yield (OY) of 116,000-800,000 mt for the Gulf of Alaska. The Team notes that because of halibut bycatch mortality considerations in the high-biomass flatfish fisheries, an overall OY for 1994 will be considerably under this upper limit. For perspective, the sum of the TACs was 304,589 mt in 1994, compared with a combined ABC of 553,050 mt.

WALLEYE POLLOCK

YEAR	ABC	EXPLOITABLE BIOMASS[1]	CATCH
1993	160,400	1,062,000	108,591
1994	109,300	726,000	86,650[2]
1995	65,360	546,000	

1/ Biomass estimates for Western and Central Gulf of Alaska.
2/ Western/Central catch reported through August 6, 1994.

The exploitable biomass estimates from 1993 and 1994 are from the stock synthesis (SS) model as determined in those years. The 1995 biomass is estimated at 546,000 mt from the current SS analysis using an Full Recruitment Fishing Mortality of 0.2. Comparisons of the 1995 biomass to previous levels should be made with biomass levels from the revised hindcast in the current assessment.

New sources of information for the 1995 SAFE include: a) the 1993 bottom trawl survey biomass estimate; b) a revised egg production estimate of spawning biomass for 1991; c) the 1994 Shelikof Strait hydroacoustic biomass estimate; d) length-frequency data from the 1990-1994 hydroacoustic surveys; e) estimates of catch-at-age from the 1992 and 1993 fisheries; and f) updated estimates of discard and catch.

The 1994 hydroacoustic survey utilized the same equipment as in 1993 with improved detectability of pollock in low density situations, and improved measurements from the near-bottom region. The 1994 Shelikof Strait biomass estimate based on the new system is 467,300 mt (similar to the 1993 estimate of 408,000 mt). A value of 366,800 mt is the best estimate of biomass that would have been obtained had the old system been utilized in 1994, and should be used for comparison to previous hydroacoustic estimates.

Length frequency data from the 1994 hydroacoustic survey shows the progression of the strong 1988 year class through the population. A bimodal distribution of population numbers suggests that the 1993 year class may be an important contributor to the future pollock fishery.

The 1992 hydroacoustic age composition showed the 1987 year class as the dominant age group. Previously, the 1987 year class was estimated as below average. Subsequent reevaluation of otoliths from this survey resulted in a change in the aging criteria. For this year's assessment the 1990-1994 hydroacoustic length frequency data were used in the SS model instead of the age composition data.

The Team evaluated two stock synthesis (SS) models that differed as follows: Model A provides a comparison to the 1993 model configuration. Model B is similar to A, but combined several years with similar selectivity curves to reduce the number of parameters used in the model. Model B was configured with a single curve for the period 1989-90 and the period 1992-95. Based on the exploratory runs and the data presented to the Team, the Team agreed that Model B was more appropriate.

Estimates of various fishing mortality rates based on biological reference points were determined from a dynamic pool model and an age-structured model. The estimated $F_{0.1}$, $F_{30\%}$, $F_{35\%}$ and $F_{40\%}$ full-selection fishing mortality rates were 0.70, 0.51, 0.43, and 0.37, respectively. Additionally, the long term productive potential of the pollock stock was explored with a stochastic age structured simulation with different recruitment scenarios. Projections were made over a 70-year time horizon with 30 Monte Carlo replications. The risk associated with a given fishing strategy was measured by monitoring the frequency that the spawner biomass fell below the threshold level during the last 50 year segment of the 70 year projection. The threshold level was defined as 20% of the unfished spawner biomass level.

To reflect recent recruitment conditions, the probability of a strong year class was set at 0.2, which is lower than the estimated probability if all of the recruitment data was used (0.4). However, as in past years, the threshold spawner biomass level was estimated from model results that assumed a higher probability of a strong year class (0.4), calculated by using all of the recruitment data. The rationale behind this decision was that the threshold spawner biomass stock level (20% of the pristine level) should reflect the entire recruitment history of the stock. The Team agreed with this procedure, although they noted concerns over the specification and implications of the threshold level.

In order to estimate an optimal fishing mortality rate, the tradeoffs between increased yield and the risk of falling below the threshold were evaluated. The optimal fishing mortality rate that simultaneously maximized yield and minimized risk was determined to be 0.3 (full selection value). This fishing mortality rate was associated with a yield of 90,000 mt which is the stock assessment authors' recommended ABC.

In 1993, the Plan Team requested that additional exploitation strategies be explored and recommended an ABC based on the fishing mortality rate that produced a minimal (5%) probability of falling below the threshold spawner biomass level in the long-term (F0.2). The yield associated with an F of 0.2 is 62,000 mt. Stock projections were made for the optimal F of 0.3 and the minimal probability F of 0.2 in the current assessment. Based on the results of these projections, the Plan Team recommended an ABC of 62,000 mt for the Western/Central (W/C) Gulf for 1995. The Plan Team chose this exploitation strategy because of recent trends in poor recruitment of Gulf of Alaska pollock and ecosystem considerations.

The Team notes that although a fishing rate may be chosen for its optimal performance over the long term, it may not be the optimal rate for the short term, especially in regard to the risk of overfishing. Such a rate is one that would be chosen when conditions were expected to be average and if there was no provision for adjustment according to changing conditions. Under current conditions, continued use of the long term optimal F (0.3) results in biomass projections below threshold biomass by 1997. The

Team remains concerned about the downward trend in pollock biomass and its approach to the threshold biomass reference point and is unaware of any compelling reason to adhere to a constant fishing rate. We note that even with the more conservative F (0.2), which had only a 5% probability of falling below the threshold over the long term, the biomass is still likely to go below the threshold, now that the stock is at a low level, and expected recruitment is pessimistic. Suggestions were made for exploring short-term strategies that take into account the current stock level and knowledge of expected recruitment. Additional sources of stock information brought to our attention will be explored.

The Plan Team recommended that the ABC be apportioned according to the most recent distribution of biomass from the 1993 bottom trawl survey: 49% in the Shumagin area (30,380 mt), 24.7% in the Chirikof area (15,310 mt), and 26.3% in the Kodiak area (16,310 mt).

The overfishing mortality rate is $F_{30\%}=0.51$ which corresponds to a harvest of 266,000 mt for the Western and Central Gulf of Alaska. Therefore, pollock are not considered overfished at the ABC level.

The Team noted the lack of any new information with which to set an ABC for the Eastern Gulf. Lack of age composition data has precluded any age-structured analysis similar to that conducted for the Western and Central areas. However, analysis of Eastern Gulf length frequency data show that recruitment patterns appear similar to that observed in the Western and Central Gulf. Thus, the Team agreed that it would be appropriate to apply the ratio of current ABC to 1993 Western and Central survey biomass to the Eastern Gulf 1993 biomass estimate. The recommended Eastern Gulf ABC is 3,360 mt. Similarly, the overfishing level for the Eastern Gulf is 14,396 mt.

