MEMORANDUM

TO: Council, SSC and AP Members

FROM: Clarence G. Pautzke
Executive Director

DATE: December 2, 1992

SUBJECT: Gulf of Alaska and Bering Sea/Aleutian Islands Groundfish

ACTION REQUIRED

(a) Review recommended assumed mortality rates for halibut bycatch.

(b) Consider comprehensive Gulf of Alaska rockfish management and receive report from Rockfish Committee.

(c) Consider adopting policy of setting TAC below ABC to provide a conservation buffer.

BACKGROUND

(a) Assumed mortality rates for halibut

In 1992, fisheries were managed using assumed halibut discard mortality rates of 75% for BS/AI trawl fisheries, 65% for GOA trawl fisheries, 16% for all hook and line fisheries, and 10% for pot fisheries. Based on a study of release condition factors, prepared by the IPHC and NMFS, the groundfish Plan Teams are recommending that fisheries in 1993 be managed using fishery-specific discard mortality rates as follows:

BS/AI Trawl fisheries

Midwater pollock - 80%
Atka mackerel, rock sole, yellowfin sole, and other flatfish - 70%
Pacific cod, bottom trawl pollock, and rockfish - 60%
Arrowtooth flounder, Greenland turbot, and 'other species' - 40%

GOA Trawl fisheries

Midwater pollock - 75%
Rockfish, shallow water flatfish, and 'other species' - 60%
Pacific cod, bottom trawl pollock, and deepwater flatfish - 55%

BS/AI Hook and Line

All targets - 20%

GOA Hook and Line

Pacific cod and rockfish - 16%
Sablefish - 25%

BS/AI and GOA Pot fisheries

All targets - 5%

The Plan Teams reviewed the analysis, included here as Item D-1(a)(1), and believe that use of these fisheries specific rates represent an improvement over the rates used in the past which were an aggregate, by gear type, across all fisheries. The Council should provide a recommendation to NMFS on use of these assumed mortality rates in managing the 1993 fisheries.

(b) Comprehensive Gulf of Alaska Rockfish Management

The Gulf of Alaska groundfish Plan Team met in November to prepare the stock assessment documents which will be presented under a separate agenda item. Much of the Team's discussion was centered on rockfish, in light of Council initiation of long-term management planning for these species. The Plan Team reviewed the latest stock assessment information for all of the rockfish species/complexes and reviewed a draft analysis of stock projections for Pacific Ocean Perch (POP) under four alternative exploitation strategies. This analysis, prepared by rockfish stock assessment scientists from NMFS, is included in your notebook as Item D-1(b)(1).

When the Council takes up rockfish under Gulf groundfish specifications, Agenda Item D-1 (d), staff will provide a detailed explanation of the biomass and ABC recommendations for 1993. In summary, the following recommendations are being made by the Plan Team: (1) use of an F35% exploitation strategy for POP, adjusted downward by the ratio of current female spawning biomass to B35% (35% of the unfished level of female spawning biomass); (2) breaking out Northern rockfish from the 'other slope' category and managing it separately, due to disproportionate targeting on this species relative to its percentage of the biomass; (3) reduction of the ABC for pelagic shelf rockfish based on the proportion of Dusky rockfish biomass in this complex; and (4) reduction of the natural mortality rate used for thornyheads, which results in a lower exploitation rate for this species.

Two draft working papers (1) Do Trawl Surveys Underestimate Rockfish Biomass?, by Steve Davis of LGL Alaska Research Associates, and (2) A Review of Rockfish Management in the Gulf of Alaska, by Barry Bracken of ADF&G were provided to the Plan Team as background information. The Plan Team reviewed these documents and found them useful to the discussions; however, the Plan Team does not explicitly endorse either paper. They are provided here, as Item D-1(b)(2) and Item D-1(b)(3) respectively, as background for the Council on the issue of rockfish management. Estimates of unreported discards of shortraker/rougheye and thornyhead rockfish in the hook and line sablefish fishery are provided in Item D-1(b)(4). Additional information, on discards of POP in other fisheries, may be available at this meeting as a supplemental item.

The Council's Rockfish Committee met on November 23, the week after the Plan Team meeting, and was provided the same documentation described above. The Committee's report is contained here as Item D-1(b)(5).

(c) Setting a Buffer Between ABC and TAC

Item D-1(c)(1) in your notebook is a letter from the Commissioner of the Alaska Department of Fish and Game urging the Council to adopt a policy of setting a buffer between ABC and TAC, for not only rockfish but all species. When TACs are set equal to ABC, the ABC then becomes the target harvest level. The rationale for the Commissioner's request is to prevent harvests from exceeding ABC, which should be a maximum level of allowable harvest. This is especially important when ABC may be equal to the overfishing level.

APPENDIX III

PACIFIC HALIBUT DISCARD MORTALITY RATES IN THE 1991 GROUNDFISH FISHERY OFF ALASKA

By
Gregg H. Williams (IPHC) and Thomas K. Wilderbuer (NMFS)
November, 1992

Abstract

Halibut discard mortality rates for the 1991 groundfish fisheries are calculated from data collected by NMFS observers. In general, trawl and pot rates were lower in 1991 than in 1990, whereas hook and line fishery rates were higher, in some cases substantially. For BSAI trawl fisheries, midwater pollock was estimated at 80%; atka mackerel, rock sole, and other flatfish at 70% (yellowfin sole was not an assigned target in 1991, but was the predominant fishery in "other flatfish"); Pacific cod, bottom trawl pollock, and rockfish at 60%; and 40% for arrowtooth flounder, Greenland turbot, and "other species". For GOA trawl fisheries: midwater pollock was estimated at 75%; rockfish, shallow water flatfish, and "other species" at 60%; and 55% for Pacific cod, bottom trawl pollock, and deep water flatfish. All BSAI hook and line fisheries were estimated at 20%. GOA hook & line fisheries were split at 16% for Pacific cod and rockfish, and 25% for sablefish. All pot fisheries were estimated at 5%. We recommend monitoring bycatch mortality for 1993 trawl and pot fisheries using the results of our analysis. Unless an in-season program requiring "careful release" techniques is adopted for hook and line fisheries, our results for hook and line fisheries should also be used.

Summary of Data Collected During 1991

We used the species composition of a vessel's weekly catch (reporting week) as the basis for determining target fishery (Table 1). These criteria were the same as those used by NMFS during 1991 in-season monitoring of fishery catches, PSC bycatches, and for the vessel incentive program.

We excluded fishery targets which were determined by the North Pacific Fishery Management Council as "bycatch-only", or targets which were artifacts of the target classification process. This included a trawl fishery for sablefish in the GOA, and hook and line fisheries for pollock, arrowtooth flounder, greenland turbot, and deep water flatfish. In most cases, the number of hauls for these categories was less than 10.

We summarized the data on groundfish catches, halibut bycatch, and the release condition data by fishery (Table 2). In 1991, observers examined 203,367 bycaught halibut for discard condition: 162,791 from trawlers, 38,647 from longline vessels, and 1,929 from vessels fishing groundfish pots. Sample size was quite large for most fisheries: the number of halibut examined in each trawl fishery usually exceeded 2,000 fish in the BSAI and 500 fish in the GOA. Sample sizes in the hook and line fisheries were large in the major fisheries, but somewhat low in the rockfish fisheries. This is probably a reflection of the relatively small size of the fishery and the lack of observer coverage on the smaller vessels in the fishery.

We also compiled length frequency data by fishery (Figures 1 through 4). The number of fish measured by observers was usually quite large, except for the smaller hook and line fisheries. The proportion of halibut $\leq$ 80 cm for each fishery is shown in Table 2. This length roughly corresponds to the minimum retainable size in the directed halibut fishery.

Trawl Fishery Discard Mortality Rates

Clark et al. (1992) reviewed the approach developed by Hoag (1975) and recommended revising the survival rates for halibut released from trawls. We adopted this recommendation for this analysis. Converting the survival rates to mortality results in a 20% mortality rate for excellent/good condition fish, 55% for fair/poor fish, and 90% for "dead" fish.

The discard mortality rate for a fishery is calculated by applying the mortality rate for condition category to the proportion of fish in that category, shown in Table 2, and summing the products across all condition categories:

$$Discard\ mortality\ rate = \Sigma(M_a)(p_a)$$

where M_a = mortality rate for each condition, a = excellent, poor, or dead;
p_a = Proportion of fish in each category, a = excellent, poor, or dead.

1991 Results

The observer data summarized in Table 2 indicate that condition factor distribution varies considerably between fisheries. For example, the proportion of excellent condition fish ranged from a low of 7% to a high of 84% in BSAI fisheries and 12% to 45% in GOA trawl fisheries. No doubt this is a function of the different manner in which each fishery operates and the cumulative effect of the factors that control halibut condition in trawls: tow duration, size of catch, size of halibut in the bycatch, length of time on deck, handling by crew, and target species.

In the BSAI, trawl fisheries that had very large groundfish catches (> 16 mt) and/or caught small fish (< 1.5 kg per individual) generally had a relatively high proportion of poor and dead condition halibut. Conversely, those fisheries that caught relatively bigger halibut (2-3+ kg per fish) and/or have a smaller catch size (< 13 mt) showed halibut to be in better condition.

In the GOA, these trends also appeared to be present, but were less definite. Larger catch size contributed to poorer condition, even though halibut size was fairly large (5-8 kg per individual), which should have resulted in better condition. In these instances, we believe that other factors may be complicating halibut condition, such as injuries from rockfish spines.

In some cases the distribution of condition was similar between fisheries. We tested the condition distributions of all fisheries using contingency table analysis of categorical data to discern if the differences were statistically significant. The results indicated significance between all fisheries, which was not unexpected given the large number of fish examined in each fishery. This means that each fishery possesses a unique condition distribution, even though the condition data may appear to be similar or almost identical.

Next, we used the condition data to calculate discard mortality rates. For BSAI fisheries, calculated rates ranged from a high of 81% in the midwater pollock fishery to a low of 29% for the "other species" fishery (Table 3). The major flatfish fisheries plus the "midwater" fisheries (pollock, atka mackerel) were highest, roughly 70% or greater. Bottom trawl fisheries for cod, pollock, and rockfish were lower, approximately 60% or less. "Directed" fisheries for greenland turbot and arrowtooth flounder were calculated at about 40%, although fisheries for these species are limited.

For GOA trawl fisheries the range was narrower, from 52% for deep water flatfish to 74% for midwater pollock (Table 3). Rockfish, shallow water flatfish, and "other species" were among the highest, ranging from 65% to 59%. Fisheries for Pacific cod, bottom trawl pollock, and deep water flatfish were slightly lower, at 52% to 56%.

Comparison Between 1990 and 1991

We calculated the discard mortality rates for the 1990 fisheries, and these are also shown in Table 3. With the exception of minor increases in BSAI fisheries for atka mackerel and rock sole and GOA fisheries for midwater pollock and rockfish, the discard mortality rate declined slightly in most fisheries. Using contingency table analysis, we tested the annual differences for statistical significance, but once again the size of the samples was so large as to make any difference statistically significant. We detected nothing in the observer data (e.g. changes in length of tow or catch size) that might cause the increases or decreases observed.

Hook and Line Fishery Discard Mortality Rates

The approach for estimating discard mortality rates in hook and line fisheries, described in several prior documents (e.g., Williams and Wilderbuer 1991), can be summarized as follows: (1)we assume a 2-5% handling mortality of halibut in the best condition (excellent); (2)halibut in poor condition have half the survival of excellent condition fish; and (3)all "dead" fish actually die. This yields the following set of mortality rates for each condition:

Condition	Low Mortality	High Mortality
Excellent	2%	5%
Poor	51%	53%
Dead	100%	100%

Although survival experiments of hook and line bycaught halibut have not been conducted, we believe the assumed mortality values are reasonable. These values probably provide a conservative estimate of a discard mortality rate, if only because some of the "dead" fish may survive. But usually the proportion of "dead" fish is low in hook and line fisheries, so any survival of "dead" fish probably has a minimal effect on the overall estimate.

1991 Results

Table 2 shows the distribution of halibut condition for the hook and line fisheries in the BSAI and GOA. The three major hook and line fisheries (GOA sablefish and cod, BSAI cod) had large sample sizes, roughly 3,000 fish or more. As with the trawl fisheries, condition factor distributions differed among target fisheries. The proportion of halibut in excellent condition was ranged from 60% to 80%. Conversely, the range of fish classified as dead was narrower, roughly 5-11%.

Overall, discard mortality rates in hook and line fisheries ranged from 16% to a high of 30% (Table 3). Rates appeared to be lowest in the GOA cod and BSAI sablefish fisheries, intermediate in GOA rockfish and BSAI cod, and highest in GOA sablefish and BSAI rockfish. We suspect that the fast-paced, "Olympic" nature of the GOA sablefish fishery is one of the primary reasons that discard mortality rates are high for that fishery, although it is unclear why BSAI rockfish would also be so high. The other hook and line fisheries are less harried, so it is not unreasonable that their rates are lower. We speculate that other, unidentified variables, such as hook strippers or poor handling by inexperienced fishermen, are contributing factors.

Comparison Between 1990 and 1991

Discard mortality rates for the 1990 fisheries are shown in Table 3. In all cases, the rates increased from 1990 to 1991. We suspect the increase is due to the number of new, large, inexperienced hook and line vessels into the fisheries, especially into BSAI cod. For example, preliminary data for 1991 indicates a 32% increase in the number of vessels in the GOA sablefish fishery (J. Terry, NMFS, personal communication). The increase would have an effect on the rates if it represented vessels that were required to carry observers. Vessels with no observer coverage ($\leq$ 60 feet LOA) would not be represented in the condition data.

Groundfish Pot Fishery Discard Mortality Rates

To determine a discard mortality rate for pot-captured halibut in last year's analysis (Williams and Wilderbuer 1991), we used the assumption that all poor and dead condition halibut die, and that all excellent condition fish survive. The mortality rate is therefore approximated by summing the percentage of poor and dead condition fish. There is no new information to suggest a better method this year, so we continued to use this method in our calculations in this analysis.

1991 Results

Condition distributions for GOA and BSAI pot fisheries for cod are shown in Table 2. Catching halibut in groundfish pots inflicts little damage or injuries, and the proportion of excellent condition fish is quite high. Halibut caught in the GOA pot fishery were slightly larger in size, which apparently resulted in a slightly better overall condition than in the BSAI pot fishery. The condition data were nearly identical between the GOA and BSAI fisheries.

Comparison Between 1990 and 1991

The results (Table 3) indicate that halibut were in better condition upon release in 1991 than in 1990. The discard mortality rates for 1991 were roughly half of the values calculated for 1990. We could not identify the cause of the improvement.

Conclusions

This analysis brings out several key points. First, that discard mortality rates vary widely among fisheries and regions. This variability is caused by the normal differences in fishery operations that control condition upon release and therefore discard mortality.

Second, halibut release condition and discard mortality rates can vary annually, in some cases by quite a bit. While many of the contributing factors are affected to some degree by the vessel operation or individual crewman, we would not have expected to see such large changes. Since the condition sampling routines for observers were unchanged, the changes we noted must be due to changes in fishermen's behavior and/or fishing methods. This is especially true with hook and line fisheries, since the crewman at the roller has the greatest impact on condition. This is less true on trawlers, simply because catch size and time on deck are the biggest factors, and the Olympic-paced fishery will not allow a vessel to make substantial changes in either factor. Hence, we expect to see only minor changes in the discard mortality rates on trawlers under current fishery conditions. An allowance of on-deck sorting by factory trawlers would, however, be a great opportunity to reduce deck time and therefore mortality. For hook and line fishermen, efforts to improve release or practice "careful release" techniques should translate to improved discard condition.

Recommendations

With trawl fisheries, we have suspected that discard mortality rates would vary by fishery, and the results verify this. The differences between fisheries are real, but in some cases it is so small that some rates are probably equal or close to it. For that reason, we have aggregated fisheries with similar rates.

Under ideal conditions, bycatch mortality should be monitored using in-season, vessel-specific data. Until this type of program is operating, we recommend that halibut bycatch mortality be monitored in 1993 using results from this analysis. Specifically, we recommend the following set of discard mortality rates:

<u>BSAI Trawl</u>

Midwater pollock: 80%
Atka mackerel, rock sole, and other flatfish: 70%
Pacific cod, bottom trawl pollock, and rockfish: 60%
Arrowtooth flounder, Greenland turbot, and "other species": 40%

<u>Gulf of Alaska Trawl</u>

Midwater pollock: 75%
Rockfish, shallow water flatfish, and "other species": 60%
Pacific cod, bottom trawl pollock, and deep water flatfish: 55%

<u>BSAI Hook & Line</u>

All targets: 20%

<u>GOA Hook & Line</u>

Pacific cod and rockfish: 16%
Sablefish: 25%

<u>BSAI and GOA Pots</u>

All targets: 5%

Target fishery definitions have changed somewhat from 1991. In 1992, the BSAI trawl fishery for yellowfin sole was added, and "other flatfish" was grouped with rock sole. Formerly, the yellowfin sole fishery was under the "other flatfish" target. We suggest that the yellowfin sole fishery be assigned a 70% discard mortality rate, since it was the dominant component of the "other flatfish" target in 1990 and 1991.

In addition, we suggest that halibut bycatch mortality in 1991 and 1992 be recalculated using these rates.

References Cited

Clark, William G., Stephen H. Hoag, Robert J. Trumble, and Gregg H. Williams. 1992. Re-estimation of survival for trawl caught halibut released in different condition factors. International Pacific Halibut Commission, Seattle, WA. Unpublished report.

Hoag, Stephen H. 1975. Survival of halibut released after capture by trawls. International Pacific Halibut Commission, Scientific Report No. 57, 18 p.

Williams, Gregg H. and Tom Wilderbuer. 1991. Revised estimates of Pacific halibut discard mortality rates in the 1990 groundfish fisheries off Alaska. Appendix III [IN] Stock assessment and fishery evaluation report for the 1992 Gulf of Alaska groundfish fishery. Gulf of Alaska Groundfish Plan Team. No. Pa. Fish. Mgmt. Council, Anchorage, AK.

Table 1. Target fishery definitions based on total catch excluding prohibited species, non-allocated species, and arrowtooth flounder in the Gulf.

Gulf of Alaska

Pacific cod: ≥ 45%

Rockfish: ≥ 30%

Shallow water flatfish: rock sole + yellowfin sole ≥ 20%

Deep water flatfish: dover sole + rex sole + other flatfish ≥ 20%

Bottom trawl pollock: ≥ 20%

Midwater trawl pollock: ≥ 95%

Other: anything else

Bering Sea/Aleutians

Turbot: ≥ 35%

Pacific cod: ≥ 45%

Rock sole: (rock sole + yellowfin sole + other flats) ≥ 40%,
rock sole > (yellowfin sole + other flats)

Other flatfish: (rock sole + yellowfin sole + other flats) ≥ 40%

Arrowtooth flounder: ≥ 20%

Rockfish: ≥ 20%

Atka mackerel: ≥ 20%

Pollock midwater trawl: ≥ 95%

Pollock bottom trawl: ≥ 20%

Other: anything else

Table 2. Summary information on catch size and halibut bycatch in 1991 groundfish fisheries.

Fishery	Groundfish Catch (mt)	Avg. Catch per tow (mt)	Halibut Bycatch: 1991 Halibut Bycatch (mt)	Halibut Bycatch: Avg. Wgt. (kg, rd wt)	Halibut Bycatch: % ≤ 80 cm	Condition subsample: No. Tows Sampled[1]	Condition subsample: No. Halibut Examined	Condition subsample: % Excellent	Condition subsample: % Poor	Condition subsample: % Dead
BSAI TRAWL										
MWT Pollock	1,171,670	59.9	582	5.0	82	954	3,258	7	13	81
Atka mackerel	28,107	23.6	64	1.7	88	233	2,631	9	30	61
Rock sole	58,056	18.9	929	0.8	98	1,142	17,106	17	29	54
O. flatfish	133,951	16.7	776	1.4	95	1,515	8,798	19	9	72
Pacific cod	93,795	13.3	1,818	0.9	99	2,331	55,389	27	31	42
BT Pollock	180,217	23.6	1,166	1.2	94	1,895	27,571	30	29	42
Rockfish	3,637	13.8	44	2.1	95	205	2,732	39	27	35
Arrowtooth	7,607	10.2	319	3.9	77	321	3,945	62	16	22
Turbot	6,750	11.3	320	8.6	52	184	2,122	62	24	14
Other sp.	3,418	9.6	72	2.0	91	26	640	84	8	9
GOA TRAWL										
MWT Pollock	79,870	27.6	32	5.1	87	80	366	12	22	66
Rockfish	12,195	12.9	1,064	8.2	43	305	3,092	21	29	50
BT Pollock	20,049	11.5	617	1.6	97	30	337	25	46	29
Sh. Flatfish	1,893	7.4	40	2.3	86	54	877	28	28	44
Other sp.	5,010	10.4	49	5.5	72	739	4,620	30	29	41
Pacific cod	56,674	11.9	924	2.0	94	1,213	28,741	34	33	34
Dp. Flatfish	17,906	7.6	937	4.5	75	53	566	45	18	37

[1]Tows where halibut were examined for release condition. Data were not collected from every tow.

.....continued

Table 2. (Continued) Summary information on catch size and halibut bycatch in 1991 groundfish fisheries.

Fishery	Groundfish Catch (mt)	Avg. Catch per set (mt)	Halibut Bycatch: 1991 Halibut Bycatch (mt)	Halibut Bycatch: Avg. Wgt. (kg, rd wt)	Halibut Bycatch: % ≤ 80 cm	Condition Subsample: No. sets sampled[1]	Condition Subsample: No. Halibut Examined	Condition Subsample: % Excellent	Condition Subsample: % Poor	Condition Subsample: % Dead
BSAI H&L										
Pacific cod	69,189	17.7	2,549	5.2	86	1,646	26,842	69	26	5
Sablefish	3,542	4.6	230	20.0	57	23	335	82	8	10
Rockfish	81	3.5	12	9.0	68	18	75	67	15	19
GOA H&L										
Pacific cod	7,289	5.8	956	8.3	64	247	7,934	79	15	7
Sablefish	18,822	2.2	4,146	12.1	40	191	3,271	61	29	11
Rockfish	602	2.1	60	11.1	35	21	190	75	15	10
BSAI POT										
Pacific cod	4,361	3.0	38	6.1	66	238	1,215	97	1	2
GOA POT										
Pacific cod	10,489	1.6	49	4.2	91	245	714	95	2	3

[1]Sets where halibut were examined for release condition. Data were not collected from every set.

