

SUMMARY OF
RESOURCE ASSESSMENT DOCUMENT
FOR
GROUND FISH IN THE BERING SEA-ALEUTIAN ISLANDS
AS ASSESSED IN 1987
AND ESTIMATED ACCEPTABLE BIOLOGICAL CATCH LEVELS FOR 1988

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Prepared by

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INTRODUCTION

This Resource Assessment Document (RAD) for Bering Sea - Aleutian Islands groundfish resources is applicable for management of the 1988 fishery under Amendment #1 of the Fishery Management Plan (FMP). In this RAD, the status of the stocks and their acceptable biological catches (ABCs) are determined. The ABC values, together with socio-economic considerations, will be used by the North Pacific Fishery Management Council to determine total allowable catches (TACs) by species, and other management strategies for the fishery under the Magnuson Fishery Conservation and Management Act and the FMP. The sum of TACs equals optimum yield (OY) for the groundfish complex.

NEW INFORMATION

Since the RAD and its supplement for management of the 1987 fishery were issued (NPFMC 1986), new data have become available to update the status of stocks:

1. Data from the 1986 and 1987 summer trawl surveys conducted by the Northwest and Alaska Fisheries Center and those in cooperation with Japan.
2. Data collected by U.S. observers aboard foreign fishing and processing vessels.
3. Data and analyses provided by Japan in documents to the International North Pacific Fisheries Commission in 1987.
4. Data and analyses provided by Japan at a bilateral meeting in 1987.

MANAGEMENT AREAS AND SPECIES

The management area lies within the 200 mile U.S. Exclusive Economic Zone (EEZ) of the eastern Bering Sea (EBS) and Aleutian Islands region (Fig. 1). International North Pacific Fisheries Commission (INPFC) statistical areas 1 to 5 are also illustrated. INPFC areas 1 and 2 make up the EBS. The Aleutian 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 RAD describes the status of the

stocks in categories (b) and (c) only.

HISTORICAL CATCH STATISTICS

Historical catch statistics since 1954 are shown for the EBS in Table 2. In this region, the initial target species for Japan and the U.S.S.R. 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 were targeted upon, principally pollock, and total catches rose to 2.2 million t in 1972. Catches have since varied from 1.2-1.9 million t as catch restrictions and other management measures were placed on the fishery.

Catches in the Aleutian Islands region (Table 3) have always been much smaller than those in the EBS and target species have generally been different. Pacific ocean perch (POP) was the initial target species and during early years of exploitation overall catches of groundfish reached a peak of 112,000 t in 1965. With a decline in abundance of POP, the fishery diversified to other species including turbot, Atka mackerel, Pacific cod, sablefish, and pollock. Overall catches declined to less than 100,000 t annually through 1979. Starting in 1980, catches of pollock and Atka mackerel increased markedly in the Aleutian region; as a result, overall catch has again been about 100,000 t or more in recent years.

RECENT TOTAL ALLOWABLE CATCH

Total allowable catches (TAC) established by the NPFMC since implementation of extended jurisdiction in 1977 are given in Table 4. The overall TAC (equals optimum yield) for all species combined has steadily increased from 1.4 million t in 1977 to 2.0 million t in 1984-1987. Species accounting for the major part of this increase have been pollock, yellowfin sole, and Pacific cod.

ACCEPTABLE BIOLOGICAL CATCH LEVELS FOR 1988

Amendment #1 to the Bering Sea - Aleutian Islands groundfish FMP provides the framework to manage the groundfish resources as a complex. The MSY of this complex was originally estimated at 1.8 to 2.4 million t. The OY is set at 85 percent of the MSY range, or 1.4 to 2.0 million t. Long-term sustainable catch level, based upon multispecies/ecosystem analysis, has been estimated to be 1.8 million t.

Tables 6 and 7 provide summaries of the current estimates of

MSY and ABC. The sum of MSY's has increased to 3.4 million t, although such an aggregate yield is not realistic considering that not all species in the groundfish complex will produce their MSY at the same time.

The sum of ABC's for the groundfish complex has increased from 2.25 million t in 1987 to 2.88 million t in 1988. This increase resulted from a combination of two key factors--(1) an actual increase in the status of some stocks, and (2) a change in calculation procedures for ABC from last year.