TAC considerations

The team recommends an ABC of 62,000 mt for the Western and Central area based on an analysis of pollock fisheries and survey data. The model results are believed to provide a reasonable characterization of these data and the anticipated trend of the Gulf pollock population. The team agreed that this ABC is biologically defensible given the assumptions used in the model. However, the Team noted that a lower exploitation rate could have benefits to the fishery and would help to address the specific TAC considerations listed below:

1) maintaining the pollock population above threshold levels.

2) limiting forage fish removals important to marine mammals and seabirds.

3) increasing the likelihood of higher long term yields.

Specific concerns are as follows:

1) Results of the stock synthesis model runs indicate that the Gulf of Alaska pollock biomass bas been declining since the mid-1980s. Projections for 1995-97 based on model B (used in computing ABC) show declines in both mid-year and spawning biomass levels which are among the lowest ever observed. Spawning biomass for 1996 is predicted to approach historic lows and to drop below threshold level in 1997.

2) Our current knowledge of this stock suggests that a single above average year class (1988) will be supporting the stock for the next few years, given that the older portion of the population (age 6+ years) is declining and the 1991 and 1992 year classes are not expected to be strong.

3) One interpretation of the differences in pollock recruitment patterns between the 1970s and 1980s shown by SS results is that the Gulf of Alaska ecosystem is undergoing changes which influence carrying capacity for pollock. Declines in some upper trophic level predators, such as Steller sea lions, harbor seals and marine birds, and increases in others, such as arrowtooth flounder and halibut over this period, further suggest that unexplained large scale changes are occurring. While the pollock fishery/sea lion relationship is uncertain, the team feels that limiting removals of pollock may be appropriate given the current low pollock stock level and continued sea lion population decline.

PACIFIC COD

YEAR	ABC	Age 3+ BIOMASS[1]	CATCH
1993	56,700	324,000	55,994
1994	50,400	296,000	46,391[2]
1995	103,000	542,000	

1/ Biomass values for 1993 and 1994 are from previous years' assessments.
2/ Catch reported as of August 6, 1994

The preliminary length-based stock synthesis model presented in the 1994 SAFE was expanded and used as the primary assessment model this year. The Plan Team supports this transition because more data from the fisheries and surveys can be used.

The projected biomass (ages three and above) for 1995 is 542,000 mt, up considerably from the 1994 projection of 296,000 mt from last year's SRA model. The Plan Team recognized the reasons for this change and accepted the authors' conclusions in fitting the model. The data indicate that the trawl surveys do not sample the adult population completely and that a selectivity pattern that decreases with larger sizes is warranted. For this reason, the model prediction of age three and older biomass is larger than the survey biomass levels (in thousands of mt):

YEAR	Model 3+ BIOMASS	SURVEY BIOMASS ESTIMATE
1984	755	571
1985	782	-
1986	792	-
1987	816	559
1988	814	-
1989	797	-
1990	767	380
1991	700	-
1992	643	-
1993	591	405

Another reason for the increased biomass levels over last year's assessment is due to the slight upturn in the 1993 survey biomass estimate (see above table).

The $F_{0.1}$ (0.57) rate was abandoned in favor of the $F_{35\%}$ value (0.40) for the ABC recommendation of 103,000 mt. This value is up from the 1994 estimate because the biomass estimate is higher and a higher natural mortality rate was assumed. The new natural mortality rate (M=0.37) is equal to that used in the Eastern Bering Sea Pacific cod and also provided a good compromise to the model fit to the GOA data. This should be distributed by management area approximately as the 1993 survey biomass is distributed:

29% (29,900 mt) in the western area, 66% (68,000 mt) in the central area, and 5% (5,100 mt) in the eastern area. For the November meeting, the Plan Team suggested that the authors examine the area-specific apportionments based on the biomass available to the fishery as opposed to the survey biomass levels. There was some concern that large adult fish not well sampled by the surveys may be more abundant in certain areas. However, the migratory nature of Pacific cod makes firm conclusions about appropriate apportionments difficult given our current level of knowledge.

The fishing mortality rate that would constitute overfishing is 0.48. This is the fishing mortality rate that would prevent the equilibrium spawner biomass-per-recruit ratio falling below 30% of its pristine value. The estimated 1995 catch corresponding to this fishing mortality rate is 120,000 mt.

In the future, the Plan Team would like to see the different fisheries (pot, longline and trawl) treated separately within the model because the selectivity of these gears is likely to be different. These factors may also affect the likelihood profile of terminal trawl survey selectivity and natural mortality.

FLATFISH

1993 Fishery	ABC	EXPLOITABLE BIOMASS	CATCH
Deep Water	45,530	227,660	6,707
Shallow Water	50,480	261,720	9,113
Arrowtooth	321,290	1,889,920	19,209
Flathead sole	49,450	247,250	2,824
TOTAL	466,750	2,626,550	37,853

1994 Fishery	ABC	EXPLOITABLE BIOMASS	CATCH[1]
Deep Water	16,510	132,030	3,094
Rex sole	11,950	95,630	2,874
Shallow water	34,420	261,720	2,743
Arrowtooth	236,240	1,889,920	15,728
Flathead sole	35,850	247,250	1,859
TOTAL	334,970	2,626,550	26,298

1995 Fishery	ABC	EXPLOITABLE BIOMASS
Deep Water	14,590	116,710
Rex Sole	11,210	89,660
Shallow water	52,270	355,590
Arrowtooth	198,130	1,585,040
Flathead sole	28,790	198,470
TOTAL	304,990	2,345,470

1/ Catch reported through August 6, 1994.

The 1995 exploitable biomass for each category is based on abundance estimated from the 1993 triennial trawl survey. As in 1994, application of age information for rex sole and maturity estimates for all species or groups has allowed calculation of ABC's based on $F_{35\%}$, rather than on $F_{0.1}$. These fishing mortality rates were applied to the exploitable biomass estimates from the 1993 triennial trawl survey to determine ABC's for the five species or groups managed under the flatfish category.

ABC and overfishing levels for the shallow water group have been determined by summing values calculated for rock sole, yellowfin sole, and other shallow-water species. The fishing mortality rates used for other species in the sballow water group are taken from the flathead sole estimates.

Fishing mortality rates used to calculate ABCs are: deepwater (0.125), rex sole (0.125), rock sole (0.147), yellowfin sole (0.149), shallow species (0.145), flathead sole (0.145), arrowtooth flounder (0.125).