Table 3. Comparison of 1990 and 1991 calculated discard mortality rates.

	1990				1991			
Fishery	% Exc	% Poor	% Dead	Discard Mortality Rate	% Exc	% Poor	% Dead	Discard Mortality Rate
BSAI TRAWL								
MWT Pollock	7	10	83	81	7	13	81	81
Atka mackerel	16	27	57	69	9	30	61	73
Rock sole	36	19	45	58	17	29	54	68
O. flatfish	16	16	68	73	19	9	72	74
Pacific cod	20	22	58	68	27	31	42	60
BT Pollock	25	22	53	65	30	29	42	59
Rockfish	27	28	45	62	39	27	35	54
Arrowtooth	34	25	41	57	62	16	22	41
Grnld. turbot	38	16	46	58	62	24	14	38
Other sp.	63	30	7	36	84	8	9	29
GOA TRAWL								
MWT Pollock	30	17	53	63	12	22	66	74
Rockfish	26	32	42	61	21	29	50	65
BT Pollock	23	27	50	65	25	46	29	56
Shall. flatfish	26	29	46	62	28	28	44	61
Other sp.	12	54	54	63	30	29	41	59
Pacific cod	28	28	44	61	34	33	34	55
Deep flatfish	39	16	46	57	45	18	37	52
BSAI H&L								
Pacific cod	78	16	5	15-18	69	26	5	20-22
Sablefish	85	12	3	11-14	82	8	10	16-19
Rockfish	72	26	3	17-20	67	15	19	28-30
GOA H&L								
Pacific cod	84	13	3	11-14	79	15	7	16-18
Sablefish	88	9	3	9-12	61	29	11	27-29
Rockfish	82	14	5	13-16	75	15	10	19-21
BSAI POT								
Pacific cod	93	6	1	7	97	1	2	3
GOA POT								
Pacific cod	90	4	6	10	95	2	3	5

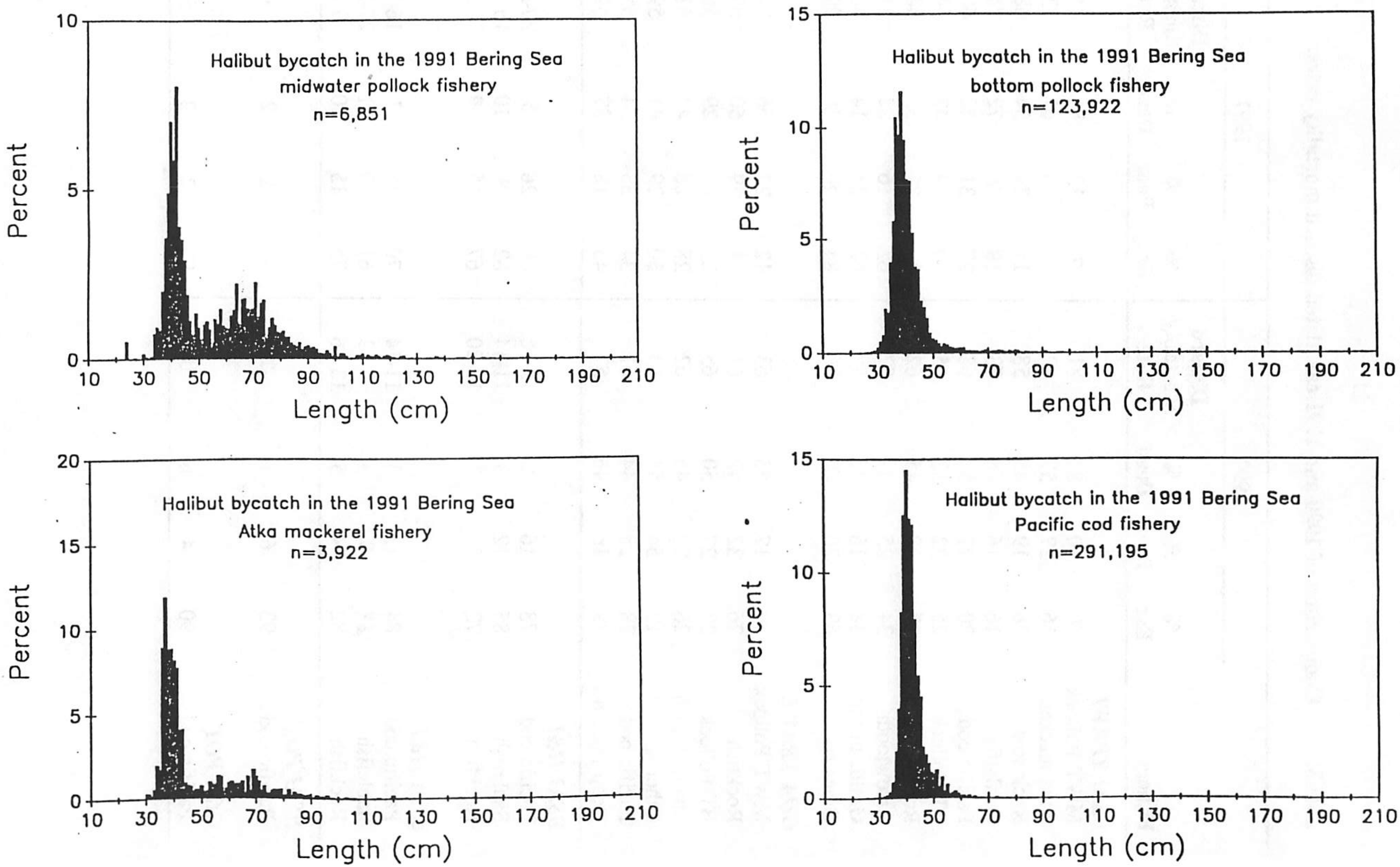


Figure 1. Pacific halibut length frequencies for 1991 Bering Sea/Aleutian trawl fisheries

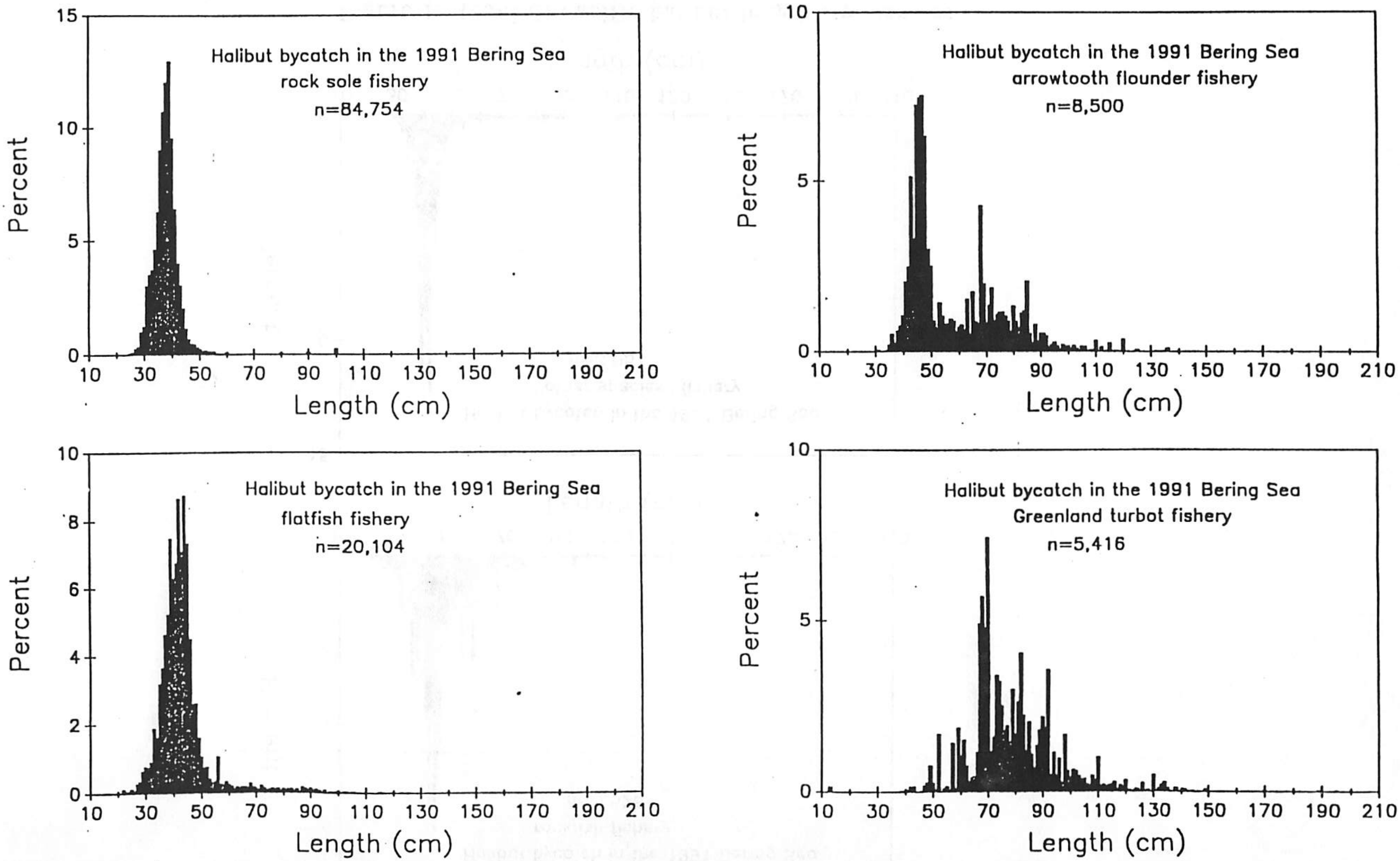
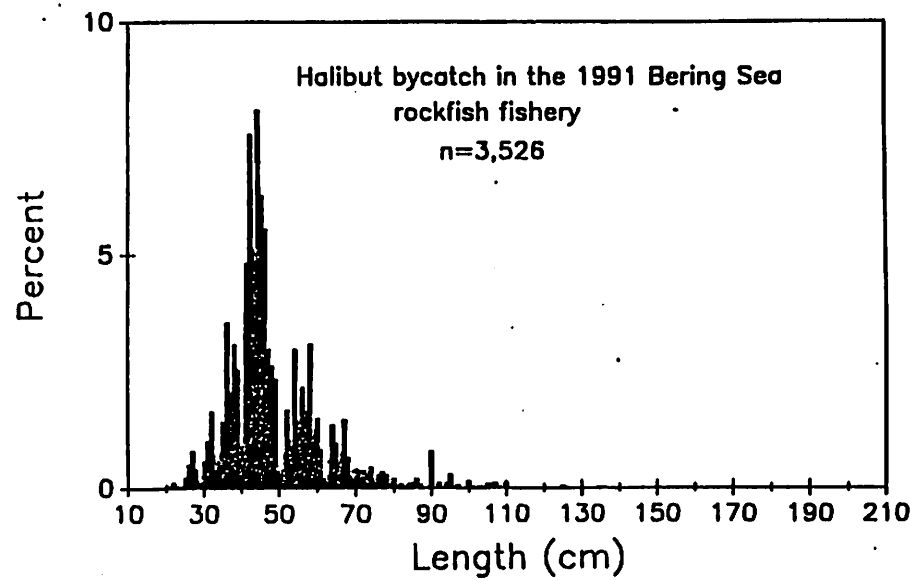


Figure 1. (cont'd) Pacific halibut length frequencies for 1991 Bering Sea/Aleutian trawl fisheries.



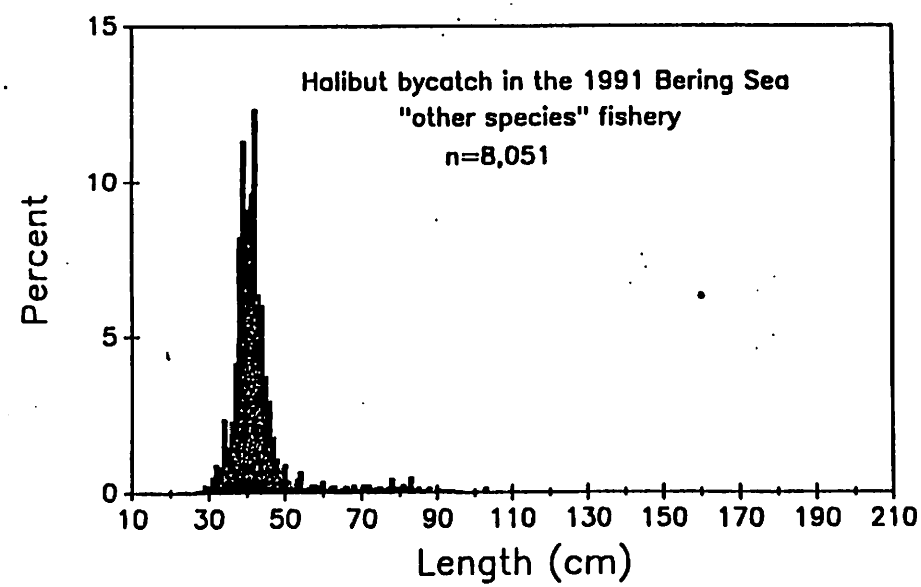


Figure 1. (cont'd) Pacific halibut length frequencies for 1991 Bering Sea/Aleutian trawl fisheries.

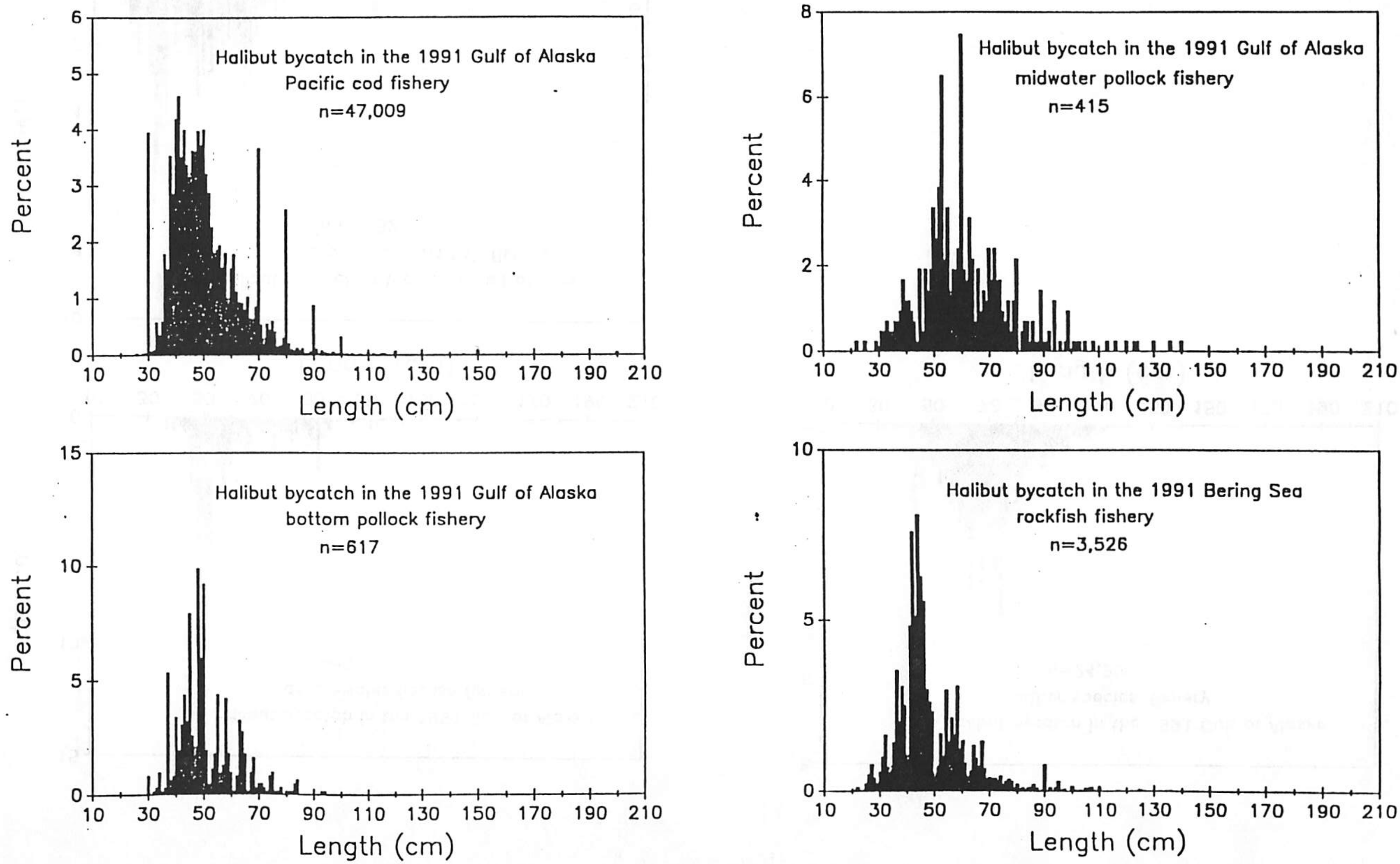


Figure 2. Pacific halibut length frequencies for 1991 Gulf of Alaska trawl fisheries.

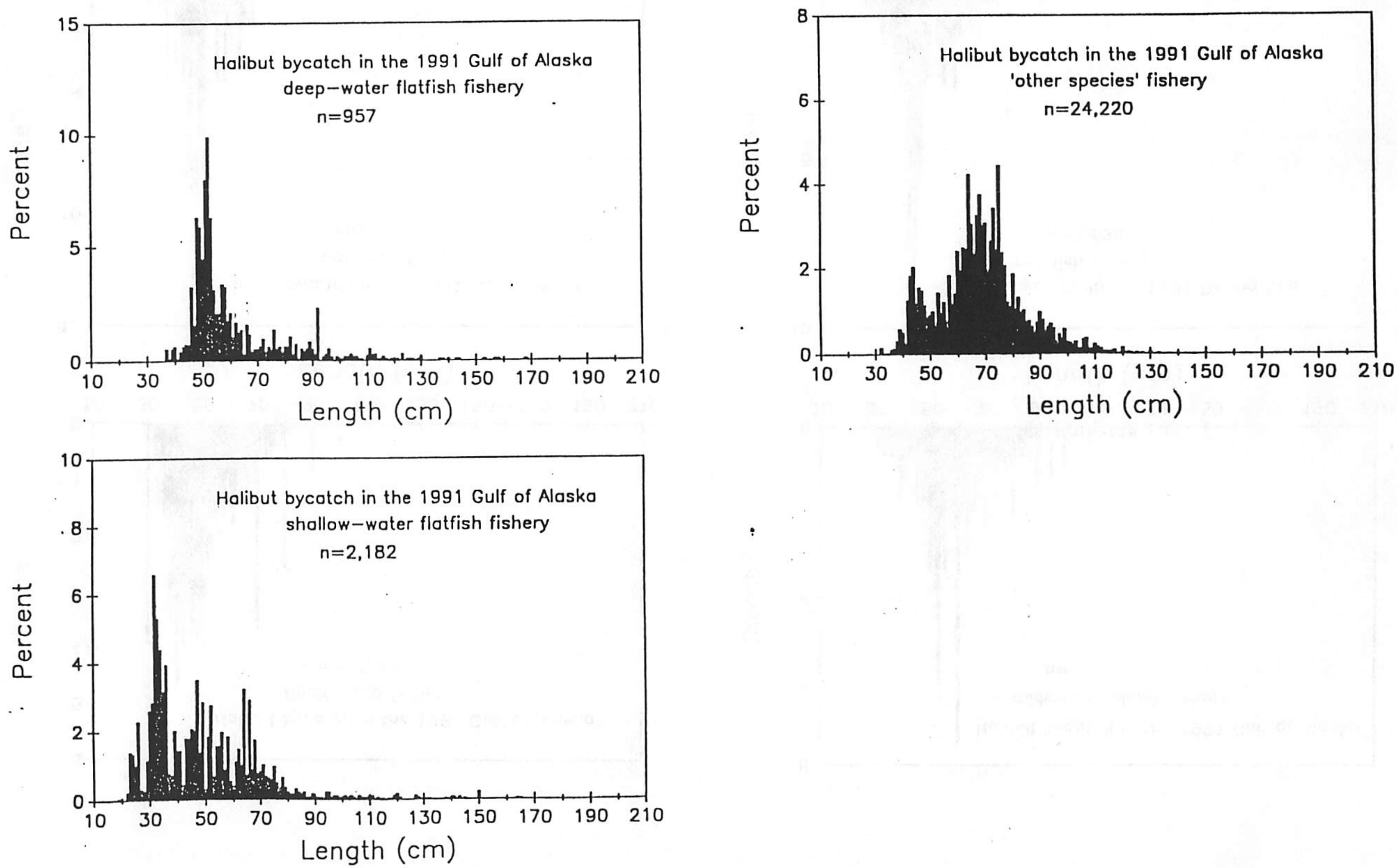


Figure 2. (cont'd) Pacific halibut frequencies for 1991 Gulf of Alaska trawl fisheries.