As in past years, calculation of ABC has varied from species to species depending upon the quality of data available and prior knowledge on the status of the stocks. These data and knowledge have been continually improved. After more than 10 years of management experience under the MFCMA, the Council has adopted a default method for calculating acceptable biological catch where, lacking other biological justification, the ABC is calculated by multiplying current exploitable biomass by the maximum sustainable yield exploitation rate.

Plan Team Procedure for Estimation of ABC

The Plan Team has used the most sophisticated techniques available to estimate ABC whenever possible, recognizing that the default technique may be an over-simplification of stock assessment. In order of preference, the Plan Team has adopted the following methods to estimate ABC's:

1. First, age-structured models are used extensively to estimate the status of the stock. Whenever possible, the model is extended to project the dynamics of the stock into the near future so that potential impacts of different catch levels can be evaluated.
2. Second, $ABC = \text{an exploitation rate} \times \text{exploitable biomass}$ is often used. The default procedure suggests that the MSY exploitation rate be specifically applied. This rate is used by the Plan Team when the stock is known to be in good condition, high in abundance, and not in danger of drastic declines due to anticipated poor recruitment.

In some cases, the proposed exploitation rate may deviate from MSY exploitation because more information is known about the stock. Sissenwine and Shephard (1986) have reviewed a number of stock exploitation histories and reported that the Fmsy exploitation strategy often leads to over-exploitation. They recommend that the F0.1 exploitation strategy developed by ICES (1984) and Deriso (1987) be used instead, since it leads to a more conservative exploitation strategy. Therefore, F0.1 exploitation is used to estimate ABC for groundfish species in the Bering Sea-Aleutian Islands which require particular conservation or caution in

setting of harvest levels.

In addition to the F_{msy} and $F_{0.1}$ exploitation rates, historical exploitation rates have been used to estimate ABC when the history of the fishery suggests that the stock is most stable when exploited at such historical rates.

3. Finally, when information is insufficient to estimate the biomass of the stock, an empirical approach of setting ABC according to historical catch levels has been applied.

Use of this order of preference has resulted in some noticeable changes in ABC's for some species compared to those estimated in last year's RAD. Exploitation rates are generally higher for this year, thereby contributing to some of the increase from 1987 to 1988 as shown in Table 6. A species-by-species discussion of the changes follows:

Pollock:

EBS	1987 ABC = 1,200,000 t	1988 ABC = 1,500,000 t
Aleutians	1987 ABC = 100,000 t	1988 ABC = 160,000 t

EBS Projected 1988 exploitable biomass = 6.5 million t
Exploitation = 23 percent; $F_{0.1}$ rate

Aleutians Projected 1988 exploitable biomass = 690,000 t
Exploitation = 23 percent; $F_{0.1}$ rate

The abundance of pollock stocks has not changed radically from last year; abundance remains relatively high. The increase in ABC reflects the use of a age-structured model of the population and the $F_{0.1}$ harvesting strategy which results in exploitation of 23 percent. The exploitation last year was 14 percent and was based upon historical experience which varied from 10 to 18 percent. The higher rate is used for 1988 because several population dynamics theories suggest that the pollock resource can be exploited more intensively without loss in productivity.

Pacific Cod:

1987 ABC = 400,000 t	1988 ABC = 385,300 t
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Projected 1988 exploitable biomass = 1.48 million t
Exploitation = 26 percent; F_{msy} rate

An age-structured model was used to simulate the structure and dynamics of the EBS cod population. The 1988 biomass was projected and ABC was calculated based on the MSY exploitation

rate. In the past six years, exploitation has only run 5-14 percent, with actual catch generally less than ABC. The current biomass is very high and is projected to remain so in 1988.

Yellowfin Sole:

1987 ABC = 187,000 t 1988 ABC = 254,000 t

Current exploitable biomass = 1.4 million t
Exploitation = 18 percent; F0.1 strategy

The increase in ABC reflects a slightly higher biomass and the use of an age-structured model to estimate population level and exploitation with the F0.1 fishing strategy. The resulting exploitation this year is 18 percent as applied to current exploitable biomass. The exploitation rate used last year was 10 percent which was applied to the total biomass.