The plan team recommends that ABCs for each group be apportioned among the three regulatory areas in proportion to biomass distributions in the 1993 trawl survey. The resulting ABCs are:

	WEST	CENTRAL	EAST	TOTAL
Deep Water	670	8,150	5,770	14,590
Rex sole	1,350	7,050	2,810	11,210
Shallow water	26,280	23,140	2,850	52,270
Arrowtooth	28,400	141,290	28,440	198,130
Flathead sole	8,880	17,170	2,740	28,790
TOTAL	65,580	196,800	42,610	304,990

Gulf of Alaska flatfish are not considered overfished so long as the fishing mortality rate remains below the level that would result in the spawning biomass-per-recruit ratio falling to 30% of its pristine value. Those fishing mortality rates and their associated catch levels are:

	Fov	OVERFISHING CATCH LEVEL
Deep water	0.146	17,040
Rex sole	0.146	13,090
Shallow water		
rock sole	0.172	
yellowfin sole	0.175	
other species	0.159	
Total shallow water		60,260
Arrowtooth	0.146	231,420
Flathead sole	0.159	31,560

These overfishing mortality rates and catch levels are all substantially higher than the ABC mortality rates and catch levels, therefore the recommended ABCs do not violate the Council's overfishing policy.

SABLEFISH

YEAR	ABC	EXPLOITABLE BIOMASS	Catch
1993	20,900	190,400	22,671
1994	25,500	218,000	17,806[1]
1995	25,500	218,000	

1/ Catch reported through August 6, 1994

An assessment update of sablefish will not be completed until after completion of the annual longline surveys which are still underway. While new assessment modeling methods are being explored and reviewed, no major change in the assessment methods and total stock harvest strategy used for the 1994 season is anticipated for 1995. The method employs a delay-difference equation population model, and an $F_{35\%}$ fishing rate adjusted in proportion to estimated current biomass. Preview(s) of new modeling method(s) will be described in the November SAFE.

One change the Team is anticipating, however, is the method of apportioning the total quota between the Bering Sea, Aleutian Island, and Gulf of Alaska regions, and between the Western, Central, West Yakutat, and East Yakutat/Southeast areas within the Gulf of Alaska. In the past, the latest distribution of survey RPW was used to apportion the total ABC to regions, while a weighted running average of annual RPW's were used to apportion to areas within the Gulf. The Team intends to use a consistent method to apportion to both regions and areas, a method that buffers rapid changes in apportionment due to annual variation in estimated RPW distribution, but is also responsive to current estimates. Some of the weighting schemes discussed at the meeting are illustrated using last year's total ABC (28,840) and the last five years of survey RPW distributions by region:

RPW Distributions

Year	EBS	AI	GOA
1989	0.16	0.21	0.63
1990	0.10	0.11	0.79
1991	0.05	0.11	0.85
1992	0.06	0.10	0.84
1993	0.02	0.10	0.88

Apportionment alternatives:

Weighting Method	RPW Weighting (93,92,91,90,89)	EBS	AI	GOA
current year only	1,0,0,0,0	0.02	0.10	0.88
double current year	2,1,1,1,1	0.07	0.12	0.81
linear decrease	5,4,3,2,1	0.06	0.11	0.84
exponential decrease	8,4,2,1,1/2	0.04	0.10	0.85

Potential ABC's

Weighting Method	RPW Weighting (93,92,91,90,89)	EBS	AI	GOA	Total
current year only	1,0,0,0,0	540	2,800	25,500	28,840
double current year	2,1,1,1,1	1,920	3,465	23,352	28,738
linear decrease	5,4,3,2,1	1,592	3,147	23,998	28,738
exponential decrease	8,4,2,1,1/2	1,224	2,995	24,519	28,738

The exponential decrease method of weighting is most sensitive to the latest year, and least sensitive to the oldest year, while still providing some buffering to variability in annual distribution. Alternative approaches to apportioning, such as projecting trends in regional abundance were also discussed.

As the Team has noted in the past, there is little concern about apportionments varying slightly from the true distribution, because sablefish exploitation rate is low, and the rate of sablefish movement between areas is high. The concern is that a method of apportionment be established that is reasonable biologically, and minimizes unnecessary sensitivity of area-specific IFQ values to survey variation.

SLOPE ROCKFISH

		ABC	EXPLOITABLE BIOMASS[1]	CATCH[2]
1993	Pacific ocean perch	3,378	156,400	2,060
	shortraker/rougheye	1,960	72,960	1,932
	northern rockfish	5,760	96,070	4,825
	other slope species	8,300	110,050	5,423
1994	Pacific ocean perch	3,030	101,800	917
	shortraker/rougheye	1,960	72,960	1,468
	northern rockfish	5,760	96,070	6,043
	other slope species	8,300	134,400	1,390
1995	Pacific ocean perch	6,800	135,840	
	shortraker/rougheye	1,910	71,811	
	northern rockfish	5,270	87,845	
	other slope species	6,930	110,054	

1/ Exploitable biomass is that which was reported in the SAFE for the given year.
2/ Catch reported through August 6, 1994.

PACIFIC OCEAN PERCH

The stock synthesis model for Pacific ocean perch is updated to include the biomass estimate and age composition from the 1993 triennial survey and length data from the 1992 fishery. Age composition data indicate an exceptionally strong 1986 year class especially in the Central and Western areas. As in last year's assessment, the optimal $F_{44\%}$ rate of 0.08 adjusted by the ratio of current female spawning biomass (121,852 mt) to target spawning biomass level of 150,000 mt is used by the authors to determine their ABC recommendation of 8,830 mt. The optimal F and target biomass were based on an analysis by Ianelli et al. (1993) of spawner recruit data generated by the stock synthesis model. In this analysis a full recruitment F value of 0.08 was slightly greater than the maxi-min F value for monetary yield and slightly less than the maxi-min F value for biological yield. The maxi-min value was defined by Clark (1991) as that which maximizes the minimum yield over a range of plausible stock recruitment relationships. Compared to the commonly used $F_{35\%}$ rate, the value of $F=0.08$ corresponds to the fishing mortality rate that would reduce the spawning biomass per recruit to 44% of its unexploited level.