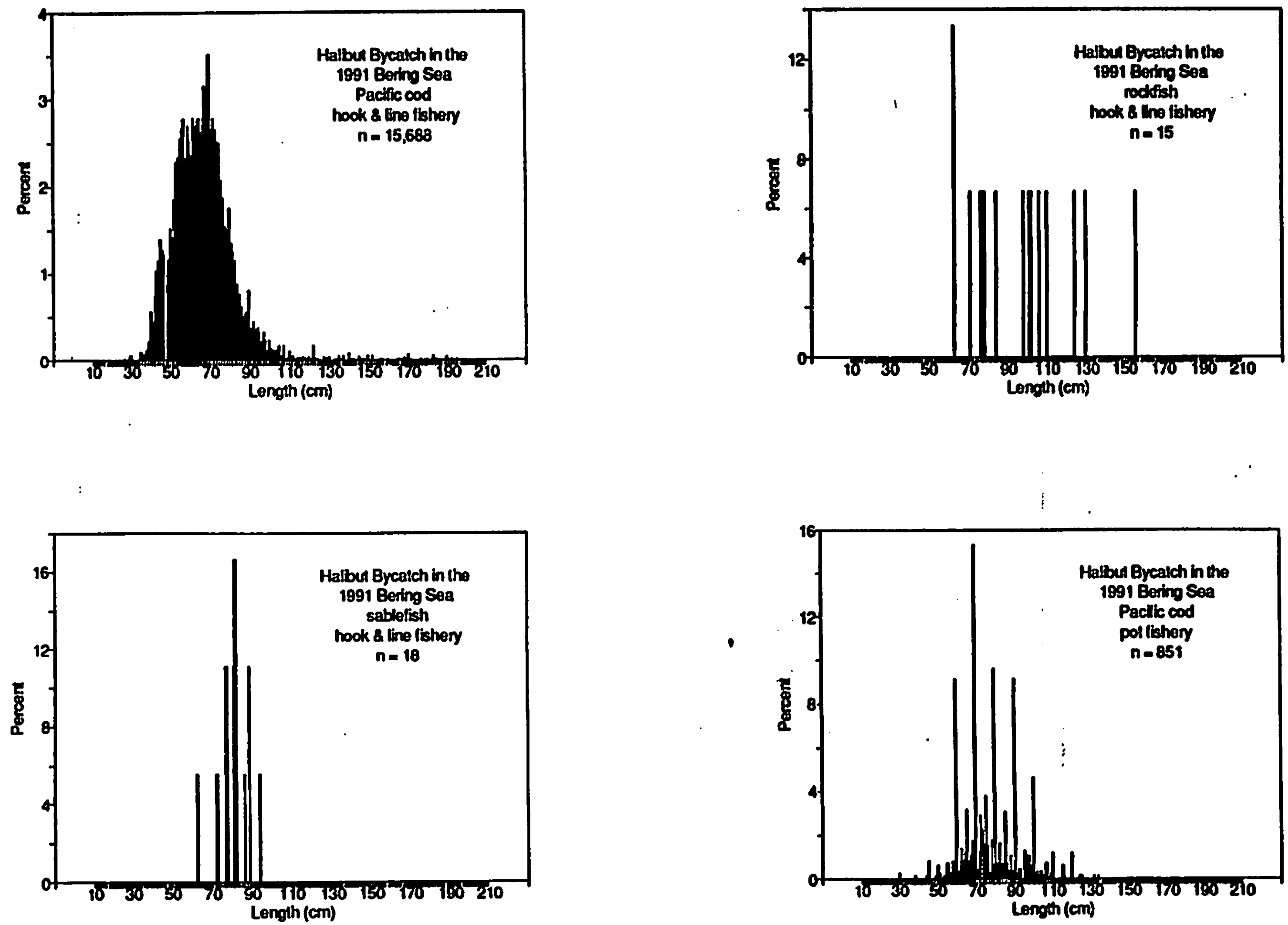


Figure 3. **Pacific halibut length frequencies for 1991 Bering Sea/Aleutian fixed gear (H&L, pot) fisheries.**

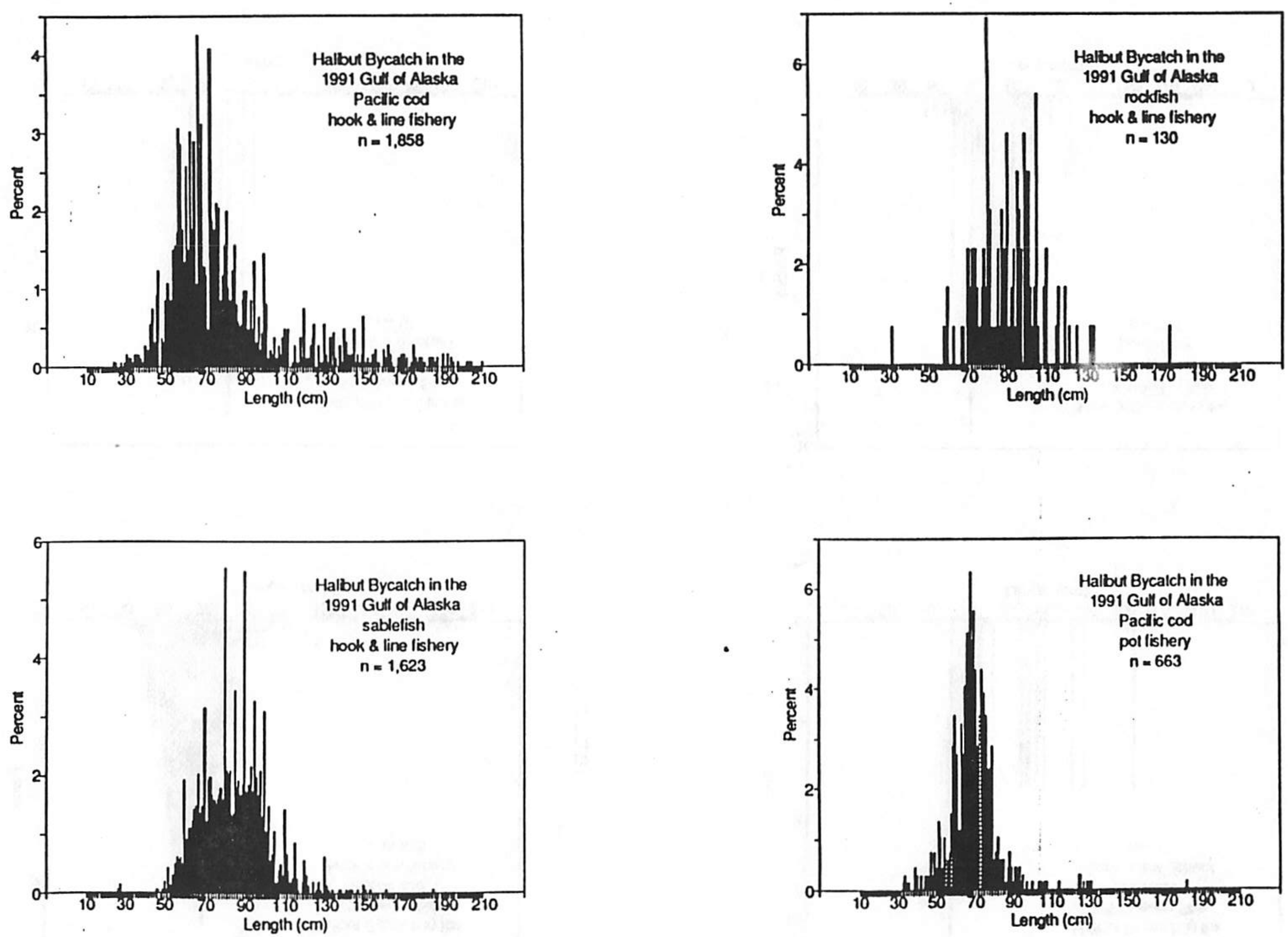


Figure 4. Pacific halibut length frequencies for 1991 Gulf of Alaska fixed gear (H&L, pot) fisheries.

AGENDA D-1(b)(1)
DECEMBER 1992

DRAFT

Stock Projections of Pacific Ocean Perch in the Gulf of Alaska Based on Different Harvest Strategies

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Introduction

In this analysis we use a simple Monte Carlo simulation with a stochastic stock-recruitment relationship to project stock size and yield for Pacific ocean perch in the Gulf of Alaska. Different harvest strategies are compared to evaluate their effectiveness in rebuilding the depleted stock to a desirable level. While no strategy can guarantee that the stock will rebuild to a desirable level within a specified time interval, this analysis should help managers make an informed decision on whether to establish a stock rebuilding program, the time frame for rebuilding, and the expected yields and risks for each strategy. Similar analyses have been used to provide management advice for overfished stocks in the northwest Atlantic ocean (Overholtz et al. 1986; Rosenberg and Brault 1990).

Balsiger et al. (1985) investigated rebuilding rates, long term yields, and economic consequences of applying different fishing rate strategies to Pacific ocean perch in the Gulf of Alaska. Their study was based on virtual population analysis and stock reduction analysis. Based on different assumed stock-recruitment relationships, they concluded that fishing mortality rates of less than 0.02 are needed for adequate rebuilding of Pacific ocean perch stocks. We update this analysis by using results of an age-structured model (stock synthesis) and a non-parametrically derived stock recruitment relationship.

Methods

The fishery selectivity pattern, biological parameters of growth, natural mortality and maturity, and the 1986 age specific stock structure from Heifetz and Ianelli's (1992) stock synthesis model 2 are used to project the population into the future. 1986 represents the last year where year class strength can be adequately estimated. Projections from 1987-1992 include observed catch for this time period. For projections starting in 1993, four different harvest strategies are compared.

The first strategy is the currently recommended F35% strategy adjusted by a reference level. In this case, given the current spawning biomass Bc, the spawning biomass corresponding to 35% of the unfished level B35%, F35% for the fully selected age group, natural mortality M, selectivity at age s(a), maturity at age m(a), numbers at age N(a), and weight at age W(a), the catch biomass Y in a given year is

$$Y = \frac{Bc}{B35\%} \sum_{age=1}^{nages} W(a)\,C(a) \quad for\, Bc < B35\% \quad (1)$$

$$Y = \sum_{age=1}^{nages} W(a)\,C(a) \quad for\, Bc \geq B35\% \quad (2)$$

$$where, \quad C(a) = N(a)\,\frac{F s(a)}{F s(a) + M}\,(1-\exp(-F s(a) - M)) \quad (3)$$

This first strategy is a variable rate fishing strategy that adapts to information on current abundance and provides increased caution when the stock is at low levels.

The second strategy is a constant F35% strategy (ie equation 2 for all spawning biomass levels). The third strategy is a constant harvest rate, defined as catch biomass divided by exploitable biomass. The harvest rate is set equal to M (0.05) and adjusted by a reference level when Bc is less than B35%. This third strategy is similar to the strategy that has been used in past to determine ABC. In the fourth strategy, F is set equal to the level that results from classification of Pacific ocean perch into a bycatch only fishery. A bycatch only fishery would result in a catch of approximately 2,000 mt in 1993 (personal communication, J. Gharrett, NMFS Regional Office). This catch equates with a fully selected F of 0.023.

Incoming recruitment is determined by the fixed interval method of Evans and Rice (1988). This method does not assume any functional form to the stock-recruitment relationship but instead relies on past observations of stock size and resulting recruitment. The spawning stock axis is divided into a chosen number of intervals each containing nearly the same number of past observations. We then assume that only past observations of recruitment in a spawning stock interval are possible, and they are all equally probable. For our application, estimates of spawning stock size and recruitment from the stock synthesis model are used as the "observations". We have 34 observations of stock size and recruitment that are divided into three intervals (Figure 1). The current spawning stock biomass is 68000 mt and is in the first interval. A spawning stock biomass of 85000 mt is needed to enter the second interval where there is an increase in the probabilty of a strong year class.

Given that Pacific ocean perch are long lived and slow growing, rebuilding will obviously require a long time. However, short term results may be useful for management. Time horizons of 1 to 30 years are used to represent a range of short to long term horizons. Two hundred replications of each harvest strategy were performed.

To evaluate the effects of different harvest policies we compared yields, the probability that the mature female biomass reaches the B35% level, and the probability that mature female biomass goes below 65000 mt. Probabilities were computed from the proportion of the 200 replicates that fell within a specific category.

Mature female biomass is an index of reproductive value. The measure of maturity at age m(a) is obviously an important life history characteristic in this computation. We converted data on length at 50% maturity and full maturity from Chikuni (1975) to age at maturity using the von Bertallanfy age-length relationship. M(a) values shown in Figure 2.

Leaman (1991) reports variability in m(a) for Pacific ocean perch values in relation to exploitation history and location. Thus, other m(a) values may prove more appropriate in the future. In addition, other reproductive value indices have been considered by Leaman (1991) that incorporate fecundity at age, generation time, and other life history characteristics. For our analysis, we only considered mature female biomass.

Results and Discussion

As expected, results from this study indicate that fishing mortality and recruitment are important in determining the future of this stock. For most of the strategies, substantial recovery can only occur if the spawning stock enters interval 2 where the probabilty of getting strong year classes is increased.

Figure 3 shows the distribution of female spawning biomass for the 200 replications over 5, 10, 15, and 30 year time horizons. There were only slight increases in stock size for the constant F35% policy. For the other strategies, not until 10-15 years are substantial increases in stock size seen. At 30 years there was substantial overlap in the projected biomass for the F35% adjusted, 5% adjusted, and bycatch strategies.

The probability that the stock will reach the desired B35% level was greatest for the bycatch strategy followed by the 5% adjusted strategy and the F35% adjusted strategy, which performed similarly (Fig. 4). For the constant F35% strategy, there was little chance ($P < 0.2$ at 30 years) of stock reaching B35% primarily because catches cause the stock to remain in the first interval where there is a low probability of a strong year class. Only for the constant F35% strategy was there a substantial chance that the stock would decline to less than 65000 mt ($P=0.35$ by 20 years; Fig. 5).

For all strategies, annual catches increased over time (Fig. 6).

After 15 years, the F35% adjusted and 5% adjusted performed similarly surpassing the other strategies. For these two strategies, slight losses in short term yields, compared to a constant F35% strategy, are later recouped by increases in the stock size. The bycatch strategy, as expected, had the lowest yields. This result may be somewhat misleading because once the stock has been rebuilt to a desirable level it will probably be reclassified into a directed fishery with higher fishing mortality rates.

As with any simulation study, there are several caveats which are important in interpreting results (also see Rosenberg and Brault 1991). We modeled recruitment based on past observations and assumed that once the spawning stock reaches 85000 mt the probability of strong year classes greatly increases. This assumption may result in an optimistic picture of the rebuilding program. In addition, recruitment was the only source of uncertainty associated with our analysis. All the other information on the stock was assumed to be known without error.

Obvious from the results, is that reductions in harvest rates with the bycatch strategy will rebuild the spawning stock biomass more quickly at the expense of short term yields. An assumption of the bycatch strategy is that the catch of Pacific ocean perch will only increase as the stock increases. The bycatch of Pacific ocean perch was based on results of the 1992 fishery. Changes in fishing patterns can have an impact in the amount of bycatch. For example, a substantial portion of the TAC of other slope rockfish and flatfish was not taken in 1992. If these species become more desirable, the bycatch of Pacific ocean perch will probably increase. Thus the rate of stock increase with the bycatch strategy may be over optimistic.

In summary, these results may provide the basis for determining the most appropriate time frame and harvest strategy for a rebuilding program. In making a decision on a harvest strategy, it is important to examine several measures of stock rebuilding as well as impacts on other fisheries. We have presented results for yields and the degree of stock rebuilding for different strategies. Similar to Balsiger et al (1985), future analyses may want to consider economic consequences and effects on other fisheries.

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Figures

Figure 1. Estimated stock and recruitment from the stock synthesis model.

Figure 2. Maturity at age estimated from Chikuni's (1975) length maturity data.

Figure 3. Distribution of female spawning biomass for the 200 replications over 5, 10, and 30 year time horizons.

Figure 4. Probability that the mature female biomass will be greater than the B35% level for four different harvest strategies.

Figure 5. Probability that the mature female biomass will be less than 65000 mt for four different harvest strategies.

Figure 6. Yields for the four harvest strategies.

Fig 1

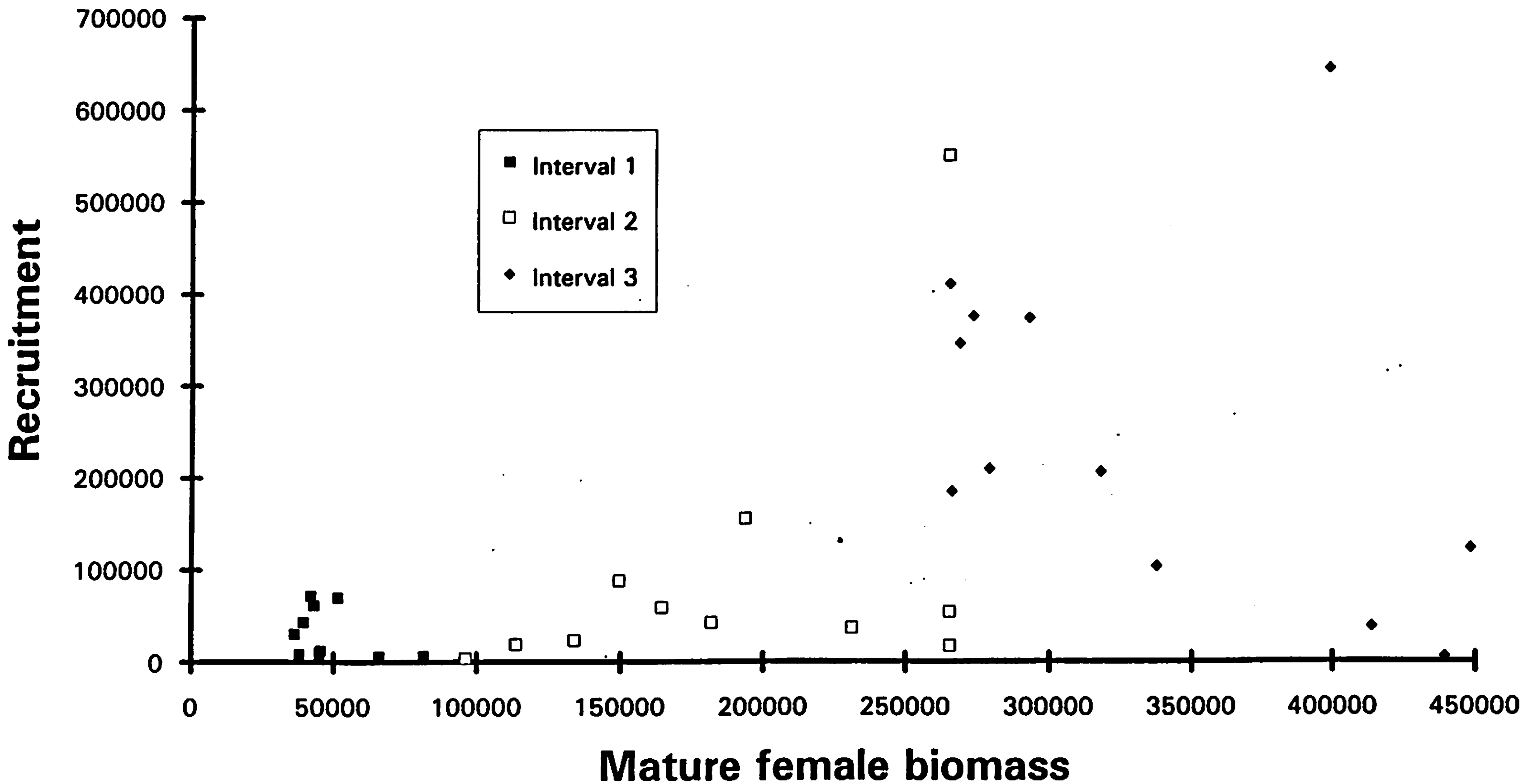
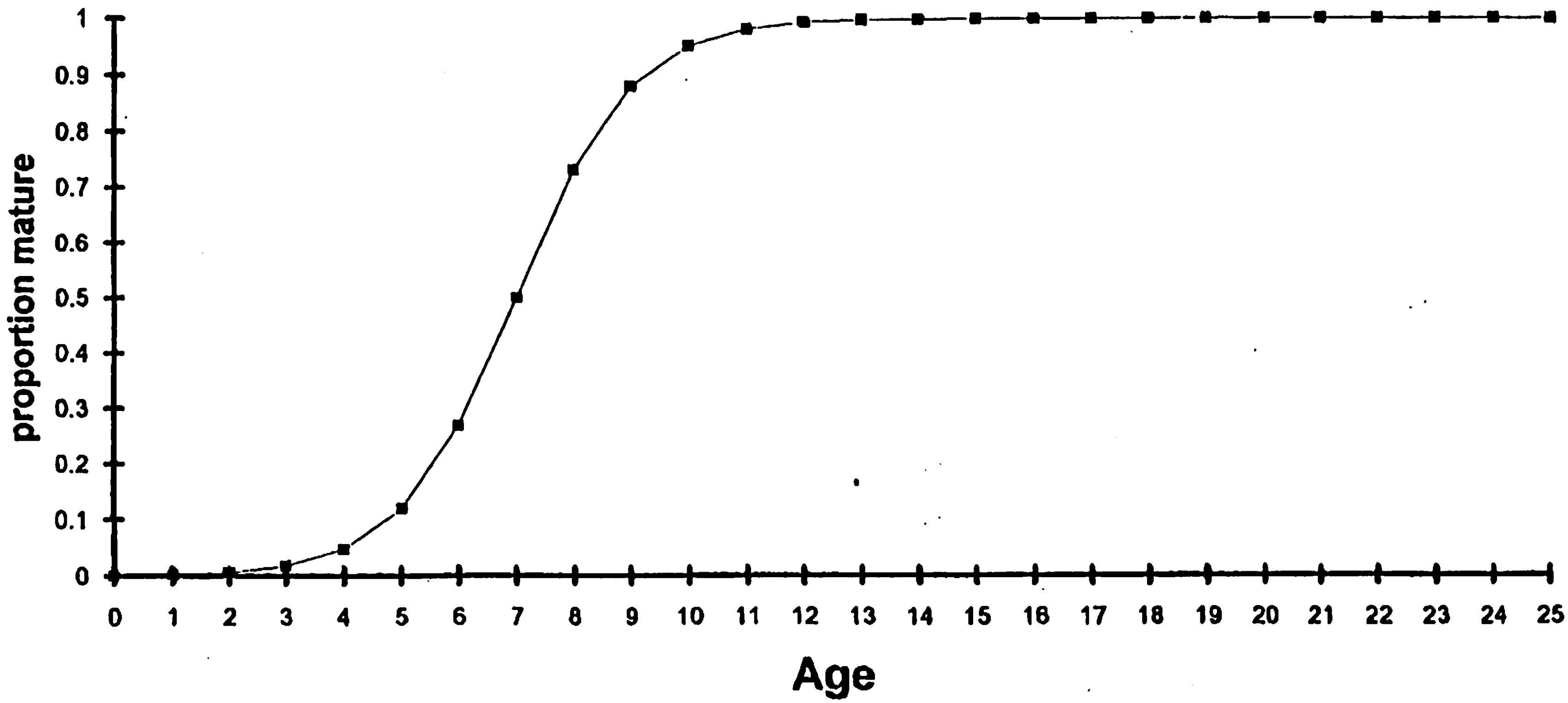
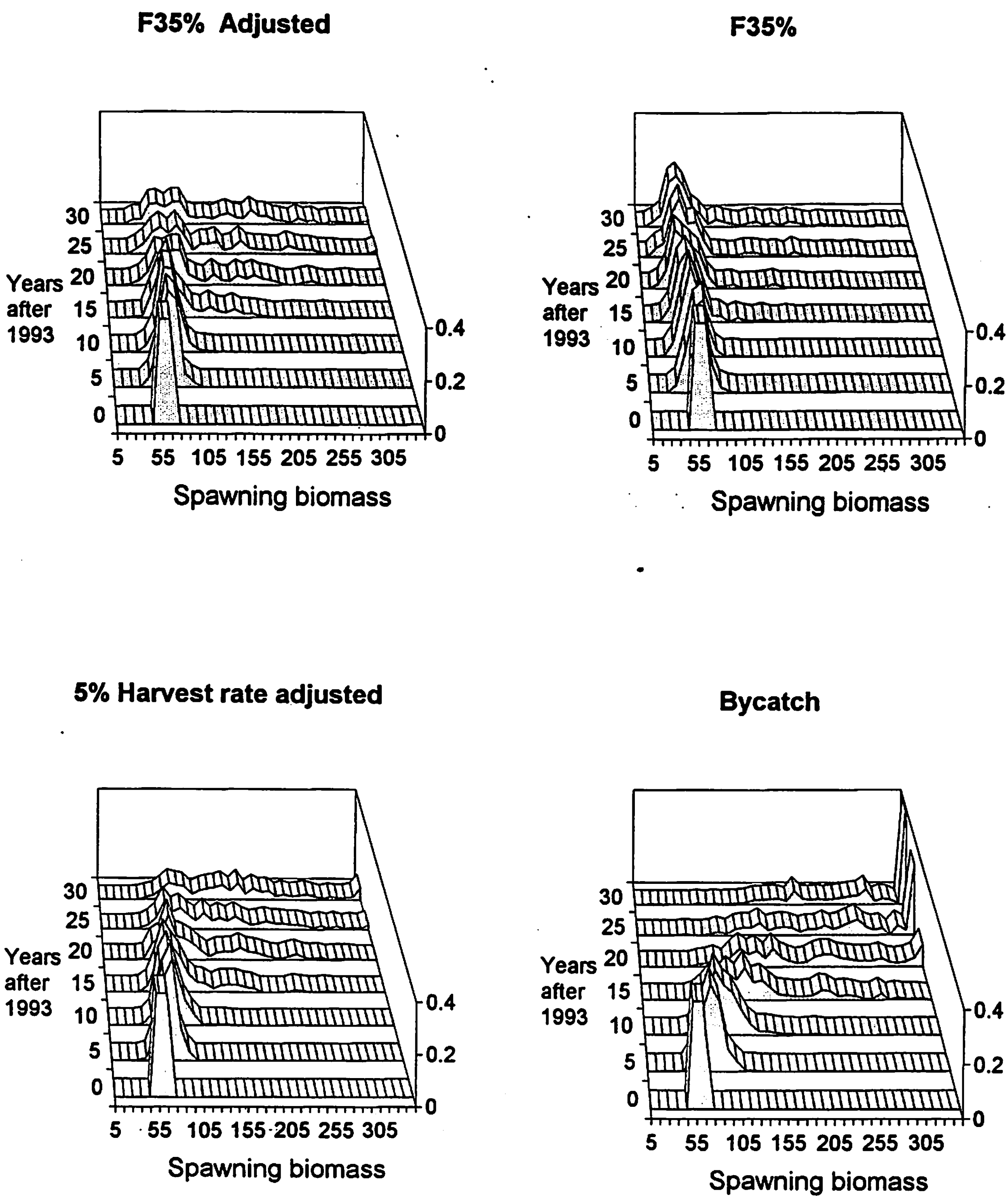