Greenland Turbot:

1987 ABC = 20,000 t 1988 ABC = 14,100 t

Projected 1988 exploitable biomass = 414,000 t
Exploitation = 3.4 percent; F0.1 rate

The change in ABC reflects the use of F0.1 exploitation rate multiplied by the 1988 projected biomass from an SRA model. The same SRA model was used last year, but the 1987 ABC was selected from different exploitation scenarios rather than using the F0.1 exploitation rate. In reality, the exploitable component of the Greenland turbot resource is estimated to have increased from 1984 to 1987, but future recruitment is expected to be poorer.

Arrowtooth Flounder:

1987 ABC = 30,900 t 1988 ABC = 109,500 t

Current exploitable biomass = 377,700 t
Exploitation = 29 percent; Fmsy rate

The substantial increase in ABC is attributed mainly to the use of the higher exploitation rate (Fmsy = 0.29) instead of the historical rate of 10% as well as an actual increase in biomass. The resource remains in excellent condition and biomass is increasing.

Other Flatfishes:

1987 ABC = 193,300 t 1988 ABC = 331,900 t

Current exploitable biomass = 2.14 million t

Exploitation = 15.5 percent; Fmsy rate

The reasons for the increase in ABC are the same as for arrowtooth flounder. Abundance of all the species in this group has remained relatively high and stable in recent years. The MSY exploitation rate used to estimate ABC was 15.5 percent. The rate used last year was 10 percent and was based upon the historical exploitation trend for the stocks.

Sablefish:

EBS	1987 ABC = 3,700 t	1988 ABC = 4,500 t
Aleutians	1987 ABC = 4,000 t	1988 ABC = 7,700 t
EBS	Current exploitable biomass = 56,500 t Exploitation = 8 percent; Fmsy rate	
Aleutians	Current exploitable biomass = 96,300 t Exploitation = 8 percent; Fmsy rate	

The increases in ABCs reflect mostly higher abundance of the stocks, as well as the use of the Fmsy exploitation rate which is higher than last year's historical rate (8 percent versus 6 percent). Sablefish stocks seem to have rebuilt to produce at or above MSY levels.

Pacific Ocean Perch:

EBS	1987 ABC = 3,800 t	1988 ABC = 6,000 t
Aleutians	1987 ABC = 10,900 t	1988 ABC = 16,600 t
EBS	Current exploitable biomass = 101,100 t Exploitation = 6 percent; F0.1 rate	
Aleutians	Current exploitable biomass = 276,500 t Exploitation = 6 percent; F0.1 rate	

Increases in ABCs reflect mostly the higher abundance of stocks because of stronger recruitment entering the fishery, as well as the use of the F0.1 exploitation rate (6% instead of last year's historical 5% rate). In general, POP stocks continue to remain low when compared to biomass levels in the early 1960's.

Other Rockfishes:

EBS	1987 ABC = 450 t	1988 ABC = 400 t
Aleutians	1987 ABC = 1,430 t	1988 ABC = 1,100 t
EBS	Current exploitable biomass = 7,100 t Exploitation = 6 percent; F0.1 rate	
Aleutians	Current exploitable biomass = 18,500 t	

Exploitation = 6 percent; F0.1 rate

Decreases in ABCs do not reflect a decline in biomass, but rather reflect a lower confidence in the reliability of biomass estimates since trawl surveys cannot sample rockfishes very well. For 1987, the assumption was adopted that the survey biomass reflected only half the biomass actually present. This year, the Plan Team reviewed the wide confidence intervals of the biomass estimates and decided to use the mean biomass derived from recent years' trawl surveys to estimate ABC. Lower biomasses were therefore used, but a slightly higher exploitation rate was also used (6% in 1988 instead of 5% in 1987) to calculate ABC. The higher exploitation rate was based on the F0.1 exploitation scenario derived for POP.

Atka Mackerel:

1987 ABC = 30,800 t

1988 ABC = 21,000 t

Current exploitable biomass was not determined
Exploitation based on F0.1 strategy

The decrease in ABC from 1987 to 1988 reflects a lower abundance of the stocks. The ABC was estimated from a Beverton and Holt (1957) yield-per-recruit model with assumptions that recruitment will be low, at the 1982-86 levels. Exploitable biomass and exploitation rate were not explicitly calculated.