When F_{msy} is known, the Council's overfishing definition (Amendment 21/16) sets F(OFL) equal to F_{msy}, and if current biomass is below B_{msy}, the rate is reduced proportionately. If the optimal fishing rate ($F_{44\%}=0.080$) used by the authors to compute ABC is considered an appropriate determination of F_{msy},

then the level of overfishing also corresponds to the recommended ABC of 8,830 mt. If the $F_{44\%}$ is not considered F_{msy}, then OFL is determined by the application of $F_{30\%}$, resulting in an OFL = 15,925 mt, a level of fishing mortality of some concern and an unnecessarily large buffer between ABC and OFL. To provide a reasonable buffer that should logically exist between ABC and OFL within the constraints of Amendment 21/16, the Plan Team adopted guidelines for reducing ABC below OFL by the proportion of $F_{35\%}/F_{30\%}$ which results in an ABC of 6,800 mt. Using the average distribution of exploitable biomass based on the 1987, 90, and 93 trawl surveys results in ABCs of 1,370 mt for the Western area, 2,460 mt for the Central area, and 2,970 mt for the Eastern area. Alternative methods of apportionment that explicitly incorporate the selectivity pattern of the fishery and area specific age composition were discussed by the Plan Team as alternative methods of apportionment.

The TAC for Pacific ocean perch is determined from the rebuilding plan for Pacific ocean perch. Under this plan the fishing mortality rate halfway between the optimal fishing mortality rate (F=.080) and the fishing mortality rate estimated to be sufficient to supply unavoidable bycatch of Pacific ocean perch in the Gulf based on 1992 bycatch rates. The fishing rate from this computation (F=0.054) corresponds to the $F_{55\%}$ rate and is adjusted downward by the ratio of current female spawning biomass to target female spawning biomass (0.812). This computation results in a F = 0.044 and a TAC for Pacific ocean perch for the 1994 fishery of 5,977 mt.

SHORTRAKER/ROUGHEYE

New exploitable biomass estimates from the 1993 trawl survey and revised estimates from the 1984, 1987, and 1990 trawl surveys were presented for the shortraker/rougheye component of the assemblage. The ABC for shortraker/rougheye component of the complex is 1,910 mt (170 mt, 1,210 mt, and 530 mt for the Western, Central, and Eastern areas, respectively) based on an F=M (.03 and .025 for shortraker and rougheye respectively) strategy and an average of the 1987, 1990, and 1993 survey biomass estimates.

An $F_{30\%}$ value of 0.046 was calculated for rougheye rockfish, which if applied to the rougheye rockfish biomass estimate of 48,123 mt results in an overfishing level of 2,214 mt. An $F_{30\%}$ for shortraker has not been computed because of a lack of growth data, therefore F=M=0.03 was applied to the biomass estimate of 23,689 mt to give an overfishing catch limit of 711 mt. The two overfishing levels were summed to obtain an overfishing limit for shortraker and rougheye of 2,925 mt.

NORTHERN ROCKFISH

New exploitable biomass estimates from the 1993 trawl survey and revised estimates from the 1984, 1987, and 1990 trawl surveys were presented for northern rockfish. The estimate of exploitable biomass estimate of 87,845 mt is based on the average of the trawl survey estimates. The recommended ABC using F=M=.06 for northern rockfish is 5,270 mt (640 mt, 4,610 mt, and 17 mt for the Western, Central, and Eastern areas, respectively). The OFL for northern rockfish is based on $F_{30\%}$ and is equal to 9,926 mt. The small ABC in the Eastern area was noted as possibly causing high proportion of discards of northern rockfish in this area. The possibility of combining northern rockfish with other slope rockfish in the Eastern area was discussed as a possible way to reduce discards.

OTHER SLOPE ROCKFISH

New exploitable biomass estimates from the 1993 trawl survey and revised estimates from the 1984, 1987, and 1990 trawl surveys were presented for other slope rockfish component of the assemblage. The ABC for other slope rockfish is obtained by applying F=M fishing rates (which range from 0.04 to 0.10) to the average of the trawl survey estimates of exploitable biomass for each species and summing to obtain a value of 6,930 mt (170 mt, 1,150 mt, and 5,610 mt for the Western, Central, and Eastern areas,

respectively). For the other slope rockfish, the rate of overfishing is determined by applying $F_{30\%}$ values of .080 for sharpchin rockfish and natural mortality rates for the remaining species. This results in an OFL of 8,229 mt for other slope rockfish.

With removal of northern rockfish from the other slope rockfish group in 1993, there has been a substantial increase in the catch of sharpchin, redstripe, harlequin, silvergrey, and yellowmouth rockfish. Concern was expressed that some species of other slope rockfish (i.e., silvergrey and yellowmouth rockfish) may be exploited at a rate disproportionately higher than their estimated abundance. These species are of higher commercial value than the other species because of their larger size.

The Team noted that the proportion of rockfish which are discarded has increased rather dramatically for some species over the past four years. For example, the discard of Pacific ocean perch has increased from 15.7% of the total catch in 1991 to 82.2% in 1993. The percent of discarded other slope rockfish has increased from 20% to nearly 70% over that same period. Only a few of the other slope rockfish species are of large enough size to be of commercial value. Most of the other components of the slope assemblage are of high value and every effort should be made to discourage discards. The directed fishing standards should be modified to allow for variable discard rates. This should help allow retention of legitimate bycatch while discouraging topping off or discard waste.

PELAGIC SHELF ROCKFISH

YEAR	ABC	EXPLOITABLE BIOMASS	CATCH
1993	6,740	75,114	3,193
1994	6,890	76,500	2,662[1]
1995	5,190	57,644	

1/ Catch reported through August 6, 1994.

As in previous assessments, determination of exploitable biomass and ABC for pelagic shelf rockfish is primarily based on results of triennial trawl surveys in the Gulf of Alaska. Two new sources of trawl survey information have become available in 1994: a) biomass estimates from the 1993 survey, and b) revised biomass estimates for dusky rockfish in the 1984, 1987, and 1990 triennial trawl surveys. Gulfwide estimates of biomass for the assemblage are now: 1984 (31,899 mt); 1987 (82,870 mt); 1990 (29,828 mt); and 1993 (60,433 mt). The new 1987 estimate is considerably less than its former value of 164,352 mt. The old 1987 estimate for dusky rockfish was calculated using a fishing power correction between survey vessels that adjusted many of the catches upward to the "most efficient" vessel. A recent re-analysis of these data indicated that the fishing power adjustments were inappropriate, and this resulted in the lower revised estimate.

Current exploitable biomass for pelagic shelf rockfish is derived by averaging the biomasses for the 1987, 1990, and 1993 trawl surveys. This value, 57,644 mt, is lower than the exploitable biomass of 76,500 mt used in last year's assessment because different years were used for the averaging (the previous assessment used 1984, 1987, and 1990) and because the revised biomass estimate for 1987 is much lower. ABC is calculated based on an F=M strategy in which the annual exploitation rate is set equal to the natural mortality rate for dusky rockfish, 0.09. Applying this exploitation rate to the estimate of current exploitable biomass yields a recommended Gulfwide ABC of 5,190 mt for 1995. This ABC is geographically apportioned as follows: 910 mt in the Western area, 3,200 mt in the Central area, and 1,080 mt in the Eastern area, using the average percent biomass in each area for the 1987, 1990, and 1993 surveys.