Interval 1
Interval 2
Interval 3
Recruitment
700000
600000
500000
400000
300000
200000
100000
0
0
50000
100000
150000
200000
250000
300000
350000
400000
450000
Mature female biomass

Fig 2



proportion mature
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Age

Fig 3



F35% Adjusted
F35%
5% Harvest rate adjusted
Bycatch
Years after 1993
0
5
10
15
20
25
30
0
0.2
0.4
5
55
105
155
205
255
305
Spawning biomass

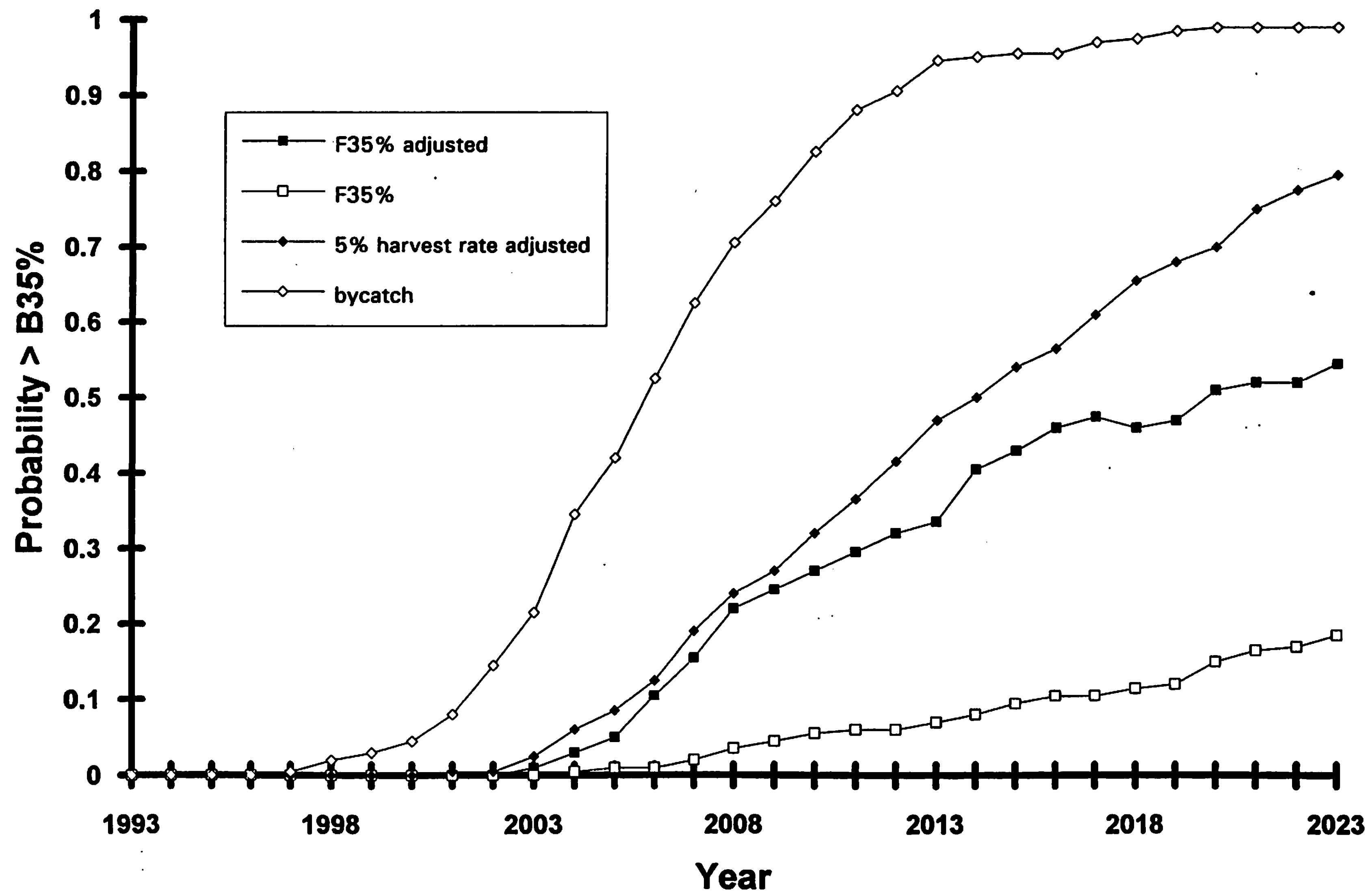


Figure 4. Probability that mature female biomass will be greater than the b35% level for four different harvest strategies.

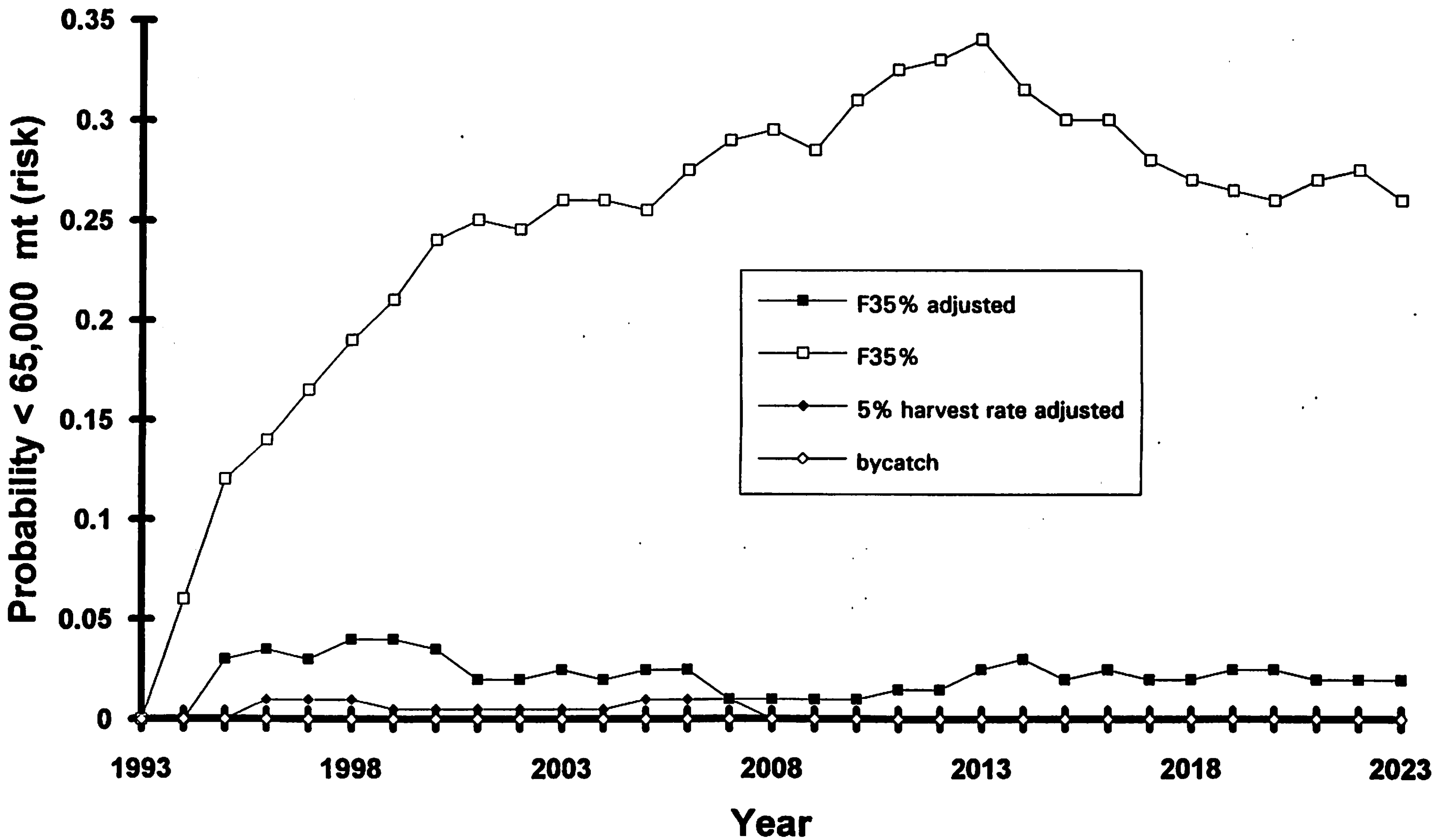


Figure 5. Probability that the mature female biomass will be less than 65,000 mt for four different harvest strategies.

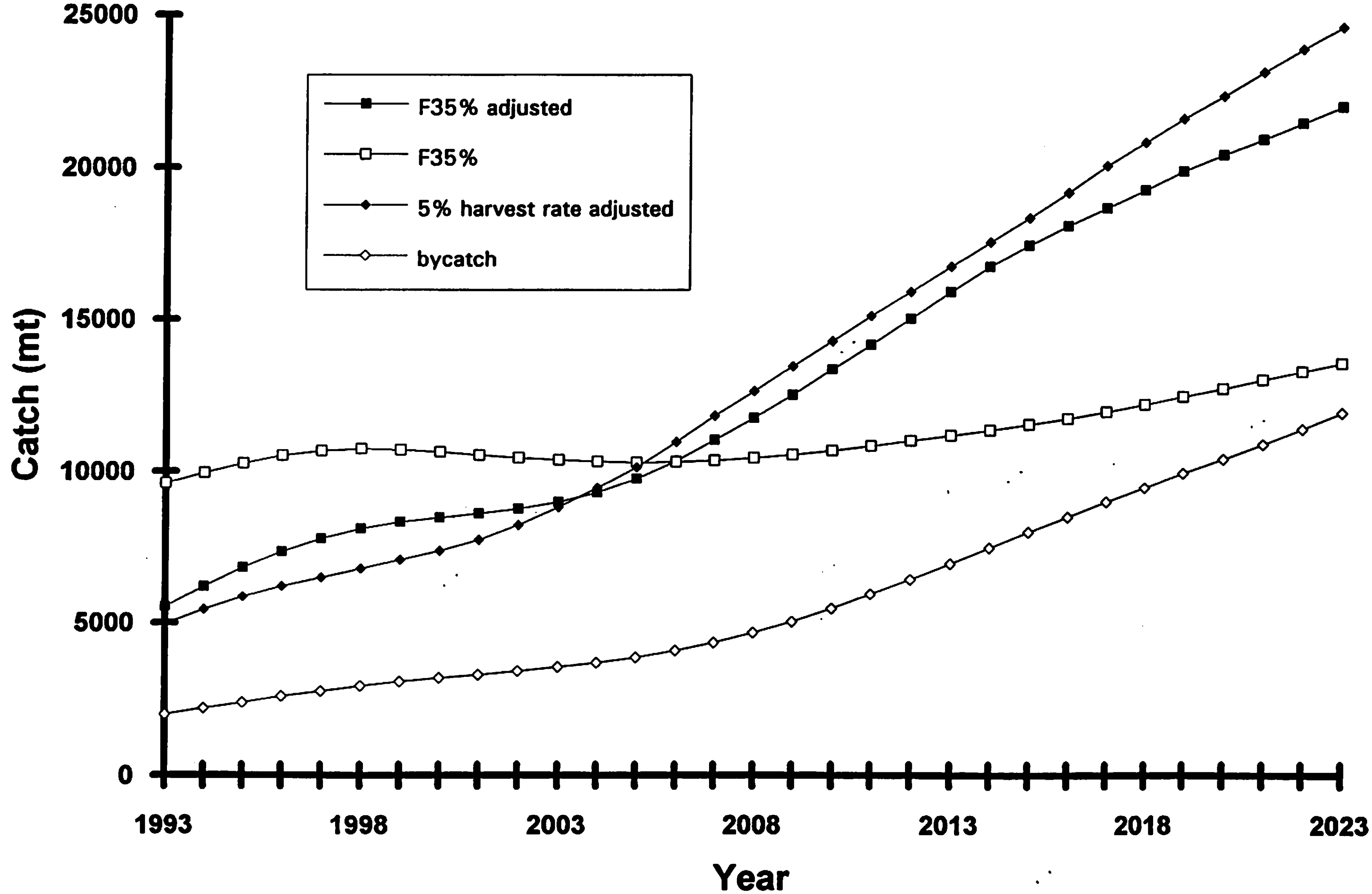


Figure 6. Yields for the four harvest strategies.

DO TRAWL ASSESSMENT SURVEYS UNDERESTIMATE ROCKFISH BIOMASS?

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INTRODUCTION

Last September there was considerable discussion on the current status of Gulf of Alaska rockfish stocks and its management by the North Pacific Fishery Management Council. Questions were raised concerning our ability to assess the health of the stocks, our ability to determine reliable biomass estimates, and whether present rates of exploitation provide for rebuilding. During the course of the meeting there were several references to the Canadian Department of Fisheries and Oceans' (DFO) work on rockfish in the north Pacific Ocean. Subsequent discussion among industry representatives during the meeting revealed uncertainty as to the "current state of affairs" with the DFO rockfish program. Given my past experience as a member of the Council staff and the Gulf of Alaska Groundfish Plan Team, and that my present employer maintains an office near DFO's Pacific Biological Station (PBS), I took the opportunity to visit PBS this past fall. My intent was to be briefed by PBS scientists on recent research and management programs and to share with you my findings. My objective was to provide clarification as to DFO's views on current rockfish assessment and management techniques. I also made an effort to bring our Canadian colleagues up-to-date on the rockfish management issues currently facing U.S. managers in Alaska. No attempt was made to summarize ongoing rockfish research by U.S. scientists. These individuals are expected to be involved in both the plan team and Scientific and Statistical Committee meetings and therefore can speak for themselves.

I visited the PBS in Nanaimo, B.C. during October 13-15, 1992. During my visit Dr. Bruce Leaman coordinated my technical briefings which were made by Leaman, Dr. Laura Richards, and Dr. Rick Stanley. Numerous reports were made available to me. My appreciation goes to Dr. Richard Beamish and his staff for a productive work session. On October 16, I met with Mr. Dan Ito, chairman of the Rockfish Working Group at the Alaska Fisheries Science Center, National Marine Fisheries Service in Seattle, Washington, for the purpose of briefing him on my PBS visit, the exchange of documents, and to discuss survey methodologies and future plans for rockfish assessment.

During the course of my review, I studied over 24 technical papers on rockfish life history, assessment, and management. Insufficient time prevents me from summarizing all these studies here. I will focus my discussion to Pacific Ocean perch (*Sebastes alutus*; POP) and the question concerning the Canadian view with regard to the use of trawl surveys in assessing rockfish stocks.

Note: LGL has been awarded a contract to perform an independent review of marine fish assessment and management programs by DFO. This work will include every regional area where DFO manages marine fishery resources. It is likely that west coast rockfish will be included in this review and subsequently further reports on the PBS rockfish program may become available in 1993.

DO TRAWL SURVEYS UNDERESTIMATE POP BIOMASS?

This was a question often asked during the September Council meeting. It was clear that some people believe that trawl surveys underestimate biomass and, thus, the resulting Acceptable Biological Catch (ABC) level is low. Other are of the opinion that trawl surveys overestimate biomass and that recent ABCs and quotas have been set too high. This issue is a frequent discussion topic within the REFM and RACE divisions of the Alaska Fisheries Science Center. NMFS scientists have held numerous meetings with Canadian and other U.S. scientists expert in rockfish. With the high value of rockfish species and the desire to rebuild these resources while providing for a limited fishery, has led to prioritizing this issue for research within RACE/REFM. The primary goal of the Center's Rockfish Working Group is to resolve this issue and develop improved assessment strategies.

In September, I was of the opinion that we are underestimating POP in our trawl surveys and that, as a result, our ABCs were conservative and allowed for rebuilding. I based my opinion on the longstanding assumption that bottom trawls used in the survey are not designed to capture rockfish and given the off-bottom/pelagic behavior of POP, that the trawls are likely to miss fish that are in the water column. Similar assumptions have been used with regards to pollock and its assessment as well. This opinion was influenced by Bakkala et al. (1985) who reported the off-bottom behavior of POP and that POP are known to inhabit rough bottom areas which are usually avoided during surveys to prevent damage to the trawls. The uncertainty surrounding POP biomass estimates was further characterized by Ito (1986). In this paper he explains that the large variances surrounding the point estimate are probably due to the highly contagious distribution of this resource. Other factors mentioned include inadequate sampling, inappropriate sampling gear, and fish behavior that may contribute to wide confidence intervals.

Recent conversations with Ito indicate that new information gathered over the last several years suggest that the trawls may actually produce an inflated estimate due to herding effects of the trawl doors. Personal observations by other NMFS scientists support this theory. The Canadian rockfish scientists also support this theory. Their research also show a herding effect, as well as a downward behavioral response to the trawl vessel or the net itself. Leaman et al. (1990) reported that POP found in the water column appear to avoid danger by moving downward. This behavior may result in fish entering the trawl from above, which would also inflate the area-swept estimate. Determination of the proper catch coefficients of a survey trawl is a difficult problem and requires frequent re-evaluation and analysis. Both U.S. and Canadian scientists are continuing their investigations into this subject.

Given the inconclusive evidence that trawls may actually be producing an inflated biomass estimate as opposed to an underestimate, I again raised the question, "What is the PBS view of the utility of trawl surveys in assessing rockfish stocks?" The answer surprised me. The Canadian scientists are currently of the opinion that trawl surveys underestimate rockfish biomass, particularly POP (Leaman, personal communication). This opinion is based on results from two studies: behavioral observations of POP; and experimental fishing. The scientists do believe that trawl surveys can provide valuable information on stock trends. However, they remain convinced that trawl surveys in their present form do not provide reliable estimates of biomass.

PBS scientists have rejected the use of trawl surveys as a method of accurately assessing rockfish biomass. They believe that using an area-swept survey approach and then extrapolating to non-trawled areas is riddled with inaccuracies and imprecision. Trawl surveys are likely to underestimate biomass, <u>not</u> because fish are in the water column (as is commonly assumed) but because of POP's diurnal and tidal behavior, the probability of towing in an area and missing fish is extremely high. Unless the trawl is fished during certain times of the day, the catch rates can be extremely low, thus, producing a low biomass estimate.

Details on these studies are summarized below:

<u>Results of a Hydroacoustic Cruise to Study Rockfish Behavior</u>

In 1990, DFO reported preliminary results from a hydroacoustic study of rockfish (*Sebastes* spp.) school structure and behavior off Quatsino Sound, B.C. (Leaman et al. 1990). Diel distribution and behavior of shelf and slope rockfishes are described, as well as the transitional pattern between nocturnal and diurnal distributions. Diurnal distributions were characterized by dense, bottom-oriented schools (Figure 1). Nocturnal distributions showed much more diffuse schools, both on-bottom and in the midwater (Figure 2). Transitional behavior was completed within approximately 30 minutes on clear days, but was extended for up to 1 hour on foggy or overcast days. The normal transition pattern was one of disaggregation of diurnal schools, followed by vertical movement. Leaman et al. (1990) also reported brief results of observations, using a trawl surveillance sonar, of fish behavior within the mouths of bottom and midwater trawls.

This study showed that depending on the time of day (or night) a trawl can experience significant differences in catch rates of rockfish. Similar variances also correlated strongly with tidal fluctuations. These results suggest to PBS scientists that given the behavioral characteristics with POP, there exists a high probability of bias (one way or the other) depending on when the survey trawl was towed through the water. These behavioral characteristics can contribute significantly to the variability in survey estimates.