Squid:

1987 ABC = 10,000 t

1988 ABC = 10,000 t

There is insufficient information to determine abundance and appropriate exploitation rates for squid stocks. The estimate of ABC is based on historical catches and is conservative.

Other Species:

1987 ABC = 49,500 t

1988 ABC = 54,000 t

Current exploitable biomass = 540,000 t
Exploitation = 10 percent = Historical rate

The increase in ABC from 1987 to 1988 is not based upon increases in biomass; the stocks have remained about the same. The change involves an interpretation that the present biomass level is best estimated by averaging the estimates of the last three years, instead of using a single estimate. Exploitation remains the same (10 percent) as used last year.

REFERENCES

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Table 5.--Bering Sea-Aleutian Islands groundfish apportionments and foreign allocations in metric tons, 1984-87.

	1984	1985	1986	November 1987
ABC	-	2,149,330	2,199,000	2,245,780
TAC	2,000,000	2,000,000	2,000,000	2,000,000
DAP	111,105	137,210	243,849	336,723
JVP	431,210	697,850	1,155,863	1,484,110
Reserve	0	1,345	10,121	46,471
TALFF	1,457,685	1,163,595	590,167	132,696
Japan	1,019,891	861,332	455,439	101,446
ROK	264,160	239,872	112,177	29,900
West Germany	27,995	0	0	0
Portugal	6,815	600	0	0
Poland	55,556	35,295	8,043	0
USSR	30,000	10,782	0	0
China	0	0	4,920	1,350
Taiwan	0	0	0	0
Unallocated	53,268	15,714	9,545	0

Table 6. Estimates of maximum sustainable yields (MSYs) and comparisons of acceptable biological catches (ABCs) for 1987 and 1988 for groundfish in the eastern Bering Sea (EBS) and Aleutian Islands.

Species/Region	MSY (t)	ABC (t)	
		1987	1988
Pollock			
EBS	2,300,000	1,200,000	1,500,000
Aleutians	245,000	100,000	160,000
Pacific cod	283,600	400,000	385,300
Yellowfin sole	150,000	187,000	254,000
Greenland turbot	19,300	20,000	14,100
Arrowtooth flounder	50,000	30,900	109,500
Other flatfish	229,700	193,300	331,900
Sablefish			
EBS	4,100	3,700	4,500
Aleutians	5,000	4,000	7,700
Pacific ocean perch			
EBS	7,400	3,800	6,000
Aleutians	18,900	10,900	16,600
Other rockfish			
EBS	500	450	400
Aleutians	1,300	1,430	1,100
Atka mackerel	39,000	30,800	21,000
Squid	> 10,000	10,000	10,000
Other species	59,000	49,500	54,000

Total all species	3,422,800	2,245,780	2,876,100

Footnote: Although MSY's add to 3.4 million t, it is not a reasonable estimate of MSY for the groundfish species complex. Aggregate MSY should be much lower because it is theoretically and practically improbable that all species in the groundfish complex would produce at MSY at the same time.

Table 7.--Summary of ABC calculations and stock abundance for groundfish in the eastern Bering Sea (EBS) and Aleutian Islands (AI) for 1988.

Species/Region	Biomass (t)	Exploitation rate (%)	ABC (t)	Abundance and trend
Pollock EBS	6,500,000	23	1,500,000	Relatively high, stable
AI	690,000	23	160,000	Relatively high, stable
Pacific cod	1,481,000	26	385,300	Very high, stable
Yellowfin sole	1,408,000	18	254,000	Very high, stable
Greenland turbot	414,000	3.4	14,100	Average, declining
Arrowtooth flounder	377,700	29 ¹	109,500	Very high, increasing
Other flatfishes	2,142,000	15.5	331,900	Very high, stable
Sablefish EBS	56,500	8	4,500	High, declining
AI	96,300	8	7,700	High, stable
Pacific ocean perch EBS	101,000	6	6,000	Below average, slow increase
AI	276,500	6	16,600	Below average, slow increase
Other rockfish EBS	7,100	6	400	Average, stable
AI	18,500	6	1,100	Average, stable
Atka mackerel			21,000	Below average, trend unknown
Squid	--	--	10,000	Average, stable
Other species	54,000	10	54,000	Average, stable
Groundfish complex	>13,622,600		2,876,100	High, stable