The team recommends that black rockfish be removed from the assemblage and assigned a separate ABC. From a biological perspective, it does not appear appropriate to assign black rockfish to the same assemblage as dusky rockfish, the primary species in the group. Black rockfish reside in shallow, rocky areas that cannot be sampled with the standard gear used in trawl surveys to assess other rockfish species. Consequently, assessment information on black rockfish is negligible. Furthermore, the fishery for black rockfish uses jigs instead of the trawls that are used in the fishery for dusky rockfish. A separate ABC also reduces possibility of over-exploitation of this species in the developing fishery for black rockfish. The team notes that commercial catches of black rockfish have increased in 1994 to 295 mt so far, and that most of this catch has been taken from a relatively small area south of the Kenai Peninsula.

The Team suggests that a Gulfwide ABC for black rockfish be computed based on the average of the commercial catches for 1991, 1992, and 1993. These catches are 569, 442, and 152 mt, respectively, which averages to approximately 390 mt. The team also suggests that this ABC not be divided into apportionments by regulatory area. A Gulfwide ABC would help to constrain the existing fishery in the Central area; at the same time, it would allow a fishery to develop in southeastern Alaska, where there has been some recent interest in harvesting this species.

DEMERSAL SHELF ROCKFISH

YEAR	ABC	EXPLOITABLE BIOMASS YELLOWEYE	CATCH
1993	800	40,050[1]	558
1994	960	42,087[2]	406[3]
1995	960	42,087	

1/ Beginning in 1993 exploitable biomass estimate is for expanded Southeast Outside
2/ No new biomass data, difference is due to the use of log-based confidence intervals.
3/ Catch reported through August 6, 1994.

Harvest of demersal shelf rockfish (DSR) in the Southeast Outside (SEO) District through August 6, 1994 totaled 406 mt, 42% of the 1994 ABC of 960 mt. This harvest does not include the estimated 97 mt of unreported bycatch mortality incurred during the June halibut fishery. Although this information is not officially reported, ADF&G does track this tonnage to insure that the combined reported and unreported catch does not exceed the TAC.

The 1994 survey data is not yet available so last year's reference numbers were used to calculate ABC and overfishing level. ABC was derived using $F_{ABC}=M$ applied to the lower 90% confidence interval of the biomass for yelloweye. This catch level was then adjusted to allow for bycatch of other DSR species by dividing it by the fraction of yelloweye in the commercial catch (0.88) for setting an ABC of 960 mt. Under national standards the overfishing level is defined as $F_{30\%}=0.04$ (1,683 mt).

The authors anticipate the new survey results will be available in time for the November meeting. The 1994 survey covered and expanded area relative to previous surveys.

The Plan Team recommends removing redbanded rockfish, *Sebastes babcocki*, from the demersal shelf rockfish group and returning it to the other slope rockfish assemblage. This species is a transitional species between nearshore and deep water. Previously it had been landed primarily as a bycatch in the DSR longline fishery. Due to shifts in fishing patterns it is now landed as a bycatch in the slope rockfish

trawl fishery. Consequently, relatively small amounts of redbanded bycatch by trawlers directly impacts the longline DSR fishery. The NMFS survey data will be used to assess the biomass of redbanded rockfish.

THORNYHEADS

YEAR	ABC	EXPLOITABLE BIOMASS	CATCH
1993	1,180	26,207	1,369
1994	1,180	26,207	1,068[1]
1995	2,320	64,770	

1/ Catch reported through August 6, 1994.

A new analysis of the thornyhead data was presented. Past stock assessments have relied upon point estimates of the NMFS trawl surveys. The current assessment uses a size-based model, constructed using NMFS trawl survey biomass estimates, NMFS domestic longline survey relative abundance indices, and size composition data from both commercial fisheries and NMFS surveys (longline and trawl). The new estimate of biomass (64,770 mt) is considerably larger than last year's estimate (26,207) for several reasons:

1) The NMFS triennial trawl survey biomass estimates have been revised (fishing power correction estimates have been updated).

2) The 1990 and 1993 trawl surveys did not extend into deeper water (> 500 m) where concentrations of larger thornyheads are known to exist. Previously the 1990 survey data was adjusted upwards by 33% (based on the 1984 and 1987 surveys) to include an estimate of biomass in the deeper water stratum. This year the new authors set size-selectivity asymptotic for the 1984 and 1987 survey and domed-shaped for the 1990 and 1993 surveys. The trawl survey estimates are then considered absolute estimates of abundance, with only the younger portion of the stock surveyed in 1990 and 1993.

3) The natural mortality estimate for thornyheads has also been revised, from 0.05 in last years' assessment to 0.07 this year. The 0.05 M previously used was arbitrary, being the average between the 0.03 value previously used for west coast thornyheads and the 0.07 advanced by Miller for Gulf of Alaska thornyheads. The 0.07 value used by the authors was derived by running the model for several different fixed values of M to examine the fit to different data components.

The Plan Team agreed with the authors that given the lack of knowledge on the stock-recruitment relationship of thornyheads, $F_{ABC} = F_{35\%} = 0.0359$. This translates to an 1995 ABC of 2,320 mt. The overfishing mortality rate is $F_{30\%} = 0.0425$, resulting in an overfishing catch level of 2,740 mt.

The Plan Team supports the advancement of this stock assessment technique for thornyheads. Although the reference levels are considerably different from past assessments, this assessment uses a full complement of available data and provides a more comprehensive picture of the resource. The Plan Team encourages the authors to include the cooperative longline survey data in their next analysis as the data becomes available. The Plan Team also strongly recommends that future NMFS trawl surveys sample deepwater strata (> 500 m) in order to adequately sample adult thornyhead.

ATKA MACKEREL

YEAR	ABC	EXPLOITABLE BIOMASS	CATCH
1993	32,100	7,010	5.146
1994	4,800	32,100	2,769[1]
1995	6,480	21,600	

1/Catch reported through August 6, 1994.

In 1994, Atka mackerel became a separate target category in the GOA with approval of Amendment 31 to the Fishery Management Plan for the groundfish fishery of the Gulf of Alaska. From 1988-93, Gulf Atka mackerel were combined in the "other species" category due to low abundance and lack of a directed fishery.