<u>Results from the Langara Spit Experimental Fishery</u>

Research surveys in the Langara Spit area, located just south of Dixon Entrance during the late 1970s (Leaman and Nagtegaal 1982, 1986) had created strong reservations about the reliability of trawl survey estimates of absolute abundance of rockfishes. These reservations were based on the observed behavioral patterns of these species in response to tidal cycles, illumination level, and the trawl gear itself. These patterns produce orders of magnitude changes in the availability of the species to the survey gear, as expressed in survey CPUE. Recent work has described some of these rockfish behavioral patterns with hydroacoustic technology (Leaman et al. 1990).

Analysis of data collected in trawl assessment surveys conducted in the Langara Spit area during 1979 and 1983 produced a total biomass estimate for POP between 1,074 mt and 1,208 mt. Beginning in 1984, and for the next two years, annual landings of total rockfish increased steadily for the first three years to a peak of almost 5,000 mt before declining in 1987 (Figure 3). Since 1986, the catch has averaged approximately 2,300 mt per year. Whereas, POP comprised over 70% of the catch in 1984 (or about 2,200 mt), it accounted for less than 55% in 1990 (1,150 mt) (Figure 4). In any event, the annual landings of POP from the Langara Spit area has consistently produced a yield which equals or exceeds the prior estimate of total biomass for the species in the area.

The most striking aspect of the experimental fishery was that the landings far exceeded even the most optimistic estimate of exploitable biomass from the trawl surveys. The recruitment of incoming cohorts, while clearly able to increase biomass over that estimated from the survey, could not account for the differences. Recruitment to POP fisheries by a cohort is believed to be extremely gradual, with partial recruitment exceeding 0.5 only at ages ≥ 11 years, and full recruitment not occurring until approximately 15 years of age (Figure 5; Leaman and Stanley 1992). Even by including an aggregation of *S. alutus*, reported just north of the U.S.-Canada border in southeast Alaska waters during both 1979 and 1985 (Leaman et al, 1990), could not alone account for the difference between the exploitable biomass estimates and subsequent catches in the experimental fishery.

The experiments have also provided additional cause to question the traditional trawl survey methodology for rockfishes. They suggest that estimates of rockfish biomass from area-swept surveys should be used with extreme caution. Strong diel and tidal behavioral patterns can yield CPUE changes of two orders of magnitude at the same site over a 24-hour period (Leaman and Nagtegaal 1986). In order to use area-swept surveys for such aggregated species, it is important to characterize within-site variance more thoroughly than has been done previously. This presents significant problems for surveys of large geographic areas. Analyses based on biological characteristics appear to provide a more reliable basis for conclusions on stock status. This is not to say that surveys have no value. Standardized surveys do capture large directional changes in stock characteristics.

While the Langara Spit experimental fishery has shown that prior trawl surveys underestimated rockfish biomass, in particular POP biomass, results from the fishery also point to a stressed stock, suggesting that POP biomass is declining at the current rate of exploitation. Over the term of the experiment, there has been a progressive truncation of the age composition towards younger fish and declining catch rates. Recruitment of POP to the fishery is primarily a behavioral rather than a physical process. Fish are physically vulnerable to the gear at approximately 6 years old but are not fully recruited as a cohort until approximately 15 years of age (Figure 5; Archibald et al. 1983; Leaman 1991). Standardized CPUE declined from 3.34 mt/hr in 1984 to 0.89 mt/hr in 1990 (Figure 6). It should be noted that this decline accompanied a rise and fall in average fishing time spent each trip. By 1989, vessels were only spending about 2 fishing days, before leaving the area. This is also reflected in the fact that, for these vessels, there was no indication of diminishing catch rates with increasing hours towed (Stanley 1992).

Summary of PBS Opinion on Trawl Surveys and Current Management

It is for these reasons that some Canadians believe that bottom trawl surveys do not provide a reliable estimate of rockfish biomass. They instead look toward improved monitoring of the commercial catch, through both dock-side sampling and at-sea observers, as their better source of assessment information. The Canadians utilize an extensive sampling program of the commercial catch which produce data on fish length, sex, and species, as well as provide samples of scales, otoliths, and other tissues for parasite and genetics analysis.

The Canadians have also developed an experimental fishery approach as a method of obtaining improved biological information on rockfish stocks. Results from these experiments are currently undergoing analysis. With U.S. scientists considering similar experimental fishery methods, the Canadians have openly shared their findings and have offered guidance to their American colleagues.

While the results of these studies may be used to argue that current POP biomass estimates are inaccurate and may, in fact, be an underestimate of true biomass, there is no doubt in the PBS scientists' minds that POP and many other rockfish stocks have been overfished and warrant rebuilding. While they believe there exists greater resource than can be accurately estimated using current techniques, DFO is not allowing for high harvests. Conservative management strategies are being used by DFO. Archibald et al. (1981) estimated mortality to be 0.05 for POP. Fishing mortality levels ≤ 0.05 are believed to provide for rebuilding. Several reviews of depleted rockfish stocks (Hightower and Grossman 1987; Walters and Collie 1989) have advocated remedial policies involving either large decreases or elimination in fishing mortality. Leaman (1991) reports that these policies may be optimal from a rehabilitation perspective, but are economically suboptimal because capital mobility in the fishing industry is limited. Table 1 outlines characteristics of assessment and management of west coast rockfish resources.

FISHERY OVERVIEW

The Canadian west coast rockfish experience has a similar history to that of the United States. Rockfish resources were heavily exploited by foreign fishing fleets during the 1960s and early 1970s. Since exploitation by these fleets was well in excess of sustainable levels, management programs put into effect soon after implementation of the 200-mile limit in 1976 have had to address the approach to optimum stock biomass from the overexploited side of the yield curve. The need of rehabilitation of these stocks resulted in the setting of quotas below the maximum levels that biomass of existing stocks are estimated to support.

During the period of 1956-1985, rockfish harvests ranged from a low of 4,022 mt in 1958 to a high of 66,419 mt in 1966; declined to 19,709 mt in 1977, and then stabilized between 14,000 mt and 31,700 mt through 1985 (Westrheim 1986). Average harvests during 1985 have been about 4,700 mt. Of this amount, POP comprises the majority of the catch, averaging 3,500 mt over this same period (Richards, personal communication).

Beginning in 1984, the Canadian domestic fishery expanded in response to increased demands for POP and other rockfish species. Since then, DFO has had to face similar industry pressures for increased quotas at a time of resource rebuilding.

DISCLAIMER

This paper is an attempt to summarize the current thought held by PBS's rockfish scientists with regard to their views on trawl surveys in the assessment of POP. Certainly, a formal paper or presentation by PBS scientists would have been preferable to my attempt at summarization, but insufficient time was available for this to occur. The results of the described research are all documented in the literature. My objective was to simply assemble relevant information on the issues being discussed before the Council at the present time. A more comprehensive review may reveal other studies which may have been useful to the discussion. I accept full responsibility for the inaccuracies or omissions which may have inadvertently been made. For further information on these studies, professional opinions, and plans for the future, I refer the reader to Dr. Richard Beamish and his staff.

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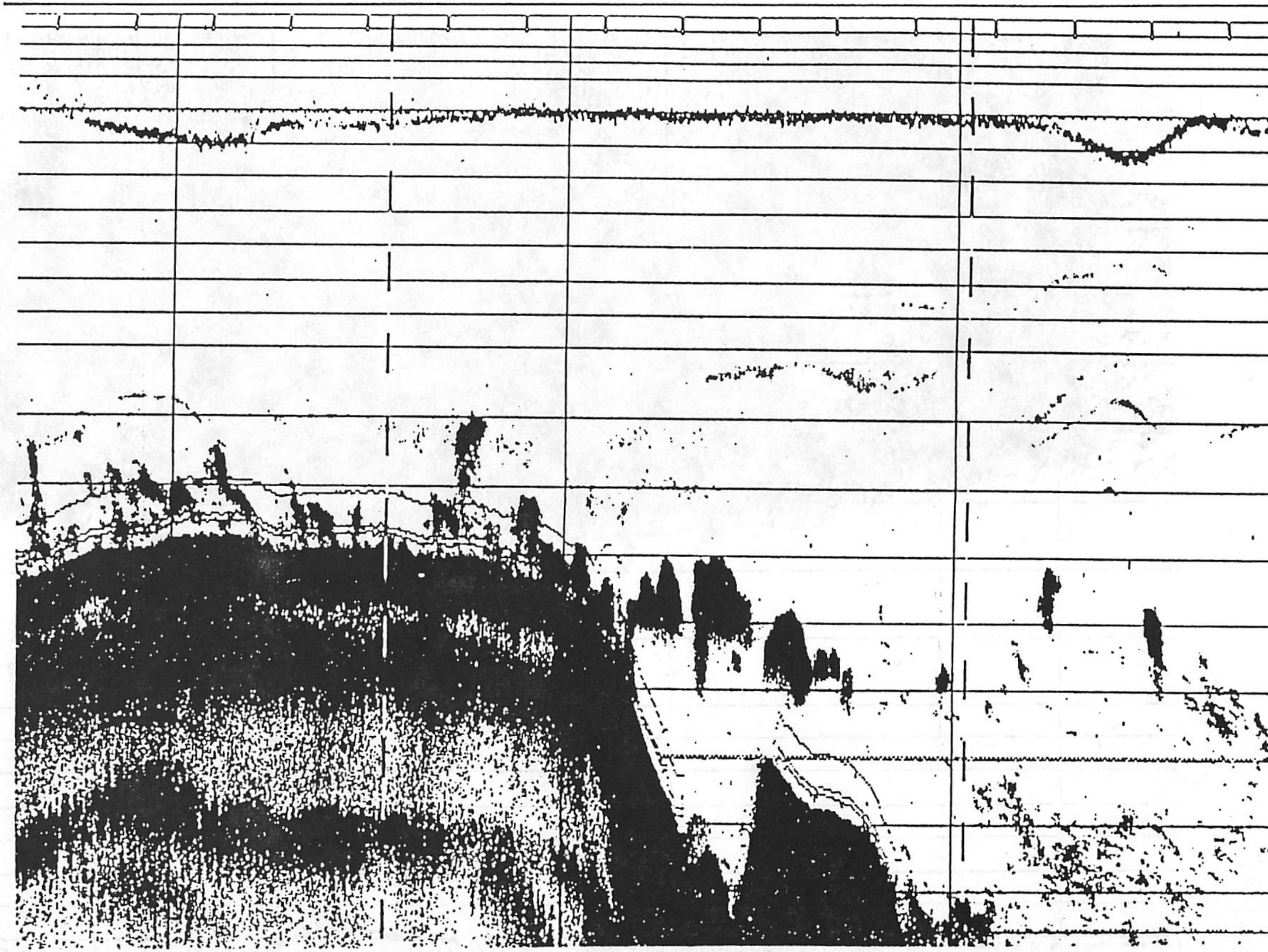

Figure 1. Typical diurnal fish distribution at the northern grid, showing dense on-bottom schools and high relief of the bottom (18/3/90, 08:00). From Leaman et al. (1990).

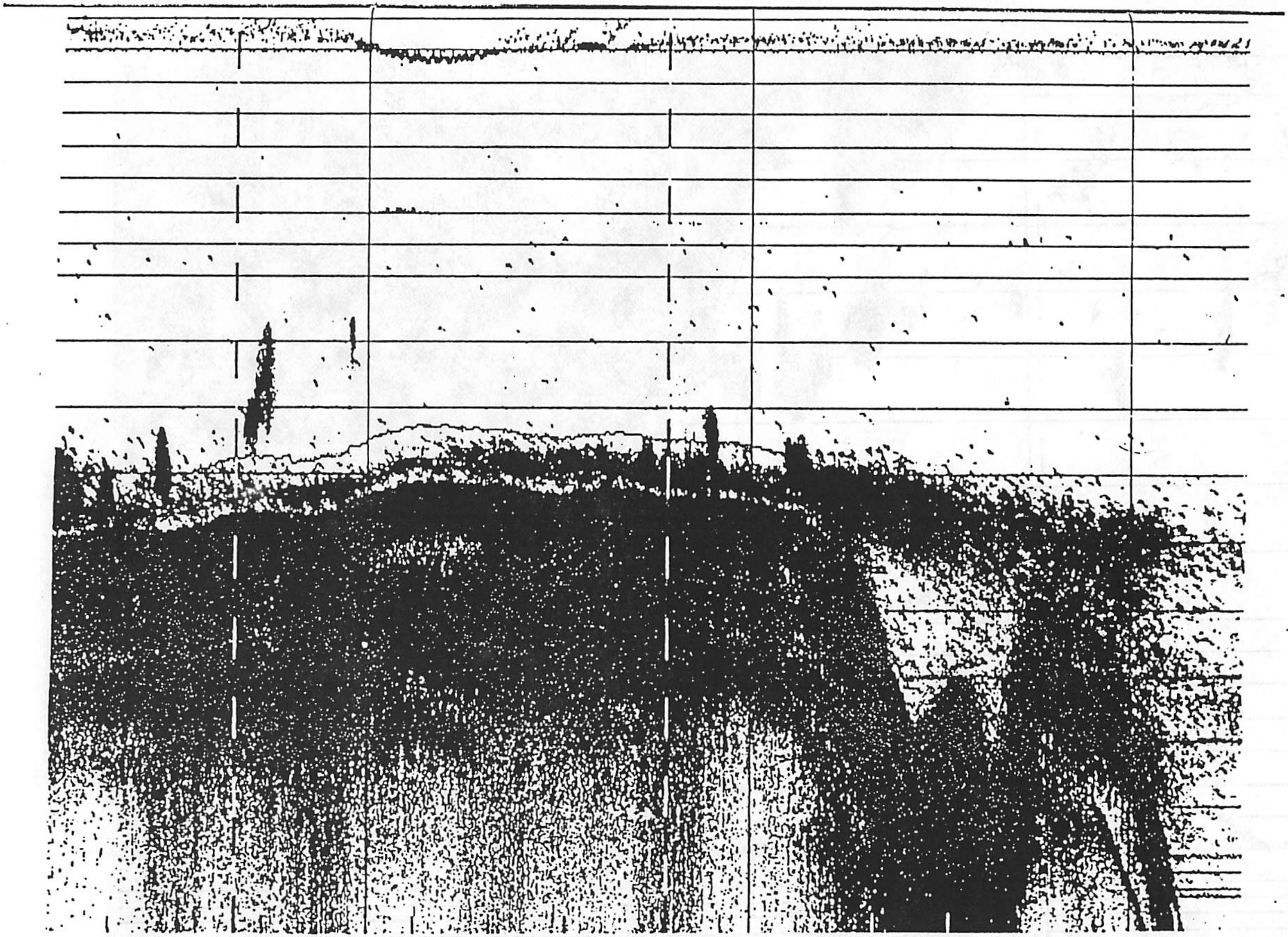

Figure 2. Typical nocturnal fish distribution at the northern grid (18/3/90; 22:00). From Leaman et al. (1990).

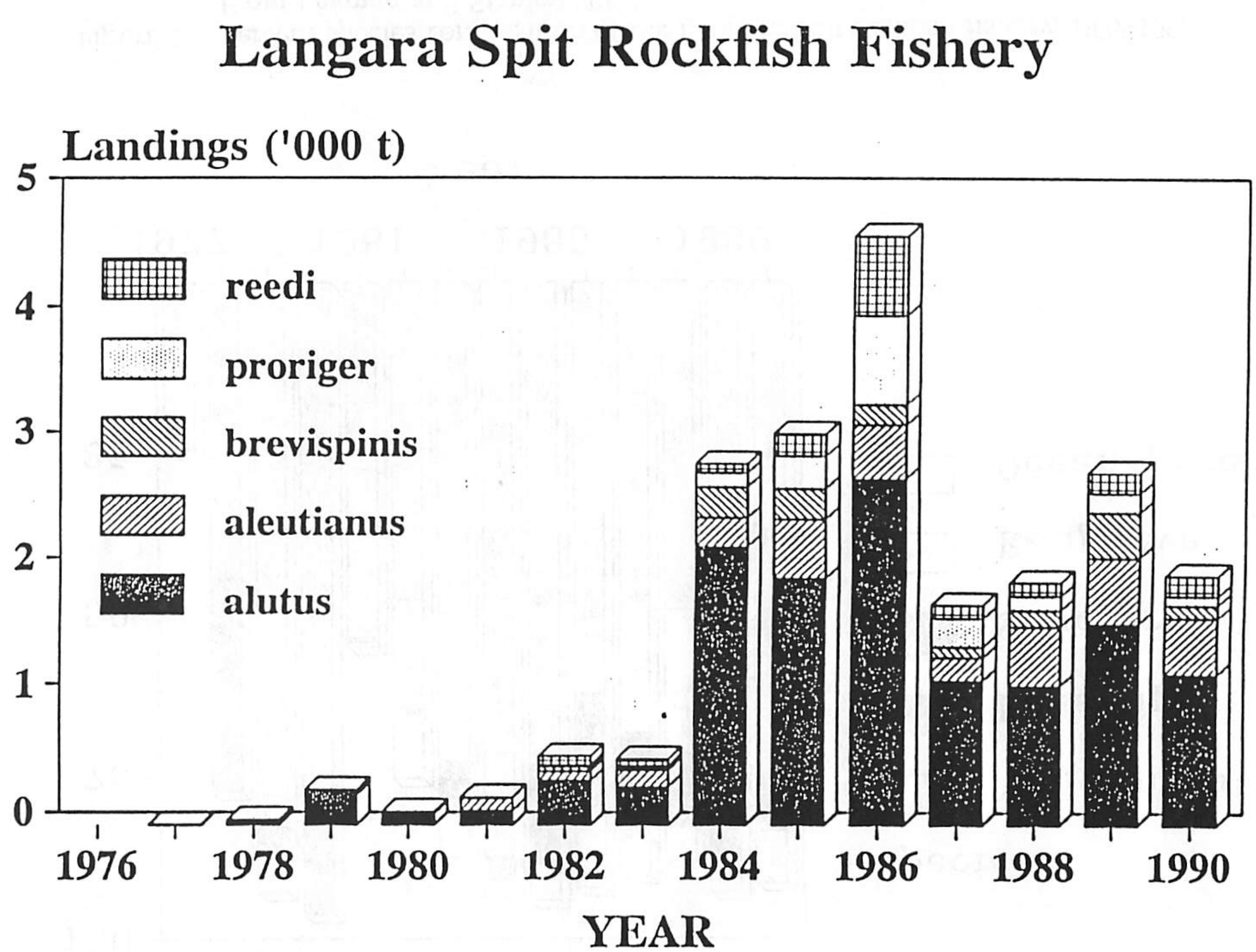

Figure 3. Landings by species, of the rockfish catch in the Langara Spit area, 1976-1990. From Leaman and Stanley (1992).

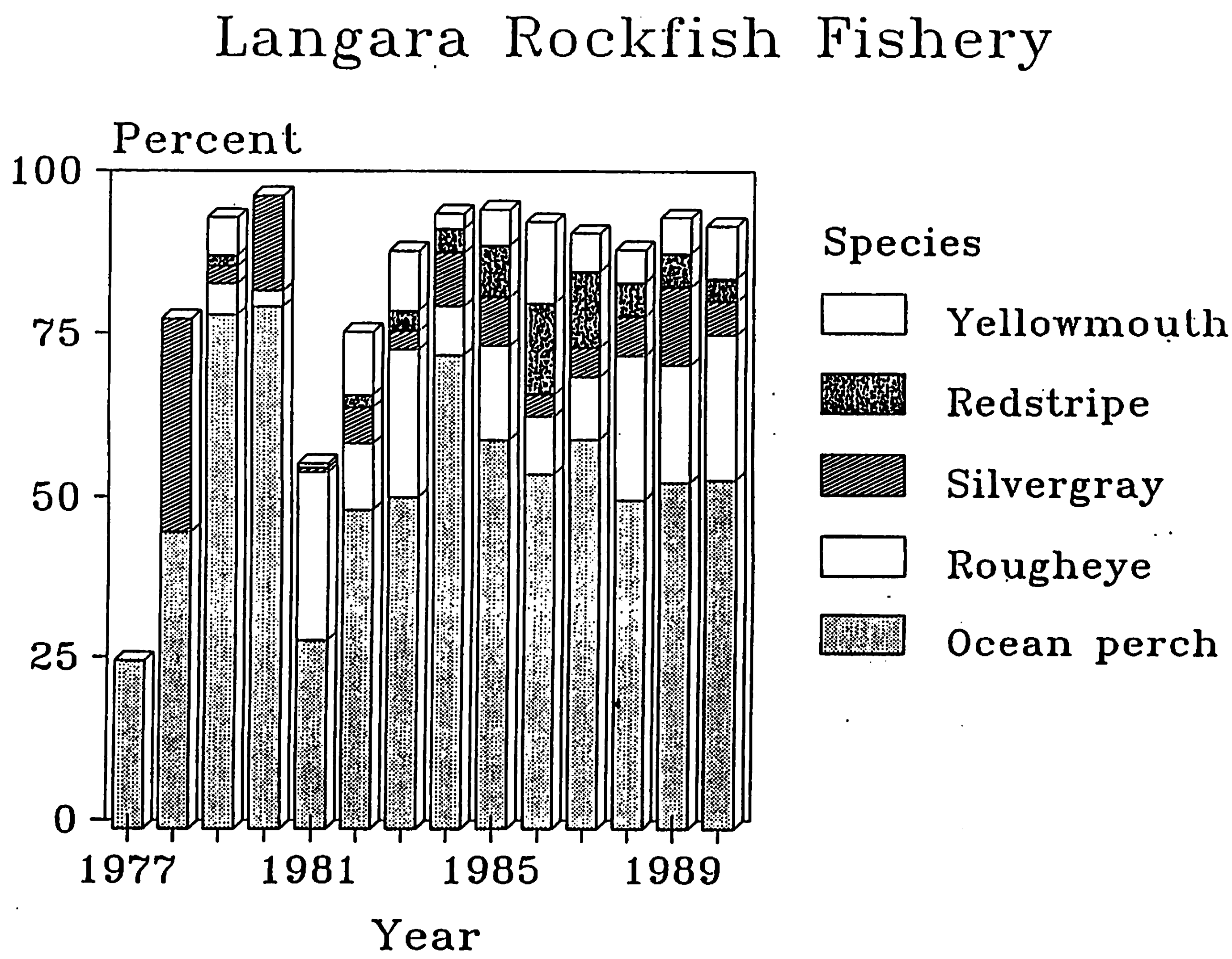

Figure 4. Percent species composition of the Langara Spit rockfish fishery, 1977-1990. From Leaman and Stanley (1992).