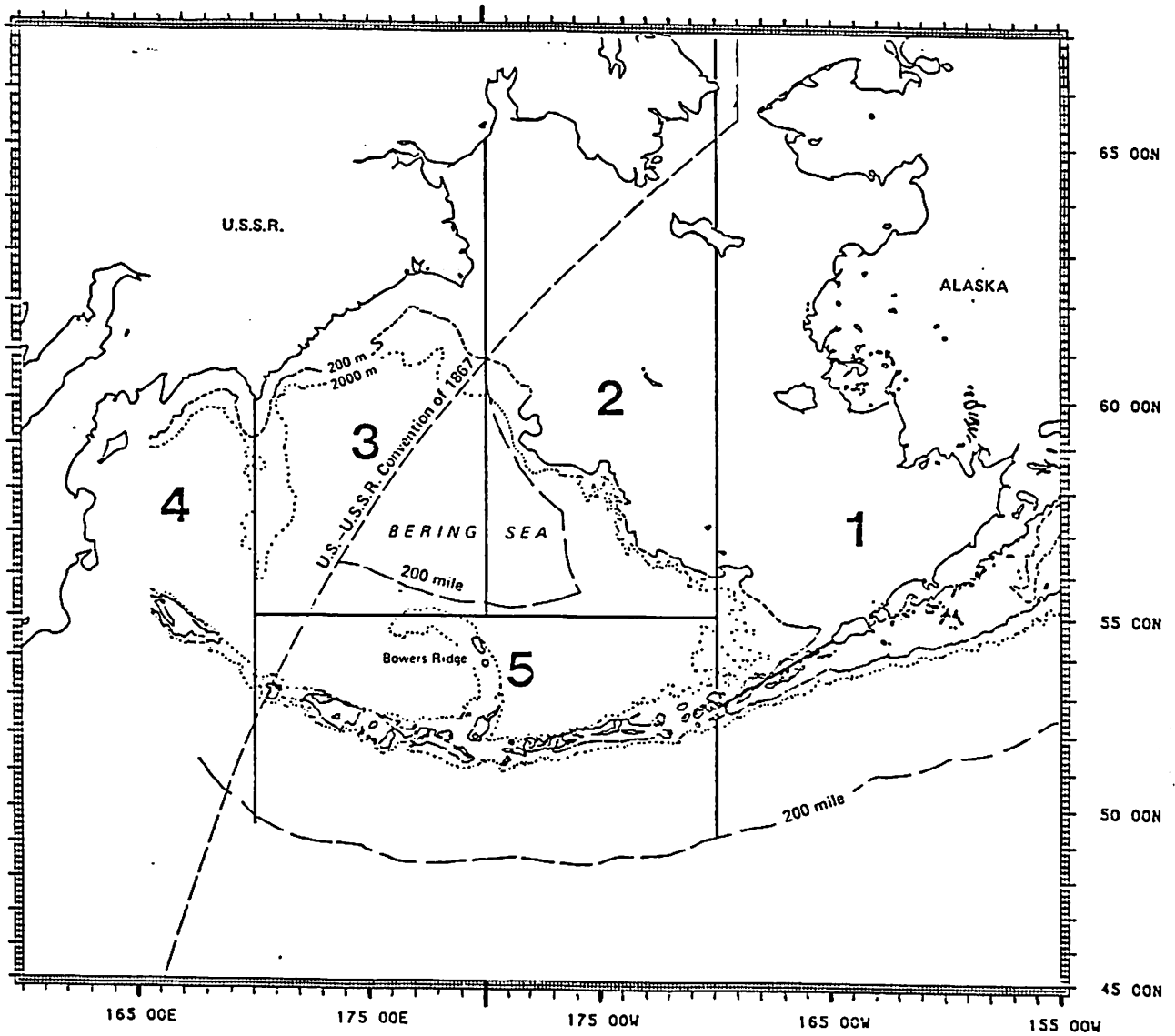


Figure 1.--Bering Sea showing U.S. 200-mile fishery conservation zone and eastern Bering Sea (areas 1 and 2) and Aleutian Islands region (area 5) management areas. Areas 1-5 are International North Pacific Fisheries Commission statistical areas.