The most recent biomass estimate for GOA Atka mackerel comes from the 1993 bottom trawl survey, which had a mean estimate of 21,600 mt. Previous surveys in 1984, 1987 and 1990 yielded mean biomass estimates of 36,000, 33,000 and 32,100 mt, respectively. The 1993 survey was preceded by the 1992 fishery which removed approximately 14,000 mt, suggesting that Atka mackerel in the GOA may be particularly sensitive to fishing pressure.

In the Aleutian Islands, the SSC approved a 6-year phase-in of Atka mackerel exploitation rates, culminating in a rate of $F=M=0.3$; 1995 would be the fourth year of that phase-in, resulting in an exploitation rate of 0.2. Since there is evidence that Gulf of Alaska Atka mackerel may be a separate stock from those in the Aleutian Islands (based primarily on size- and weight-at-age data), the Team was hesitant to use the same approach used for the Aleutian Islands to arrive at an ABC for GOA Atka mackerel. Therefore, the Team used an exploitation rate of $F=M=0.3$ applied to the most recent biomass estimate (21,600 mt) to compute an ABC of 6,480 mt. The Team recognizes that this approach results in a doubling of the exploitation rate from 1994 despite a decrease in the survey biomass estimate, but feels that this is the most appropriate means to arrive at an ABC.

There are several factors, along with the one noted above regarding the possible sensitivity of GOA Atka mackerel to fishing pressures, which suggest that TAC be lower than ABC. Recent Steller sea lion food habits data indicate that Atka mackerel is an important prey species in the Aleutian Islands, which includes the Western GOA management area. The Team is concerned about the high levels of fishery removals in the last 3 years (80-99%) that have occurred within 20 nm of important Steller sea lion habitat, specifically rookeries on Adugak, Ogchul, Atkins and Chernabura Islands. Furthermore, most of these removals have occurred in winter (November-March, a particularly sensitive period for juveniles and recently weaned pups) and the fishery has been brief (on the order of days to weeks). Therefore, the Team recommends that TAC be reduced below ABC due to concerns about possible fishery effects on the recovery of Steller sea lions in the western GOA, or that other measures be taken to minimize fishery/marine mammals interactions.

MARINE MAMMALS/ECOSYSTEMS

The marine mammal and ecosystem considerations sections will be revised and expanded for the November 1994 SAFE.

The following marine mammal summary contains 1993 research results for Steller sea lions, and updates status of research activities for northern fur seal, harbor seal, killer whale and harbor porpoise from the November 1992 SAFE.

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%.

A population viability analysis was performed for Steller sea lions. The models predicted the Alaskan population will be reduced to levels approaching extinction within 100 years from the present if the 1985-92 trend persists into the future.

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

There were no changes to the December 1993 Economic SAFE. An update will be provided in the final SAFE in December 1994.

OVERVIEW OF APPENDICES

Appendix A: Pacific Halibut Stock Assessment Summary

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 round weight (RW) 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 RW) for the Gulf areas (Areas 2C, 3A, and 3B) and 28.8 million pounds (dressed weight, or 17,400 mt RW) 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 RW). For the IPHC areas in the Gulf of Alaska (GOA), the commercial catch was 41.9 million pounds (dressed weight, or 25,300 mt RW). Catches in the BSA areas totalled 6.3 million pounds (dressed weight, or 3,800 mt RW.). 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 RW). 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 RW) in 1993. The largest decrease was noted in the BSA, which was offset somewhat by an increase in the GOA.

Appendix B: Prohibited Species Catch Summary for Halibut

Information on halibut bycatch in the groundfish fisheries conducted in the Gulf of Alaska (GOA) is provided in Appendix B. It is intended for use by the Council in its utilization of the halibut species bycatch framework measures.

The PSC limits for halibut in the Gulf of Alaska are set by gear type and apportioned seasonally over the fishing year (Amendment 21). For 1994, the Council recommended the following halibut PSC apportionments for the Gulf of Alaska groundfish fisheries:

Trawl gear		Hook and Line gear		
1st quarter		600 mt (30%)	1st trimester	200 mt (26.7%)
2nd quarter	400 mt (20%)	2nd trimester	500 mt (66.7%)	
3rd quarter	600 mt (30%)	3rd trimester	50 mt (6.7%)	
4th quarter	400 mt (20%)			
TOTAL	2000 mt		750 mt	

Bycatch mortality of Pacific halibut in the 1993 Gulf of Alaska groundfish fisheries totalled 2,556 mt through August 6, 1994 for trawl and hook-and-line fisheries. Halibut bycatch mortality from trawl gear was 1,403 mt. The following bycatch mortality totals (rounded to nearest mt) were calculated from observer data from the trawl fisheries, using the fishery specific mortality rates discussed above:

Fishery	Bycatch Mortality
Pacific cod	450 mt
Deepwater flatfish	465 mt
Shallow flatfish	423 mt
Pollock	150 mt
Rockfish, including thornyheads	250 mt
'Other' fisheries	115 mt

The hook-and-line fisheries exceeded their halibut mortality limit of 750 mt, with 1,153 mt of halibut mortality through August 6. The sablefish fisheries in 1994 took 898 mt, or 78%, of the GOA hook and line halibut bycatch. The other hook and line fisheries, including the Pacific cod fishery, had lower halibut bycatch mortality (255 mt, or 22%) in 1994.

Pot gear was used to harvest mostly Pacific cod in 1993. Total mortality attributed to pot gear is 400 mt. Pot gear was exempt from any PSC mortality limit for the 1994 fishing year.

Appendix C: Pacific Halibut Discard Mortality Rates

The Team reviewed a report by IPHC staff (Appendix C) 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 halibut bycatch, 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 D: 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 D.

Table 1. Gulf of Alaska groundfish 1994 and 1995 ABCs, 1994 TACs, and 1994 catches reported through August 6, 1994. MSY is unknown for all species.