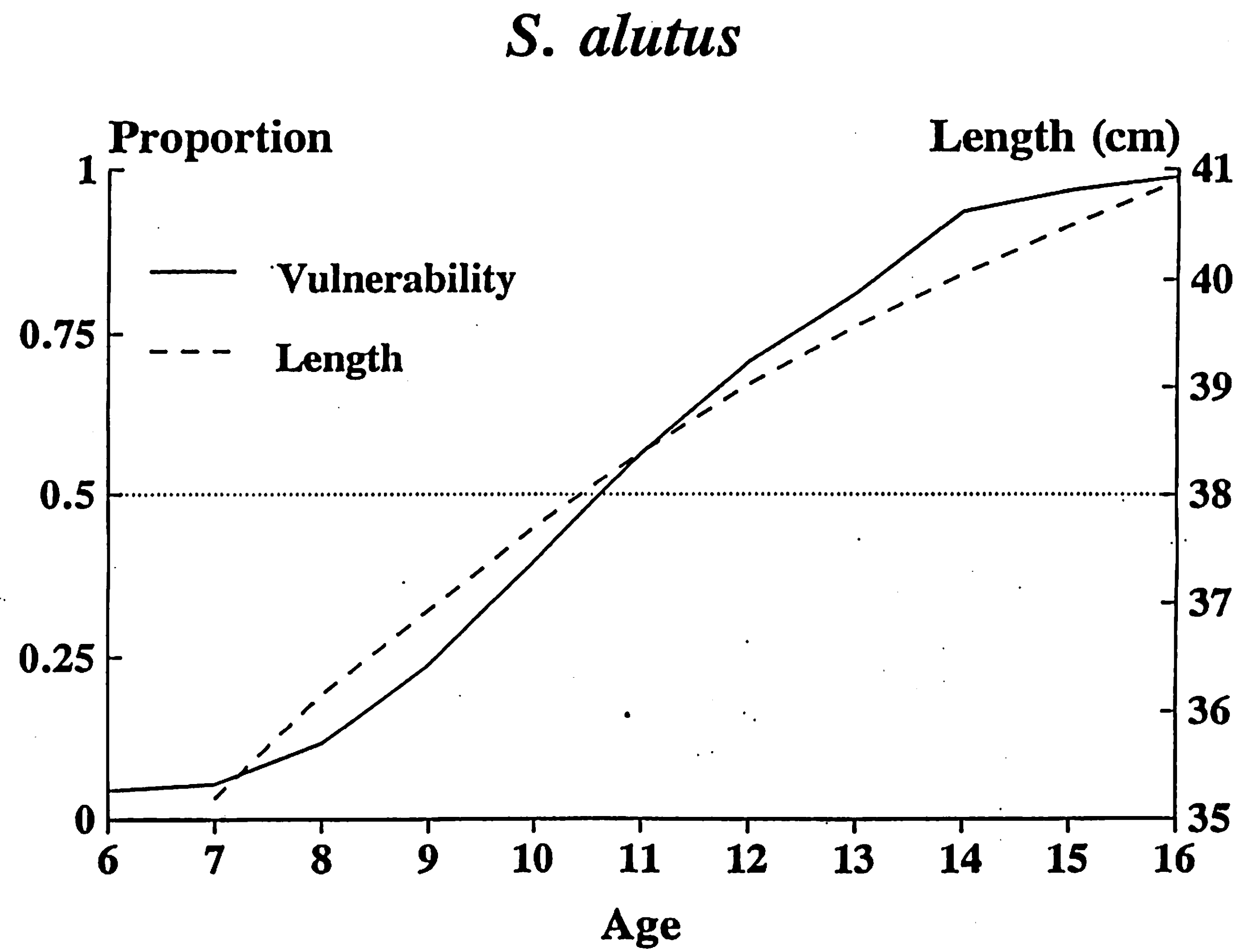

Figure 5. Length and vulnerability to the fishery by age, for Pacific Ocean perch. Horizontal line represents the portion where 50% of a cohort is vulnerable to the fishery. From Leaman and Stanley (1992).

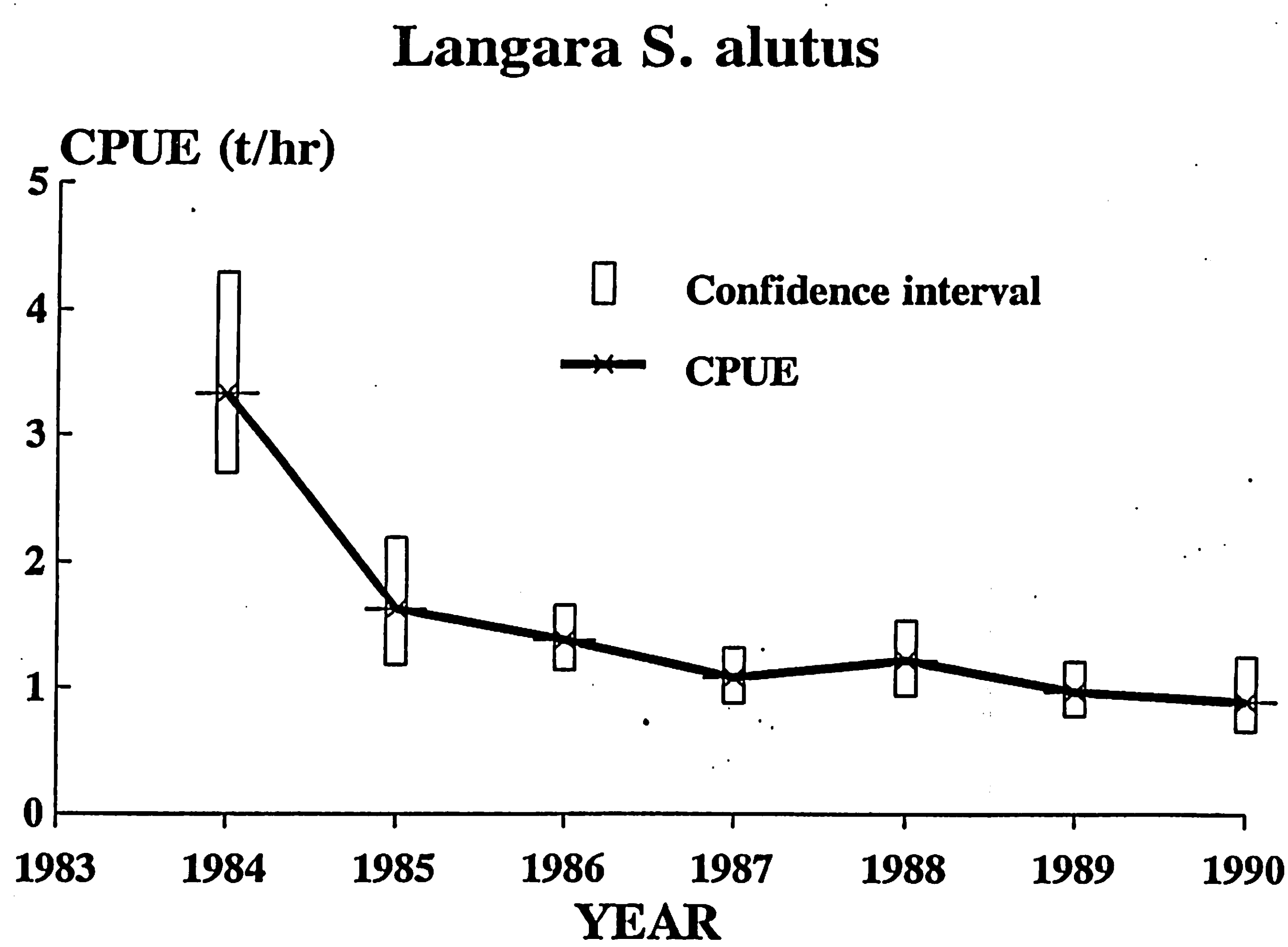

Figure 6. Standardized catch rates (CPUE) and 80% confidence intervals for Pacific Ocean perch fisheries for the Langara Spit POP Fishery, 1984-1990. From Leaman and Stanley (1992).

Table 3. Characteristics of assessment and management for groundfish fisheries off the west coast of Canada.

PACIFIC GROUNDFISH SPECIES

1. General (Fargo and Leaman 1991)
   - all recommendations expressed as range from low risk - high risk
   - some experimental harvest programs (Leaman and Stanley, this volume)
   - multi-year assessment and recommendation framework
   - some IQ management programs
   - quarterly quotas and variable trip retention limits

2. Pacific cod (*Gadus macrocephalus*)
   - $F_{0.1}$ strategy based on VPA and environmentally-driven recruitment model
   - variable seasonal closures to protect juveniles (Foucher and Tyler 1991)

3. Flatfishes (*Eopsetta jordani, Lepidopsetta bilineata, Parophrys vetulus, Microstomus pacificus*)
   - $F_{0.1}$ strategy based on VPA and yield per recruit modelling (Fargo 1991)
   - annual trip limits for some species
   - minimum size limit to decrease juvenile mortality
   - environmentally-driven recruitment model for some species

4. Sablefish (*Anoplopoma fimbria*)
   - $F_{0.1}$ and $F_{0.05}$ management strategy based on VPA and several deterministic recruitment scenarios (Saunders and McFarlane 1991)
   - minimum size limit to decrease juvenile mortality

5. Pacific hake (*Merluccius productus*)
   - separable SPA assessment model (Saunders 1991)
   - target spawning biomass strategy based on probabilistic sampling of recruitment series
   - F levels set through hybrid strategy with fixed F_{opt} when > CUTOFF and variable F and when spawning biomass < CUTOFF, i.e.

     $$F_t = F_{opt} (SB_t / SB_{opt})$$

   - low, moderate, and high risk levels set at F = M, F_{MSY}, and $F_{0.1}$, respectively
   - Canada-U.S. trans-boundary stock management

6. Rockfishes (*Sebastes* spp.)
   - F = M and F_{opt} strategies
   - F estimated from length frequency analysis, CPUE analysis, depletion methods, and separable SPA
   - variable trip limits and quarterly quotas to prolong fishery
   - assemblage and experimental management programs
   - some habitat-based assessment
   - some sensitivity analysis of population parameters and SRRs (Leaman 1991)

Table 1. From Leaman (1992).

AGENDA D-1(b)(3)
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A REVIEW OF ROCKFISH MANAGEMENT IN THE GULF OF ALASKA

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by

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A REVIEW OF ROCKFISH MANAGEMENT

IN THE GULF OF ALASKA

Introduction

There has been a great deal of attention placed on management of North Pacific rockfish stocks in recent years. This concern has made rockfish management a major focal point of North Pacific Fisheries Management Council (NPFMC) annual Gulf of Alaska (GOA) groundfish stock status review. This report briefly outlines the history of the GOA rockfish fisheries, describes past management action, discusses stock status, reviews management theory for long-lived species such as rockfish, and makes general recommendations for future rockfish management.

Concern for depleted slope rockfish stocks was cited as a one of several reasons for a longline industry request to eliminate trawl effort from the Eastern Gulf of Alaska (Amendment 26, NPFMC, 1992). The National Marine Fisheries Service (NMFS) recently formed a working group to review stock survey methodology and to design better methods of evaluating stock status. An industry working group was also formed by the NPFMC to examine management strategy from an industry perspective. At their 1992 meeting, the Technical Sub-Committee of the Canada/U.S. Groundfish Committee recommended a coast-wide workshop to review management strategies for *Sebastes* rockfishes. That workshop is tentatively scheduled for May, 1993.

However, concern over rockfish management in the Gulf of Alaska (GOA) is not a new issue. Quast (1972) reported, "If fishing ceased (for Pacific ocean perch, *Sebastes alutus*), entirely, which seems unlikely, decades would be required for moderate recovery." He went on to warn, "There is the distinct possibility that recovery of the Pacific ocean perch is now permanently blocked in the time span of present human generations by rules of the new environmental system brought about by fishing, which should encourage replacement of the Pacific ocean perch by faster growing and faster cycling species." A decade later, Ito (1982) continued the admonition stating, "Drastic actions are probably required to return these stocks (POP) to former levels of abundance. Perhaps a first step should be to impose a ban on Pacific ocean perch fishing. However, even with such a moratorium, there is no assurance that the stocks will attain their former levels. In addition, incidental catches made while seeking other species may be sufficiently great to keep Pacific ocean perch stocks in a depleted state, even in the absence of a targeted fishery on S.alutus."

Rigby (1982) presented evidence that Pacific ocean perch (POP) stocks were severely depressed in the Eastern GOA and were in extreme need of rebuilding. Blackburn (1984) wrote a paper advising that the conservative bycatch-only management of POP which was adopted for the Eastern GOA in 1982 as a result of Rigby's paper should also be applied to the remainder of the Gulf and recommended immediately reducing the OY set for POP to no more than 6% of the former level.

The downward trend in stock status apparently continued through the mid-1980's which lead Balsiger et. al. (1985) to conclude that there was "little optimism for short-term imminent change" in POP stock status. Shippen (1985) concluded "There continues to be little firm evidence of any significant improvement in the condition of Pacific ocean perch stocks. Because of the slow growth rate of the individual fish and apparent slow recruitment, it may be some years before any significant change in the status quo can be expected." This conclusion followed two years where catch was less than one sixth of ABC. Carlson, et.al (1986) further stated, "There is no consistent evidence to indicate that a substantial rebuilding of S.alutus stocks is occurring".

The triennial stock assessment trawl surveys conducted by NMFS in the GOA during 1984, 1987, and 1990 indicate that the abundance of POP and shortraker/rougheye components of the slope rockfish assemblage continued to decline into 1990. The preliminary POP stock projections for 1993 which are listed in the slope rockfish chapter of the preliminary 1993 Stock Assessment Fisheries Evaluation Report are the lowest ever advanced by NMFS biologists.

While most concern has been expressed over the status of POP stocks, other species of rockfish are also showing signs of possible over-exploitation. Management strategies for the other species of slope rockfish and the other three rockfish assemblages, demersal shelf rockfish (DSR), pelagic shelf rockfish (PSR), and thornyhead rockfish, should also be thoroughly reviewed.

History of the GOA Rockfish Fishery and a Review of Stock Status

Slope Rockfish

Fishery

Rockfish have been taken in the GOA incidental to fisheries for other species such as halibut (*Hippoglossus stenolepis*), Pacific cod (*Gadus macrocephalus*), and sablefish (*Anoplopoma fimbria*) since the turn of the century. However, it was not until the foreign distant-water trawl fleets entered the GOA in the early 1960's that extensive directed fisheries developed. The primary target species was POP, but other slope rockfish and thornyhead rockfish, genus *Sebastolobus*, were also taken. Some relatively minor incidental harvest of DSR and PSR was also likely to have occurred.

The foreign slope rockfish trawl fishery peaked in 1965 in the GOA with an estimated harvest of approximately 350,000 mt. This apparent overfishing resulted in a precipitous decline in catches in the late 1960's (Heifetz and Clausen, 1992). Harvests continued to decline through the 1970's, even though there were few if any regulatory constraints in place during that time. The reported foreign harvest of POP declined to just over 8,000 mt in 1978, the year the GOA Fishery Management Plan (FMP) was adopted. However, catches were not well documented, particularly during the early days of the fishery, and so it is very difficult to accurately determine species composition of the foreign catch. The best estimates of species composition occur during the latter years of the fishery when a larger percentage of the foreign fleet had observers aboard.

Total foreign landings may be substantially underestimated, particularly during the earlier years of the fishery, since the estimated harvest is comprised of undocumented harvests from the Soviet fisheries combined with voluntarily catch reports from other nations. Reported harvests from some nations have been documented to be understated.

Foreign fisheries were entirely phased out of the GOA by 1985 and total all-nation slope rockfish harvests of just over 1,000 mt that year were the lowest since the directed rockfish fisheries began in 1961. Domestic harvests of slope rockfish rapidly increased to a peak of 21,114 mt in 1990 before tapering off slightly the past two years. Figure 1 from Heifetz and Clausen (1992), shows the total estimated all nation 1960-91 harvests of POP and other slope rockfish.

During the period between 1965 and 1978 the catch per unit of effort (CPUE) of POP in the GOA Japanese trawl fishery declined from 5.8 mt per hour to approximately 100 kg per hour, a decrease of over 98% (Carlson, et.al., 1986). The proportion of POP in the Japanese trawl harvest also declined from over 90% of all groundfish reported to less than 20% of all groundfish taken, a decrease of nearly 78%. Reported changes in CPUE and the proportion of POP in the Japanese trawl fishery are shown in figure 2 from Carlson, et.al.

(1986). Harvest limits were minimal during that period, and it must be presumed that these values reflect declines in abundance, particularly since POP remained one of the most valuable groundfish species.

It is quite possible that the decline in POP CPUE underestimates the actual decrease in abundance. Aggregating species, such as POP, which remain concentrated as abundance declines, continue to be vulnerable to the fishery even at lower abundance levels. Also, changes in technology and experience tend to make the fleet more efficient at locating and harvesting fish over time even with lower abundance levels. This type of CPUE/stock abundance relationship is referred to as hyperstability (Hilborn and Walters, 1992). MacCall (1990), also suggested that aggregating populations tend to contract toward the most favorable habitat resulting in the actual abundance declining more rapidly than indicated by CPUE data from the fishery. This pooling effect also increases the likelihood that an arbitrary single fish in the stock will be captured as the population decreases.

Harvests of other slope rockfish species are even less well documented. Prior to 1979 POP harvests were tracked independently or it was simply presumed that virtually all harvest of slope rockfish was comprised of POP. However, from 1979 through 1987 POP were managed as part of a five-species rockfish complex which also included shortraker (*S. borealis*), rougheye (*S. aleutianus*), northern (*S. polyspinis*), and sharpchin (*S. zacentrus*) rockfish. This five-species rockfish complex was formed at the request of Japanese fishing companies because of alleged difficulties with identifying POP on board the catcher vessels. Some individuals questioned this action, pointing out that the primary species involved were generally marketed independently and expressed concern that the request was possibly an attempt to mask the continued decline in POP stocks by allowing the fishery to continue on other species. One advantage of this approach from a management standpoint was that ABC for the entire complex was based on the stock status of POP as if were the only species in the complex.

Management of POP as part of a five-species complex, coupled with low levels of observer coverage, made it very difficult to accurately determine species composition of slope rockfish harvests, particularly in the domestic fisheries which were developing at the time. Testimony before the NPFMC during the mid-1980's indicated that some domestic trawlers would first take the quota set for the POP complex and then target on "deep-water snapper", another name for shortraker rockfish. This additional harvest was attributed to the "other rockfish" management category. This "double dipping" may have resulted in harvests of both POP and other species within the POP complex at substantially greater levels than were actually reported. Conversely, it is conceivable that much of the harvests attributed to the "other rockfish" category between 1979 and 1987 were actually species of the POP complex.

From 1988 through 1990 all slope rockfish were managed as a single complex. The change to a single complex in 1988 resulted in an increase in total slope rockfish quota from 5,000 mt in 1987 to 16,800 mt in 1988. The harvest also increased dramatically from 4,981 mt in 1987 to 13,779 mt in 1988, 19,002 mt in 1989, and 21,114 mt in 1990 (Fujioka and Clausen, 1992). This resulted in the highest total slope rockfish harvests since 1977, the year prior to the adoption of the GOA FMP.

During 1991 and 1992 shortraker and rougheye rockfish were placed in a separate management category as was POP. This resulted in substantial declines in total slope rockfish harvest indicating that these three species had been the primary target species of the combined slope rockfish complex. Harvests, ABC, and quotas for slope rockfish are shown in table 1 from Fujioka and Clausen, (1992).

Bycatch of some slope species is still likely to be under-reported, particularly in the halibut and sablefish hook-and-line fisheries where observer coverage is limited and the managers rely entirely on cooperation from the fleet for reporting at-sea discards. It is unknown whether the unreported bycatch is significant from a management standpoint, but this source of unreported fishing mortality should be quantified. This is particularly true for species such as shortraker, rougheye, and thornyhead rockfish which have very low ABC and TAC levels. As a result, any unreported harvest in excess of the TAC increases the chance that the ABC will be exceeded because of the very low quotas.

Management Strategy and Stock Status

Pacific Ocean Perch

From 1977 to 1981 the quota for all slope rockfish species was set at levels between 25,000 and 30,000 mt (Fujioka and Clausen, 1992). In 1982 the NPFMC adopted an OY for the Eastern GOA of 875 mt which was the amount considered necessary for bycatch in fisheries for other species. The intent was to provide for maximum rebuilding (Environmental Assessment to Amendment 10, NPFMC, 1982). This reduced the POP complex quota for the entire GOA to approximately 11,500 mt.

The Gulf-wide quota remained fairly low between 1985 and 1987, apparently as an attempt to discourage foreign fishing on this resource. However, in 1987 the POP OY for the Eastern GOA was increased to 2,000 mt even though there was little, if any, evidence that any stock rebuilding had occurred. A major difference in the fishery between 1982 and 1987 was that by 1987 the GOA groundfish fisheries had become fully "Americanized" and there was a greater industry demand for high-value fish to satisfy the expanding domestic factory trawl fleet.

From 1988 through 1990 all slope rockfish were managed as a single complex and quotas were quadrupled from the 1987 level of 5,000 mt to 20,000 mt in 1989. The slope complex TAC was reduced to 17,700 in 1990. However, the TAC for the complex was exceeded by 19% and it was estimated from observer data that 62.2% of the 21,114 mt 1990 harvest consisted of POP.

During 1991 and 1992 the slope complex was separated into three components for management: POP, shortraker/rougheye, and "other slope rockfish". While this separation resulted in a substantial reduction in the TAC for POP to only 5,800 mt, it resulted in even higher quotas for the entire slope complex. The 1992 TAC of 21,220 mt for all slope rockfish was the highest since 1981. Each year from 1988 through 1992 the TAC was set at or very near ABC for all species groups, leaving no allowance for management imprecision.

The POP stock has been listed as "depressed, increasing" in the NPFMC Stock Assessment Fishery Evaluation (SAFE) reports for a number of years. However, the notion that POP stocks are increasing is supported primarily by model assumptions, and each year the subsequent estimate of biomass listed in the SAFE report has resulted in a lower number. The POP biomass estimates originally derived from the 1984 and 1987 surveys have just recently been adjusted downward approximately 38% by revising the fishing correction factor. Revised estimates indicate POP biomass was 231,699 mt in 1984 and 132,369 mt in 1990, a decline of 43%. Whether the reduction is viewed as an indicator of absolute abundance or relative abundance, the trend is decidedly downward (Figure 3).

The POP proportion within the slope complex in the trawl survey declined from 52.2% of the assemblage biomass in 1984 to only 35.6% in 1990 (Heifetz and Clausen, 1992). The proportion and relative biomass of other less heavily exploited species such as northern rockfish, sharpchin, redstripe (*S. proriger*), and harlequin (*S. variegatus*) rockfish actually increased over the same period. This may indicate either a replacement of POP by faster-cycling species as suggested by Quast, (1972) or that significant selective removals of POP are occurring.