Footnote on Area Notations

INPFC Areas	1	2	3	4	5
U.S. Management Areas ...	I	II	III	None	IV

BERING SEA/ALEUTIAN ISLANDS PUBLIC COMMENT SUMMARY

Comments Received on Initial 1988 ABCs and Proposed TACs

1. Kodiak Longliners' Assn. - recommends that the Council use the plan team, rather than the SSC, estimates for ABCs.
2. Domestic Processors - a letter signed by a group of domestic processing interests advocated no change to 1987 ABCs, stating that both the plan team and SSC estimates for 1988 are unnecessarily risky and threaten prudent conservation of the stocks.
3. Kemp Pacific Fisheries - similar comments as group of domestic processors above.
4. Pacific Seafood Processors Assn. - similar comments as group of domestic processors above.
5. Wards Cove Packing Co. - similar comments as group of domestic processors above.
6. Japan Fisheries Agency - recommends that the Council set ABCs somewhere between estimates given by the plan team and the SSC.
7. Fishing Vessel Owners' Assn. - recommends that ABCs not be increased unless there has been an identifiable increase in biomass.
8. American High Seas Fisheries Assn. - recommends that ABCs and TACs be generally set at values presented in analyses of the September RAD. Specifically, pollock (EBS) = 1.41 million mt, (AI) = 126,000 mt; yellowfin sole = 257,000 mt; and Pacific cod = 326,000 mt.
9. Murray Hayes - cautions against defining ABC as product of biomass and MSY exploitation rate.

BERING SEA/ALEUTIAN ISLANDS GROUND FISH: Preliminary recommendations for 1988 ABC; Council recommendations for 1988 TAC, DAP, JVP, and TALFF apportionments; and Catch-to-date (all in metric tons).

Species	Area	1987		1988 ABC Recommendations		Current 1987 and Proposed 1988 Apportionments				Catch to early 9/87	
		ABC	TAC 1/	(PT)	(SSC) 2/	TAC 3/	DAP	JVP	TALFF	DAP	JVP
Pollock	BS	1,200,000	1,200,000	1,410,000	2,820,000	1,200,000	185,987	1,009,013	5,000	106,715	967,416
	AI	100,000	88,000	160,000	320,000	88,000	7,210	80,790	0	126	26,479
Pacific cod		400,000	280,000	326,000	700,000	280,000	91,767	94,938	73,295	33,160	53,697
Yellowfin sole		187,000	187,000	216,000	349,000	187,000	100	181,900	5,000	0	182,775
Greenland turbot		20,000	20,000	19,000	19,000	20,000	15,213	67	1,750	5,821	56
Arrowtooth flounder		30,900	9,795	109,500	109,500	9,795	830	3,363	5,602	21	806
Other flatfish		193,300	148,300	440,700	440,700	148,300	17,043	71,972	37,080	13,374	33,803
Sablefish	BS	3,700	3,700	3,900	6,800	3,700	3,310	350	40	2,728	1
	AI	4,000	4,000	6,700	11,600	4,000	3,317	83	0	2,958	44
Pacific ocean perch	BS	3,800	2,850	6,000	6,000	2,850	2,423	120	17	403	43
	AI	10,900	8,175	16,600	16,600	8,175	6,786	563	0	312	490
Other rockfish	BS	450	450	400	400	450	382	59	9	352	5
	AI	1,430	1,430	1,100	1,100	1,430	1,001	304	0	92	226
Atka mackerel		30,800	30,800	21,000	21,000	30,800	250	30,540	10	104	25,014
Squid		10,000	500	10,000	10,000	500	4	48	393	0	35
Other species		49,500	15,000	59,000	59,000	15,000	500	10,000	4,500	204	5,750
BS/AI TOTAL		2,245,780	2,000,000	2,805,900	4,890,700	2,000,000	336,123	1,484,110	132,696	166,370	1,296,640

- NOTES:
1. These TACs were immediately reduced by 15% for apportionment to non-specific reserves.
 2. The Council endorsed recommendations from the SSC, which were generally ranges from PT recommendations upwards to the values listed.
 3. Current reserves equal 47,071 mt; actual 1988 apportionments will initially set reserves equal to 15% of the sum of TACs.

Sept. 30, 1987