Species	1994	ABC (mt) 1994	ABC (mt) 1995	1994 TAC	1994 Catch
Pollock	W(61)	22,130	30,380	22,130	16,709
	C(62)	23,870	15,310	23,870	18,475
	C(63)	56,000	16,310	56,000	44,618
	E	7,300	3,360	7,300	6,848
	Total	109,300	65,360	109,300	86,650
Pacific cod	W	16,630	29,900	16,630	14,679
	C	31,250	68,000	31,250	30,066
	E	2,520	5,100	2,520	1,646
	Total	50,400	103,000	50,400	46,391
Flatfish[1] (deep water)	W	460	670	460	53
	C	12,930	8,150	7,500	2,344
	E	3,120	5,770	3,120	697
	Total	16,510	14,590	11,080	3,094
Rex sole[2]	W	800	1,350	800	50
	C	9,310	7,050	50500	2,819
	E	1,840	2,810	1,840	5
	Total	11,950	11,210	10,140	2,874
Flatfish[3] (shallow water)	W	20,290	26,280	4,500	184
	C	12,950	23,140	12,950	2,549
	E	1,180	2,850	1,180	10
	Total	34,420	52,270	18,630	2,743
Flathead sole	W	9,120	8,880	2,000	495
	C	23,080	17,170	5,000	1,362
	E	3,650	2,740	3,000	2
	Total	35,850	28,790	10,000	1,859
Arrowtooth flounder	W	28,590	28,400	5,000	1,165
	C	186,270	141,290	20,000	14,141
	E	21,380	28,440	5,000	422
	Total	236,240	198,130	30,000	15,728
Sablefish	W	2,290	2,290	2,290	566
	C	11,220	11,220	11,220	8,112
	WY	4,850	4,850	4,850	2,836
	SEO	7,140	7,140	7,140	6,292
	Total	25,500	25,500	25,500	17,806
Slope rockfish (other)	W	330	170	199	74
	C	1,640	1,150	988	590
	E	6,330	5,610	1,048	726
	Total	8,300	6,930	2,235	1,390
Northern Rockfish	W	1,000	640	1,000	1,610
	C	4,720	4,610	4,720	4,384
	E	40	20	40	49
	Total	5,760	5,270	5,760	6,043
Pacific Ocean Perch	W	680	1,370	571	170
	C	850	2,460	714	626
	E	1,500	2,970	1,265	121
	Total	3,030	6,800	2,550	917

(continued on next page)

Table 1. (continued)

Species	1994	ABC (mt) 1994	1995	1994 TAC	1994 Catch
Shortraker/Rougheye	W	100	170	100	77
	C	1,290	1,210	1,290	837
	E	570	530	570	554
	Total	1,960	1,910	1,960	1,468
Pelagic shelf rockfish	W	1,030	910	1,030	253
	C	4,550	3,200	4,550	1,226
	E	1,310	1,080	1,310	888
	Total	6,890	5,190	6,890	2,367
Black Rockfish	GW		400		295
Demersal shelf rockfish	SEO	960	960	960	406
Atka mackerel	GW	4,800	6,480		2,769
	W			2,500	
	C			1,000	
	E			5	
	TOTAL			3,505	
Thornyhead rockfish	GW	1,180	2,320	1,180	1,068
Other species	GW	NA		14,405	2,913
Totals		553,050	535,110	304,495	196,781

1/ Shelikof Strait pollock is included within the W/C ABC range.
2/ "Deep water flatfish" means rex sole, Dover sole, and Greenland turbot in 1993. In 1994 rex sole is a separate target category.
3/ "Shallow water flatfish" means rock sole, yellowfin sole, butter sole, starry flounder, and other flatfish not specifically defined.
4/ Demersal shelf rockfish catch incudes 97 mt of unreported mortality from halibut fisheries.

NOTE: ABCs are rounded to nearest 10.
GW means Gulfwide.
Catch data source: NMFS Blend Reports.
Northern Rockfish were separated from Slope Rockfish in 1993.
Atka mackerel was separated from "other species" in 1994.
Black rockfish was recommended for separation from the pelagic shelf rockfish in 1995.

Table 2. Gulf of Alaska exploitable biomasses, 1995 ABCs, and estimated trends and abundances for Western, Central, Eastern, Gulfwide, West Yakutat, and Southeast Outside regulatory areas.

Species	Exploitable Biomass (mt)		1995 ABC	1995 Overfishing Level	Abundance,[3] Trend
Pollock	546,000[1]	{ W(61)	30,380 }		Below,
		{ C(62)	15,310 }	266,000	declining
		{ C(63)	16,310 }		
		E	3,360	14,400	
		Total	65,360	280,000	
Pacific cod	542,000	W	29,900		Above,
		C	68,000		declining
		E	5,100		
		Total	103,000	120,000	
Flatfish (deep water)	116,710	W	670		Unknown,
		C	8,150		Unknown
		E	5,770		
		Total	14,590	17,040	
Rex sole	89,660	W	1,350		Unknown,[4]
		C	7,050		Stable
		E	2,810		
		Total	11,210	13,091	
Flatfish (shallow water)	355,590	W	26,280		Unknown,[4]
		C	23,140		increasing
		E	2,850		
		Total	52,270	60,262	
Flathead sole	198,470	W	8,880		Unknown,[4]
		C	17,170		stable
		E	2,740		
		Total	28,790	31,557	
Arrowtooth flounder	1,585,040	W	28,400		Above,
		C	141,290		stable
		E	28,440		
		Total	198,130	231,416	
Sablefish	218,000	W	2,290		Near,
		C	11,220		stable
		WYK	4,850		
		SEO	7,140		
		Total	25,500	31,700	
Slope rockfish (Other)	110,054	W	170		Unknown,
		C	1,150		Unknown
		E	5,610		
		Total	6,930	8,229	
Northern Rockfish	87,845	W	640		Unknown,
		C	4,610		Unknown
		E	20		
		Total	5,270	9,926	
Pacific ocean Perch	135,840	W	1,370		Below,
		C	2,460		increasing
		E	2,970		
		Total	6,800	8,830	

(continued next page)

Table 2. (continued)

Species	Exploitable Biomass (mt)		1995 ABC	1995 Overfishing Level	1995 Abundance,[3] Trend
Shortraker/ Rougheye	71,811	W	170		Unknown,
		C	1,210		Unknown
		E	530		
		Total	1,910	2,925	
Pelagic shelf rockfish[2]	57,644	W	910		Unknown,
		C	3,200		Unknown
		E	1,080		
		Total	5,190	8,704	
Black rockfish		GW	400	400	Unknown,[4] Unknown
Demersal shelf rockfish	49,280	SEO	960	1,680	Unknown, Unknown
Atka mackerel		GW	6,480	11,700	Unknown, Unknown
Thornyhead rockfish	64,770	GW	2,320	2,740	Unknown, Stable
Other species	NA	W	NA		TAC = 5%
		C	NA		of the sum
		E	NA		of TACs

1/ Biomass estimates includes only Western and Central Gulf areas.
2/ Pelagic shelf rockfish for 1994 includes black rockfish
3/ Abundance relative to target stock size as specified in SAFE documents.
4/ Historically lightly exploited therefore expected to be above the specified reference point.

Note: ABCs are rounded to nearest 10.
Overfishing is defined Gulf-wide.
Northern Rockfish were separated from Slope Rockfish in 1993.
Atka mackerel will be separate from "other species" in 1994.
Rex sole was part of deepwater flatfish until 1994.
Black rockfish was separated from the pelagic rockfish in 1995.