In recent years the management strategy has been to use an annual exploitation rate applied to a biomass estimate derived from stock survey data. When there were conflicting survey results, two or more surveys were averaged to obtain the "best estimate" of biomass.

Prior to 1992 Stock Reduction Analysis (SRA) was used to determine stock status for POP. This method relied heavily on an assumed stock/recruitment relationship and was tuned to the trawl survey data. The latest published run (Heifetz and Clausen, 1992) indicates that B_0 (virgin biomass) ranged from 1.34 to 1.47 million mt depending on which stock recruitment shape parameter was used. This resulted in B_{msy} values of 368,600 to 648,000 and corresponding inversely related MSY values of 27,700 to 15,000 mt. The notable point of these data is that if the more recent estimates of biomass (Heifetz and Clausen, 1992) are correct, the current biomass is a much smaller fraction of the presumed B_0 and B_{msy} than previously believed.

When setting the POP ABC for 1992 the NPFMC's Scientific and Statistical Committee (SSC) adjusted the exploitation rate to 1/2 M=F to account for the fact that POP were presumed to be approximately 1/2 of B_{msy}. This resulted in an exploitation rate of 0.025. However, this exploitation rate was applied to the average biomass estimate of the 1987 and 1990 surveys prior to revision. Recall that the 1990 survey (132,369 mt) indicated a biomass which was only 38% of the biomass indicated by the 1987 survey (352,736 mt). Thus, averaging the estimated biomass of the two surveys resulted in an ABC (5,730 mt) which was 70% larger than it would have been if the same exploitation rate had been applied to the 1990 survey biomass estimate alone (3,309 mt). Given that the preliminary biomass estimate for 1993 is even lower than the estimate from the 1990 trawl survey, it is very likely that POP were exploited at an inappropriately high level during 1992.

The most recent biomass estimate from the preliminary 1993 SAFE report (Heifetz and Clausen, 1992), was derived from the newly-implemented Stock Synthesis Model (Methot, 1990). It estimated the preliminary 1993 POP "best fit" biomass to be slightly over 94,000 mt. This is significantly (59%) lower than the accepted estimate of 229,000 mt for 1992 which was based on an average of the exploitable biomass from the uncorrected 1987 and the 1990 triennial trawl surveys.

Use of the Stock Synthesis Model is a notable departure from methods used previously and appears to be a substantial improvement over previous methods. In addition to biomass estimates from stock assessment surveys, auxiliary data are incorporated into the Stock Synthesis Model. These auxiliary data include fishery CPUE and age and size composition from several different surveys. The relative emphasis placed on each of these additional data sources can be varied to achieve an acceptable overall fit of model estimates to the combination of data, rather than relying on only a few sources of data. In addition, low emphasis is placed on a stock recruitment relationship, which seems appropriate, since there is no clearly defined stock recruitment relationship for POP. Instead, individual recruitment levels are estimated. As indicated by Heifetz and Clausen, (1992), the population equilibrium assumption inherent in the prior applications of SRA is questionable. This is an additional consideration supporting the use of the Stock Synthesis Model. The preliminary results of the model suggest that the population prior to 1960 may have actually been lower than in the peak years of the fishery (Figure 4) and future projections are uncertain. However, application of this model is still evolving for use with POP and the final results for 1993 are expected to be somewhat different than those presented in the preliminary SAFE report.

Three notable results suggested by this model are: (1) the 1990 survey may have been much closer to the actual biomass than the earlier surveys and (2) the population over the past decade has been much lower than the presumed level derived from other methods such as SRA analysis and biomass survey data, and (3) the model projects that the population has been increasing over the past decade which is in direct contridiction to the results of the triennial trawl survey. In fact, the only way to replicate the downward trend shown by the survey is to dramatically increase the emphasis on the survey results in the model (Personal communication with John

Hiefetz, NMFS Auke Bay Laboratory). The discrepancy between the downward trend indicated by the survey and the upward trend suggested by the model needs to be evaluated and explained.

Use of the higher biomass estimates derived from previous methods as an indicator of stock status has resulted in substantially higher exploitation rates than are suggested by the current model. These higher exploitation rates could at least partially explain why the stock has apparently not improved appreciably during the last decade.

In recent years the fishery has been characterized by large amounts of highly efficient fishing effort concentrated into relatively short periods, making in-season management within pre-set quotas extremely difficult. In 1990 POP was combined with other slope species for management and the Gulf-wide ABC for the assemblage was exceeded by 3,414 mt (19%). Observer data indicate that POP were taken in amounts much greater than their proportion of the assemblage biomass during that year resulting in a harvest of over 12,000 mt of POP alone. In 1991 and 1992 POP were managed as a separate subgroup of the slope assemblage with separate ABCs, TACs, and overfishing levels. The 1991 ABC was exceeded by 337 mt (5%), the 1992 ABC was exceeded by 12%, and the 1992 overfishing level for the GOA was also surpassed.

Another concern regarding POP stock status is the current age distribution of the remaining population. The majority of the GOA population in the 1990 survey was less than 15 years with a mean age of 9.8 years (Figure 5) (Heifetz and Clausen, 1992). In addition, there is evidence that the portion of the population greater than age 25 has declined between the 1984 and 1990 surveys (Heifetz and Ianelli, 1992) (Figure 6) suggesting a differential removal of the older aged more fecund portion of the population. Industry testimony before NPFMC committees in September, 1992 indicated that larger fish are indeed being targeted because of their higher value.

The remaining age distribution of POP in the GOA is highly inconsistent with the expected age distribution of lightly or even moderately exploited rockfish stocks. This is particularly alarming given that POP are known to live in excess of 75 years. Age classes in an unexploited population would normally be distributed over a much broader range as a result of long-term accumulation of recruitment. Also, the "large" year classes reported in recent years (1976, 1980, and 1984) which have been viewed as an indicator of improving stock conditions are quite small when compared to the annual recruitment predicted by the stock synthesis model for the period between 1953 and 1970 (figure 7 from Hiefetz and Clausen, 1992).

There are also discrepancies in the data being used to predict future recruitment in the analytical models. The Stock Synthesis Model assumes 50% maturity at age seven and full reproductive recruitment at age nine. This assumption was based on data from Chikuni, (1975) who used scales to determine age at maturity. Gunderson (1977) estimated 50% sexual maturity for female POP ranged from age 9 to age 11 in British Columbia and off Washington. Using break-and-burn otolith age reading techniques on samples from British Columbia, Archibald, et. al. (1983) estimated the age of maturity for POP to be 11 years. The implication of this is that if Chikuni is correct, a much larger proportion of the GOA POP population is sexually mature and contributing to potential future recruitment. On the other hand, if Gunderson and Archibald's maturity schedules are more accurate, a large percentage of the POP population observed in the 1990 trawl survey, which was presumed to accurately reflect the current GOA POP stock, was acctually made up of immature fish (Figure 5).

Shortraker and Rougheye Rockfish

Prior to 1991 shortraker and rougheye rockfish were either managed as part of the POP complex (1979-1987) or as part of the general slope category (1988-1990). By 1990 it was obvious that these two species were being harvested at rates much greater than their relative abundance in the slope assemblage. This led biologists to recommend managing these two species as a separate management subgroup beginning in 1991. The current strategy for setting ABC is to apply F=M to the average mid-point biomass estimates for both species as indicated by the 1987 and 1990 trawl surveys. The estimate of M for both species (0.03) is derived using by using the calculated M for rougheye rockfish (0.025) multiplied by the ratio of the presumed maximum age of the two species (140/120) (Heifetz and Clausen, 1992). The TAC has been set equal to ABC the past two years.

The triennial trawl survey results indicate that between 1984 and 1990 both species have decreased in abundance, shortraker by 82% and rougheye by 40%. As with POP, the trend is decidedly downward and should be cause for concern. However, there are two confounding factors in determining the status of shortraker and rougheye rockfish stocks. First, there is concern that the triennial trawl surveys may not provide a good index of absolute abundance of either species. Second, the results of the annual longline survey are inconsistent with the results of the triennial trawl survey. The relative population weight of both species actually increased in the longline survey between 1988 and 1991 Heifetz and Clausen, 1992). One possible explanation for the apparent increase in rockfish catch in the longline survey is that sablefish CPUE decreased over the same interval which could conceivably have made more hooks available for rockfish. This is believed to be a possible explanation for the same discrepancy observed for thornyhead rockfish (Dawson, 1992).

Additional concerns include selective harvest and bycatch. Shortraker rockfish made up approximately 50% of the 1991 harvest of this subgroup although they made up less than 18% of the estimated 1990 biomass of the two species. Since shortraker rockfish are considerably more valuable than rougheye rockfish, this may be the result of selective targeting.

Bycatch of both shortraker and rougheye rockfish regularly occur in deep-water fisheries for other species. Hook-and-line fishermen in the GOA complain that they have often been prohibited from landing these species in target fisheries for other species because the TAC levels have already been taken by other gear types. It is difficult to determine the bycatch needs of the hook-and-line fishery since not all of the fish caught are actually landed, and there is very little observer coverage for much of the hook-and-line fleet. Regardless, the unreported bycatch of shortraker and rougheye rockfish is an additional source of mortality which needs to be quantified.

Other Slope Rockfish

All other slope rockfish species are currently managed as a single subgroup. Biomass trends for other slope species are even more uncertain than for POP or shortraker and rougheye rockfish. As mentioned previously, triennial trawl survey data indicate that the most abundant species, northern, sharpchin, redstripe, and harlequin rockfish increased in abundance from 1984 to 1987 and then decreased again in 1990. The overall trend from 1984 to 1990 suggests a slight increase in biomass over that interval.

The ABC for other slope rockfish is set using an F=M (0.06) strategy applied to an average biomass of the entire group as assessed in the 1987 and 1990 trawl surveys. The estimate of M is derived from the weighted average of the presumed natural mortality rates of four predominate species within the complex. As with the other species (POP, shortraker and rougheye rockfish), averaging the two years of the survey tends to increase the estimated biomass of the group by a considerable amount since the estimated biomass of the five most abundant species (listed above) was 49% lower in 1990 than in 1987.

Northern rockfish made up approximately 47% of the estimated 1990 biomass of this subgroup. However, the 1991 harvest was comprised of 93.5% northern rockfish. This appears to be another case where a single species is being harvested disproportionate to their abundance in the assemblage. NMFS biologists have also pointed out this problem (Heifetz and Clausen, 1992) and may recommend that northern rockfish be placed in a separate management subgroup to reduce the risk of overharvest in the future.

Demersal and Pelagic Shelf Rockfish

Fishery

Beginning in 1988, at the recommendation of ADF&G, the NPFMC separated the *Sebastes* rockfishes into three categories for management. The slope rockfish category included POP and other deeper water species which were taken predominantly in the deep-water trawl fishery. The DSR assemblage was comprised of ten near-shore bottom-dwelling species which are taken primarily in the near-shore longline fishery. The PSR assemblage is comprised of five species of generally near-shore species which are often aggregated in off-bottom schools. The assemblage composition is shown in Table 2.

DSR are currently recognized as a separate management category only in the Southeast Outside District as described in the GOA FMP. Although the assemblage originally included ten species, it has since been modified to include only eight species. Yelloweye rockfish (*S. ruberrimus*) is the predominant species of that assemblage and the entire complex is managed using yelloweye rockfish as an indicator species for biological parameters and abundance estimates.

The PSR category is comprised of five species with dusky rockfish (*S. ciliatus*) by far the most prevalent species throughout the GOA. Black rockfish (*S. melanops*) is the predominate near-shore pelagic species.

Harvests of DSR and PSR have been small relative to harvests of slope rockfish, and the directed fisheries are much more recent. The directed DSR fishery began in 1982 and only 120 mt were harvested that year. The harvest increased rapidly peaking in 1987 at 855 mt. Since then the harvest has been constrained by regulations and the total harvest declined to 510 mt in 1991. The reported harvest averaged 460 mt in the Southeast Outside District for the ten-year period between 1982 and 1991, which includes the low production "start-up" years of the fishery.

Harvest reports are available for PSR only since 1988. Prior to 1988 they were included in the "other rockfish" management category. From 1988 through 1991 the reported harvest averaged 1,703 mt peaking in 1991 at 2,342 mt. Approximately one quarter (574 mt) of the 1991 catch was from the near-shore, hook-and-line fisheries and is presumed to be comprised primarily of black rockfish. The remainder is presumed to be predominantly dusky rockfish taken by trawl gear both incidental to fisheries for other species or as a target fishery.

Management Strategy and Stock Status

Demersal Shelf Rockfish

The NPFMC first recommended management action for the DSR fishery in 1984. That year, at the request of ADF&G, the NPFMC approved a provisional 600 mt OY and established a special quota area in the central portion of the Southeast Outside District. ADF&G subsequently expanded management to the remainder of the Southeast Outside District and was given limited management authority under a provision of the GOA FMP in 1986. That authority was expanded in 1990 with the passage of Amendment 21 which assigned principle management authority for the DSR fishery in the Southeast Outside District to the State of Alaska, with oversight by the NPFMC.

The original quota set in 1984 was intended to place a cap on the rapidly expanding fishery. Between 1985 and 1990 an annual TAC was recommended by ADF&G based on performance indicators from the directed fishery. The TAC recommendation also included an estimate of the amount of DSR required for bycatch in target fisheries for other species.

In 1990 the NPFMC adopted a default definition for setting ABC and the DSR ABC was set equal to the average harvest from 1982 through 1990. That method was also used to set the ABC and TAC levels for 1991.

In 1992 the Southeast Outside District was expanded to include the East Yakutat Area. A biomass estimate of DSR was derived for the East Yakutat portion of the area using line transects from a manned submersible (O'Connell and Carlile, 1992). The presumed natural mortality of 0.02 was multiplied by the biomass estimate to determine ABC. The resulting ABC estimate for the East Yakutat area was added to the average harvest data for the remainder of the Southeast Outside District to calculate ABC for the entire area.

For 1993 the line transect biomass estimate was expanded to include the remainder of the Southeast Outside District. The exploitation rate was again set at F=M (0.02). However, ADF&G recommended that the exploitation rate be applied to the lower 90% C.I. of the biomass estimate rather than the mid-point of the estimate to determine ABC. This resulted in a more conservative ABC of 800 mt compared to 967 mt if the mid-point biomass had been used. ADF&G used this approach because of uncertainty in the data and the fact that the submersible survey only covered a very small fraction of the entire management area. This precautionary reduction is intended to reduce the risk of over-exploitation until better information becomes available.

During 1992 the International Pacific Halibut Commission (IPHC) cooperated with the ADF&G to obtain an estimate of the unreported mortality of DSR in the halibut fishery. Initial results indicate that the bycatch rate of rockfish in the Eastern Gulf halibut fishery is approximately 10% which amounted to nearly 300 mt of DSR in 1992. The data also suggests that only about 35% of the bycatch is reported on fish tickets. In the future, the directed DSR fishery will be managed to account for the estimated bycatch mortality in the halibut fisheries by applying the best estimate of bycatch rate to the annual halibut harvest in the area.

In addition to annual harvest objectives, ADF&G has developed additional in-season management strategies to minimize the risk that harvest objectives will be exceeded. The bycatch mortality estimated in fisheries for other species is subtracted from the TAC before the directed fishing quotas are set. Also, the directed fishery is managed with a series of regulations which tend to slow down the harvest to a more manageable level. These include gear specifications, trip limits, mandatory logbooks, hot-spot authority, and split seasons (Bracken, 1990). These regulations were developed in conjunction with an industry working group and so there has been very good cooperation with the industry. While this approach is quite labor intensive, it has produced the positive benefit of DSR being the only *Sebastes* rockfish group which has been consistently managed under the annual quota level over the life of the fishery.

Pelagic Shelf Rockfish

The biomass of dusky rockfish has fluctuated markedly over the three years during which the GOA triennial trawl survey was conducted. Estimated biomass increased from 37,313 mt in 1984 to 163,188 mt in 1987 and decreased to 24,141 mt in 1990. The confidence intervals for PSR are extremely high, suggesting that catches are sporadic and variable. Since that type of fluctuation cannot be explained based on population or fishery dynamics, these values should be considered unreliable. Never the less, ABC for PSR is derived by applying the natural mortality rate for dusky rockfish to the average biomass estimate from all three years of the NMFS triennial trawl survey, including the extraordinarily high 1987 estimate.

The current biomass estimate does not account for other species such as black rockfish which reside primarily in the near-shore area and which are not assessed by the triennial trawl survey. The Plan Team accepted an ADF&G recommendation for setting provisional black rockfish TAC limits for 1992. The recommendation was based on a combination of harvest trends and anecdotal information on relative stock condition. That approach was not adopted by the NPFMC and the PSR assemblage continues to be managed as a single unit based on the average results of the triennial trawl surveys.

Thornyhead rockfish

Fishery

Thornyhead rockfish have generally been landed incidentally in fisheries for other species such as slope rockfish and sablefish. There is no evidence that target fisheries for thornyhead rockfish have occurred. However, with their relatively high value, they are considered to be a valuable component of the deep-water rockfish trawl fishery.

The initial OYs adopted for thornyhead rockfish in the GOA FMP were based on average reported incidental catch in the foreign sablefish longline fishery and estimates of biomass and ABC were not available. Only recently have thornyhead rockfish been managed according to estimated biomass levels derived from the triennial trawl surveys.

The species has become progressively more valuable in recent years and reported domestic harvests increased from very low levels in the mid-1980's (a 500 mt average from 1982 through 1986) to over 3,000 mt in 1989. Since then the harvest has been constrained by more restrictive TAC levels and the catch declined to 1,217 mt in 1991. The average harvest between 1982 and 1991 was 1,321 mt.

As with the slope rockfish species, it is presumed that some bycatch of thornyhead rockfish goes unreported. This is particularly true of the hook-and-line sablefish fishery where observer coverage is limited.

Management and Stock Status

Although there are actually three species of *Sebastolobus* rockfish in the North Pacific, one species, the shortspine thornyhead, (*Sebastolobus alascanus*) dominates the GOA population and is by far the most prevalent species in the catch. According to Dawson (1992) "the population structure for thornyheads has not been defined" in the GOA. Biological information on thornyheads is also very sparse. The estimate of natural mortality (M) is based on a single age sample from Southeast Alaska as reported in Miller (1985). Age at recruitment and longevity are also presumed from that one sample.

The triennial trawl survey indicates a biomass decline of nearly 79% from 123,005 mt in 1984 to only 26,207 in 1990. It must be pointed out, however, that the numbers are not directly comparable since for 1990 the deeper-water component was estimated from ratios established in earlier surveys rather than measured directly. Regardless, the abundance trend for this species, as indicated by the triennial survey, is decidedly downward.

As with shortraker and rougheye rockfish, there is a discrepancy in the trends indicated by the triennial trawl survey and by the annual longline survey. Also, there is a discrepancy between the cooperative longline survey and the domestic longline survey causing the SAFE chapter author to conclude, "This may indicate that longline surveys are not a particularly good means to assess changes in thornyhead abundance" (Dawson, 1992).

The cooperative longline survey indicates a 47% decrease in relative population numbers between 1984 and 1991. However, the domestic longline survey presents a different picture and indicates a 105% increase in relative population numbers between 1988 and 1991. Dawson (1992) quotes Sigler and Zenger (1990) as suggesting that "the decline in sablefish abundance may have been responsible for the increase in thornyheads in the domestic survey between 1988 and 1989". One must presume that, if true, this relationship would apply to the more recent surveys as well.

Since 1990 the ABC for thornyheads has been derived by applying the presumed natural mortality (0.07) to the midpoint of the biomass as assessed in the 1990 trawl survey. The ABC was reduced to 1,800 mt in 1990, approximately 1/2 of the level prior to 1990. In their preliminary recommendation for 1993, the Plan Team recommended applying the natural mortality rate to the lower 90% C.I. of the 1990 triennial trawl survey biomass estimate resulting in a further reduction of ABC to 1,500 mt. The ABC and TAC for this species are applied Gulf wide and there is no attempt to manage thornyhead rockfish by regulatory district.

The instantaneous natural mortality rate of 0.07 for thornyhead was derived from the Ricker (1975) procedure applied to fish less than age 30 (Miller, 1985) from a sample taken off Cape Ommaney, Southeast Alaska in the early 1980's. Miller reported a maximum age in her sample of 62 years and it is unclear why she based her derivation of natural mortality on fish less than age 30 or why she used the Ricker derivation of M when a Z statistic was also derived from the data. Preliminary aging from a sample collected by ADF&G in 1991 indicated older maximum ages than observed in Miller's sample (Personal communication, Kris Munk, ADF&G, Douglas, Alaska). It is unknown how this might impact the natural mortality estimate, but suggests that the natural mortality rate estimated from the earlier sample may be too high when applied to the entire age spectrum of the population. If this assumption is correct, then the current exploitation rate of 0.07 may actually exceed the natural mortality rate of this species.

Unsolicited information received from both long-time fishermen and processors suggests that both numbers and average size of thornyhead rockfish have decreased in the off-shore sablefish fisheries in recent years. Attempts should be made to verify and quantify this information.

Management of Long-lived Species

Conventional fishery management still subscribes to the theory of balance whereby a decrement in total stock is compensated for by an increment in recruitment and/or growth per unit stock, or a reduced rate of natural mortality (Ricker, 1954, Cushing, 1974, Ricker, 1975). This theory assumes that annual surplus production will actually increase as a result of reductions in unexploited stocks caused by fishing, providing of course, that the decrease is not too great.

However, many fisheries yield or production models in use today are based on relatively short-lived species. Beverton and Holt (1956) based their work on plaice which acquired a maximum assumed age of approximately 15 years. Much of Ricker's (1954) stock and recruitment projections were based on salmonids, clupeids, and haddock, all of which are short-lived species. Schaefer's (1954) work was based on a study of yellow-fin tuna, which is also a fast cycling species. The application of theoretical stock yield or production models to species such as rockfish which exhibit extreme longevity is questionable. This concern has been advanced by various researchers over the years.

Adams (1980) described two basic life history patterns in marine fishes. The first, referred to as *r* selective, produce the largest possible total number of offspring. The second strategy, referred to as *K* selective, produce offspring with the highest possible fitness. Attributes of *K* selective species include, delayed maturity, reduced growth rates, low natural mortality rates, large body size, and longer life span. *K* selective species are also normally much less fecund than *r* selective species. With their advanced age at maturity and extreme longevity, rockfish represent the far end of *K* selective spectrum. According to Adams, these animals are "highly sensitive to overfishing and, once depleted, recovery would require a long time".