Table 3. Summary of fishing mortality rates for the Gulf of Alaska, 1995.

Species	ABC Rate[1]	FABC[2]	OFL Rate[3]	F_{OFL}
Pollock	0.200	F_{ABC}	0.510	$F_{30\%}$
Pacific cod	0.40	$F_{35\%}$	0.48	$F_{30\%}$
Deepwater flatfish	0.125	$F_{35\%}$	0.146	$F_{30\%}$
Rex sole	0.125	$F_{35\%}$	0.146	$F_{30\%}$
Flathead sole	0.145	$F_{35\%}$	0.159	$F_{30\%}$
Shallow water flatfish	0.145-0.149[5]	$F_{35\%}$	0.159-0.175[6]	$F_{30\%}$
Arrowtooth	0.125	$F_{35\%}$	0.146	$F_{30\%}$
Sablefish	0.131	$F_{35\%}$[4]	0.166	$F_{30\%}$
Pacific Ocean Perch	0.05	$F_{44\%}$	0.065	F_{msy}
Shortraker/rougheye	0.03/0.025	F=M	0.03/0.046	F_{mix}[7]
Rockfish (other slope)	0.04-0.10	F=M	0.04-0.10	F_{mix}[8]
Northern Rockfish	0.060	F=M	0.113	$F_{30\%}$
Rockfish (Pelagic Shelf)	0.090	F=M	0.151	$F_{30\%}$
Black rockfish				
Demersal Shelf Rockfish	0.020	F=M	0.040	$F_{30\%}$
Thornyhead	0.0359	$F_{35\%}$	0.0425	$F_{30\%}$
Atka Mackerel	0.30	F=M	0.54	$F_{30\%}$

1/ Maximum 1993 catch level allowable under overfishing definition.
2/ Fishing mortality rate corresponding to acceptable biological catch.
3/ Maximum fishing mortality rate allowable under overfishing definition.
4/ Adjusted by current biomass.
5/ Shallow water flatfish; yellowfin sole 0.149, rocksole 0.147, others 0.145.
6/ Shallow water flatfish; yellowfin sole 0.175, rocksole 0.172, others 0.159.
7/ $F_{30\%}$ for rougheye, F=M for shortraker.
8/ $F_{30\%}$ for sharpchin, F=M for other species.

Table 4. Groundfish landings (metric tons) in the Gulf of Alaska, 1956-1994.

Year	Pollock	Pacific Cod	Flat Fish	Sable Fish	Shelf Rock Fish /a	Pelagic Shelf Rockfish	Demersal Shelf Rockfish /b	Thorny Heads /c	Atka Mackerel	Other Species /d	Total All Species
1956				1,391							1,391
1957				2,759							2,759
1958				797							797
1959				1,101							1,101
1960				2,142							2,142
1961				897	16,000						16,897
1962				731	65,000						65,731
1963				2,809	136,300						139,109
1964	1,126	196	1,028	2,457	243,385						248,192
1965	2,749	599	4,727	3,458	348,598						360,131
1966	8,932	1,376	4,937	5,178	200,749						221,172
1967	6,276	2,225	4,552	6,143	120,010						139,206
1968	6,164	1,046	3,393	15,049	100,170						125,822
1969	17,553	1,335	2,630	19,376	72,439						113,333
1970	9,343	1,805	3,772	25,145	44,918						84,983
1971	9,458	523	2,370	25,630	77,777						115,758
1972	34,081	3,513	8,954	37,502	74,718						158,768
1973	36,836	5,963	20,013	28,693	52,973						144,478
1974	61,880	5,182	9,766	28,335	47,980						153,143
1975	59,512	6,745	5,532	26,095	44,131						142,015
1976	86,527	6,764	6,089	27,733	46,968						174,081
1977	112,089	2,267	16,722	17,140	23,453			0	19,455	4,642	195,768
1978	90,822	12,190	15,198	8,866	8,176			0	19,588	5,990	160,830
1979	98,508	14,904	13,928	10,350	9,921			0	10,949	4,115	162,675
1980	110,100	35,345	15,846	8,543	12,471			1,351	13,166	5,604	202,426
1981	139,168	36,131	14,864	9,917	12,184			1,340	18,727	7,145	239,476
1982	168,693	29,465	9,278	8,556	7,991		120	788	6,760	2,350	234,001
1983	215,567	36,540	12,662	9,002	7,405		176	730	12,260	2,646	296,988
1984	307,400	23,896	6,914	10,230	4,452		563	207	1,153	1,844	356,659
1985	284,823	14,428	3,078	12,479	1,087		489	81	1,848	2,343	320,656
1986	93,567	25,012	2,551	21,614	2,981		491	862	4	401	147,483
1987	69,536	32,939	9,925	26,325	4,981		778	1,965	1	253	146,703
1988	65,625	33,802	10,275	29,903	13,779	1,086	508	2,786	-	647	158,411
1989	78,220	43,293	11,111	29,842	19,002	1,739	431	3,055	-	1,560	188,253
1990	90,490	72,517	15,411	25,701	21,114	1,647	360	1,646	1,416	6,289	236,591
1991	107,500	76,997	20,068	19,580	13,994	2,342	323	2,018	3,258	1,577	247,657
1992	93,904	80,100	28,009	20,451	16,910	3,440	511	2,020	13,834	2,515	261,694
1993	108,591	55,994	37,853	22,671	14,240	3,193	558	1,369	5,146	6,867	256,482
1994	86,650	46,391	26,298	17,806	9,818	2,662 /g	406	1,068	2,769	2,913	196,781

a/ Catch defined as follows: (1) 1961-78, Pacific ocean perch (S. alutus) only; (2) 1979-1987, the 5 species of the Pacific ocean perch complex; 1988-1990, the 18 species of the slope rockfish assemblage; 1991-1994, the 20 species of the slope rockfish assemblage.

b/ Catch from Southeast Outside District.

c/ Thornyheads were included in the other species category, and are foreign catches only.

d/ After numerous changes, the other species category was stablized in 1981 to include sharks, skates, sculpins, eulachon, capelin (and other smelts in the family Osmeridae) and octopus. Atka mackerel and squid were added in 1989. Catch of Atka Mackerel is reported separately for 1990-1992; thereafter Atka mackerel was assigned a seperate species.

e/Atka mackerel was added to the Other Species category in 1988.

f/Catch data reported through August 6, 1994.

g/ PSR includes light dusky rockfish, black rockfish, yellowtail rockfish, widow rockfish, dark dusky rockfish, and blue rockfish. Beginning in 1995 black rockfish will be separated out from the assemblage.

Figure 1

Regulatory and reporting areas of the Gulf of Alaska