Leaman and Beamish (1981) contended that "fundamental errors of management may occur directly as a result of the failure to consider evolved biological characteristics of species with extreme longevity". They point out that the most obvious benefit of longevity is a long reproductive life which reduces the risk that a long period of unfavorable environmental conditions will result in a loss of the stock. The stability of the reproductive value for a stock might be the most important trait, particularly when reproductive success is highly variable. They point out that there is little evidence that an increase in the quantity of reproductive output will increase recruitment and that long-lived species may have evolved mechanisms to optimize the contribution of more limited productive output. There may also be species-specific advantages to retaining larger (and older) fish in the population. The primary concern expressed is that exploitation will result in a truncation of the age spectrum of the adult stock possibly decreasing its total reproductive value. The paper concludes by warning that the "production and growth-oriented management strategies derived for shorter-lived species may result in rapid over-exploitation of accumulated biomass and a prolonged period of rehabilitation for the long-lived fish". They also conclude that in extreme cases, a competing species may fill the void left by the long-lived species preventing the over-exploited species from regaining its former abundance.

Francis, (1985) stated the process of fishing down the standing stocks of long-lived species was more comparable to mining rather than renewable resource exploitation. He concluded that "the biological nature of these species, (sablefish and rockfish) seems to preclude their recovery from overfishing while still maintaining any semblance of a viable and productive fishery". He went on to state that "it is of paramount importance that fisheries biologists and managers of the Alaska region must develop a plan for the orderly and conservative development of their domestic rockfish and sablefish fisheries."

Leaman, (1992) proposed that POP have very little buffering against the effects of reduced life span. While individual growth rate increased and age at maturity appeared to decrease as a result of reduced population levels and truncated age distribution, size-specific fecundity also decreased. He felt this is an indication of an energy allocation protocol in a stressed population which favors growth over reproduction. This renders the reproductive value of the population extremely sensitive and continuous with changes in abundance. He concludes that "management policies developed for shorter-lived species are shown to be inappropriate for rockfishes."

Conclusions and recommendations

Although there have been vast improvements in recent years, we do not believe that rockfish have been or are currently being managed successfully in the GOA. Successful management has been hampered by a number of factors. These include lack of conclusive information on stock status, often conflicting information from available data, questionable management strategies based on the available information, lack of explicit management goals expressed by the NPFMC, and industry pressure to embrace the more optimistic view of stock status in the face of conflicting data.

Exploitation rate strategies successfully applied to faster-growing shorter-lived species may be totally inappropriate for *K* selective species such as rockfish. Even F=M exploitation strategies may hold depleted populations in check reducing the potential for stock rebuilding.

We are encouraged by recent attempts to improve survey methodology for rockfish and by the quantitative advancements offered by use of the Stock Synthesis Model for POP. We will also remain committed to continuing to develop better ways to determine stock status and appropriate management strategies for those species over which ADF&G has been given management authority.

We also believe it is necessary to heed the warnings advanced by rockfish researchers over the past two decades. The NPFMC must begin to develop a completely different approach to rockfish management. The following is a list of recommendations for immediate action:

1. For those few remaining species which are currently considered to be lightly exploited ("other slope" rockfish and pelagic shelf rockfish), very conservative exploitation rates should be applied at least until better information on stock status and biological parameters becomes available.

2. For those species which have been heavily exploited (shortraker/rougheye, DSR, and thornyheads) or depleted (POP), explicit stabilization or rebuilding schedules and long-term management goals should be established immediately. The short-term strategy should be one that projects an upward stock trend even under the most pessimistic recruitment scenarios until long-term objectives are established. Rebuilding schedules should involve time-certain objectives. For example the Pacific Fishery Management Council has embarked on a 20-year rebuilding schedule for POP.

3. When there is a range of possible values available for determining appropriate harvest strategy, the less encouraging view of stock status should be taken and the most conservative exploitation rate applied unless there are compelling reasons to do otherwise.

4. In view of the advice offered by others on the sensitivity of long-lived species to over-exploitation and the implications of changes in the age structure of the population on reproductive success, rebuilding schedules should consider factors other than just total biomass. A more broadly distributed age structure and total reproductive potential of the population are examples of other such considerations.

5. For species managed as a complex, ABC for the entire complex should be based only on the predominant commercially exploitable species in the complex, not on the sum of the component parts. This approach is currently used for DSR management in the Southeast Outside District where the complex is managed as if yelloweye rockfish were the only species. Other possibilities would be to use northern rockfish as an indicator species for "other slope" rockfish in the Central and Western Gulf. Perhaps sharpchin rockfish could be used as an indicator species for "other rockfish" in the Eastern Gulf. This approach can be modified to concentrate on different species over time or to use different indicator species for each regulatory district to the extent defensible from the available data.

6. Potential impacts on other important rockfish species must be considered when allowing development of new fisheries for lightly exploited species. For example, it may be impractical to allow a fishery on sharpchin if it is determined that the resulting bycatch of POP or other fully exploited species is unacceptably high.

7. For species declared in need of rebuilding, management strategies must be developed which protect these species from excessive bycatch mortality during the rebuilding period even if that means foregoing some harvest of other non-rockfish species to accomplish that objective.

8. Better means must be developed to determine total fishing mortality, particularly for those species such as shortraker, rougheye, and thornyheads which are landed as bycatch in unobserved fisheries.

9. Management strategies should be developed which assure that legitimate and unavoidable bycatch of rockfish is allowed in established fisheries for species other than rockfish even if it means foregoing directed rockfish harvest to meet that need. For those species with very low TACs such as shortraker/rougheye, and thornyheads, it may be best to relegate the entire harvest to bycatch only and to set reasonable directed fishing standards to prevent "topping off" with those species.

10. Where ABC levels are low and industry has shown the ability to reach or exceed the TAC, the TAC must always be set far enough below the ABC to assure that the ABC is not exceeded. One way of doing this would be to view the buffer between TAC and ABC as a PSC, thus once the ABC was reached fisheries could be shut down. This procedure places the burden of avoidance on the industry and penalizes it directly for maintaining high bycatch rates once the TAC is taken.

11. Innovative management approaches should be considered. These might include: (1) effort limitation schemes to lessen the potential for exceeding harvest objectives, (2) marine sanctuaries to determine rebuilding rates, monitor natural population fluctuations, and provide reproductive reserves to repopulate adjacent areas, or (3) rotational harvest strategies to protect stocks from long-term directed fishing effort.

It is hoped that this paper will be accepted in the constructive light that it is intended. The NPFMC is currently at a crossroads with rockfish management. Progress is being made, but in the meanwhile, available stock status indicators suggest that our most valuable rockfish populations are continuing to decline. We have had a tendency in recent years to disbelieve the "bad news" because it could not be logically explained. We have also operated under the possible illusion the triennial trawl surveys tend to underestimate stock abundance and that the results provided a buffer on the side of conservative management. However, new information (Krieger, 1992) suggests that the triennial trawl surveys may actually overestimate the abundance of POP. This may occur because the avoidance behavior of the fish is likely to place more of a school in the trawl path, fish are apparently moved into the trawl path by the doors and bridles, and a greater proportion of the population resides on trawlable ground than previously thought. The actual impact of these effects on trawl estimates are currently being analyzed by NMFS biologists.

We believe that it is time to take the declining stock trends indicated by the trawl survey at face value at least until the data is replaced by new information which is accepted as a better estimator of stock abundance. We must recognize that much of the available data indicates that our rockfish management strategy is apparently not working and is in drastic need of change.

Decisions made now will very likely determine whether or not there will be viable rockfish fisheries in the GOA in the future. At the very least, a more conservative approach should be adopted until better information becomes available. Given the low natural mortality rates recognized for rockfish, erring on the side of conservation simply means foregoing some short-term harvest and resulting revenue for the sake of uncertainty. If we ultimately determine that there is no need for reduced harvest levels, the fish will still be available at a later date and possibly at a larger and more valuable size.

We feel that rebuilding of already depleted rockfish stocks is possible. The recruitment of POP observed in 1976, 1980, and 1984, while small in a historic perspective, provide an encouraging indicator that rebuilding is possible. We also believe that there are better ways to manage all rockfish stocks to safeguard them from potential future or on-going over-exploitation. However, to continue to employ the current management strategies may very well put the stocks at risk of further depletion and possibly jeopardize future management options.

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Table : .--Catch[a] (mt) of fish in the slope rockfish assemblage in the Gulf of Alaska, with gulfwide values of acceptable biological catch (ABC) and fishing quotas[b] (mt), 1977-92. Values listed for 1977-88 are landed catches only, whereas values for 1989-92 also include fish reported by fishermen as discarded at sea.

Year	Fishery category	Regulatory area			Gulfwide Total	Gulfwide Management value	
		Western	Central	Eastern		ABC	Quota[b]
1977	Foreign	6,282	6,166	10,993	23,441		
	U.S.	0	0	12	12		
	JV	-	-	-	-		
	Total	6,282	6,166	11,005	23,453	50,000	30,000
1978	Foreign	3,643	2,024	2,504	8,171		
	U.S.	0	0	5	5		
	JV	-	-	-	-		
	Total	3,643	2,024	2,509	8,176	50,000	25,000
1979	Foreign	944	2,371	6,434	9,749		
	U.S.	0	99	6	105		
	JV	1	31	35	67		
	Total	945	2,501	6,475	9,921	50,000	25,000
1980	Foreign	841	3,990	7,616	12,447		
	U.S.	0	2	2	4		
	JV	0	20	0	20		
	Total	841	4,012	7,618	12,471	50,000	25,000
1981	Foreign	1,233	4,268	6,675	12,176		
	U.S.	0	7	0	7		
	JV	1	0	0	1		
	Total	1,234	4,275	6,675	12,184	50,000	25,000
1982	Foreign	1,746	6,223	17	7,986		
	U.S.	0	2	0	2		
	JV	0	3	0	3		
	Total	1,746	6,228	17	7,991	50,000	11,475
1983	Foreign	671	4,726	18	5,415		
	U.S.	7	8	0	15		
	JV	1,934	41	0	1,975		
	Total	2,612	4,775	18	7,405	50,000	11,475
1984	Foreign	214	2,385	0	2,599		
	U.S.	116	0	3	119		
	JV	1,441	293	0	1,734		
	Total	1,771	2,678	3	4,452	50,000	11,475
1985	Foreign	6	2	0	8		
	U.S.	631	13	181	825		
	JV	211	43	0	254		
	Total	848	58	181	1,087	11,474	6,083
1986	Foreign	Tr	Tr	0	Tr		
	U.S.	642	394	1,908	2,944		
	JV	35	2	0	37		
	Total	677	396	1,908	2,981	10,500	3,702
1987	Foreign	0	0	0	0		
	U.S.	1,347	1,434	2,088	4,869		
	JV	108	4	0	112		
	Total	1,455	1,438	2,088	4,981	10,500	5,000

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Table ..--(Continued).

Year	Fishery category/ Management subgroup	Regulatory area Western	Central	Eastern	Gulfwide Total	Gulfwide Management value ABC	Quota[b]
1988	Foreign	0	0	0	0		
	U.S.	2,586	6,467	4,718	13,771		
	JV	4	5	0	8		
	Total	2,590	6,471	4,718	13,779	16,800	16,800
1989	Foreign	0	0	0	0		
	U.S.	4,339	8,315	6,348	19,002		
	JV	0	0	0	0		
	Total	4,339	8,315	6,348	19,002	20,000	20,000
1990	Foreign	0	0	0	0		
	U.S.	5,203	9,973	5,938	21,114		
	JV	0	0	0	0		
	Total	5,203	9,973	5,938	21,114	17,700	17,700 — 62.2% POP
1991[c]	POP[d]	1,401	2,765	1,971	6,137	5,800	5,800
	Shortraker/ Rougheye	73	868	410	1,351	2,000	2,000
	Other slope[e]	847	5,127	532	6,506	10,100	10,100
1992[c]	POP	1,223	2,190	2,249	5,662	5,730	5,200
	Shortraker/ Rougheye	88	1,209	639	1,936	1,960	1,960
	Other slope	987	2,857	458	4,302	14,060	14,060

} 17,900 Total (1991)

} 21,220 Total (1992)

JV = Joint venture. Tr = Trace catches.

Sources: Catch: 1977-84, Carlson et al. (1986); 1985-88, Pacific Fishery Information Network (PacFIN), Pacific Marine Fisheries Commission, 305 State Office Building, 1400 S.W. 5th Avenue, Portland, OR 97201; 1989-92, National Marine Fisheries Service, Alaska Region, P.O. Box 21668, Juneau, AK 99802. ABC and Quota: 1977-1986 Karinen and Wing (1987); 1987-91, Heifetz and Clausen (1991); 1992, North Pacific Fishery Management Council Newsletter, Dec. 19, 1991. P.O. Box 103136, Anchorage, Alaska 99510.

[a]Catch defined as follows: 1977, all Sebastes rockfish for Japanese catch, and Pacific ocean perch for catches of other nations; 1978, Pacific ocean perch only; 1979-87, the 5 species comprising the Pacific ocean perch complex; 1988-90, the 18 species comprising the slope rockfish assemblage; 1991-92, the 20 species comprising the slope rockfish assemblage.

[b]Quota defined as follows: 1977-86, optimum yield; 1987, target quota; 1988-92, total allowable catch.

[c]There were no foreign or joint venture catches in 1991 or 1992; updated as of August 7, 1992.

[d]Pacific ocean perch management subgroup.

[e]Other slope rockfish management subgroup.

Table 2.--Species comprising the slope rockfish assemblage in the Gulf of Alaska.

Common name	Scientific name	Management subgroup
Pacific ocean perch	*Sebastes alutus*	Pacific ocean perch
Shortraker rockfish	*S. borealis*	Shortraker/rougheye
Rougheye rockfish	*S. aleutianus*	Shortraker/rougheye
Northern rockfish	*S. polyspinis*	Other slope rockfish
Sharpchin rockfish	*S. zacentrus*	Other slope rockfish
Redstripe rockfish	*S. proriger*	Other slope rockfish
Harlequin rockfish	*S. variegatus*	Other slope rockfish
Silvergrey rockfish	*S. brevispinis*	Other slope rockfish
Yellowmouth rockfish	*S. reedi*	Other slope rockfish
Bocaccio	*S. paucispinis*	Other slope rockfish
Greenstriped rockfish	*S. elongatus*	Other slope rockfish
Darkblotched rockfish	*S. crameri*	Other slope rockfish
Pygmy rockfish	*S. wilsoni*	Other slope rockfish
Splitnose rockfish	*S. diploproa*	Other slope rockfish
Aurora rockfish	*S. aurora*	Other slope rockfish
Blackgill rockfish	*S. melanostomus*	Other slope rockfish
Chilipepper	*S. goodei*	Other slope rockfish
Shortbelly rockfish	*S. jordani*	Other slope rockfish
Stripetail rockfish	*S. saxicola*	Other slope rockfish
Vermilion rockfish	*S. miniatus*	Other slope rockfish

Table --Species comprising the pelagic shelf rockfish assemblage in the Gulf of Alaska.

Common name	Scientific name	Former management grouping (1979-87)
Dusky rockfish	Sebastes ciliatus	Other rockfish
Black rockfish	S. melanops	Other rockfish
Widow rockfish	S. entomelas	Other rockfish
Blue rockfish	S. mystinus	Other rockfish
Yellowtail rockfish	S. flavidus	Other rockfish

Table 2. Rockfishes which are included in the demersal shelf rockfish assemblage in the Gulf of Alaska.

Common Name	Scientific Name
canary	*Sebastes pinniger*
China	*S. nebulosus*
copper	*S. caurinus*
quillback	*S. maliger*
redbanded	*S. babcocki*
rosethorn	*S. helvomaculatus*
tiger	*S. nigrocinctus*
yelloweye	*S. ruberrimus*

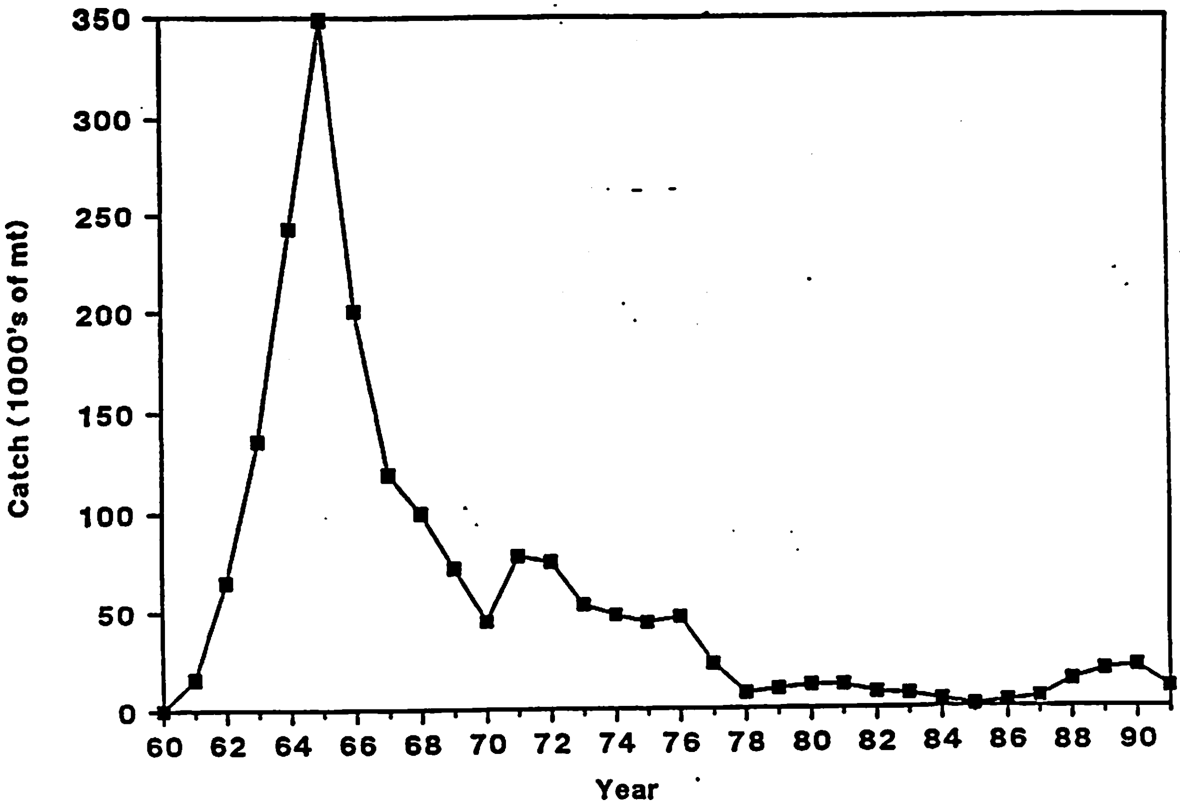

Figure , -1.--All-nation catch of Pacific ocean perch and other slope rockfish in the Gulf of Alaska, 1960-91. Data based on the following sources: 1960-63, Balsiger et al. (1985); 1964-84, Carlson et al. (1986); 1985-91, Table 5-2, this report.

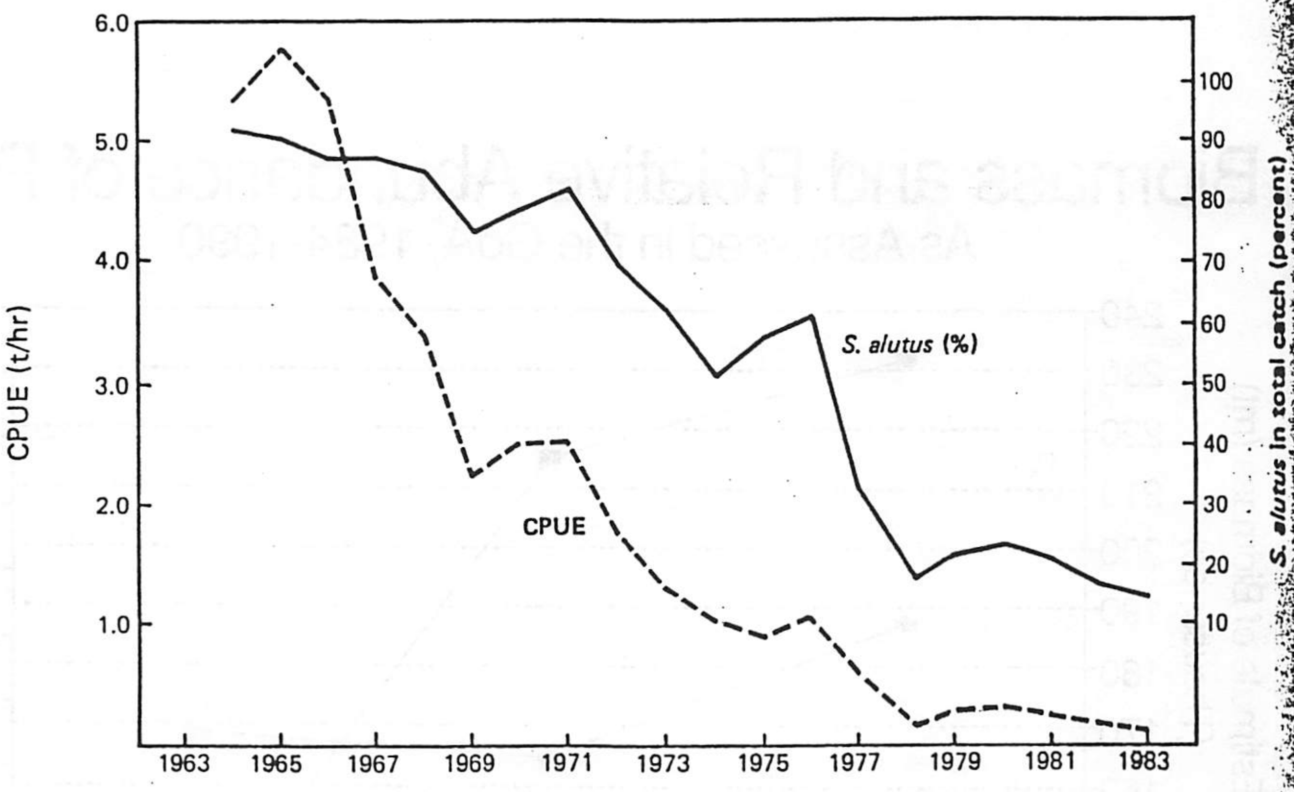

Figure 2.--Annual changes in the percentage of S. alutus in the Japanese trawl catches and S. alutus catch per unit of effort (CPUE) in the Gulf of Alaska.

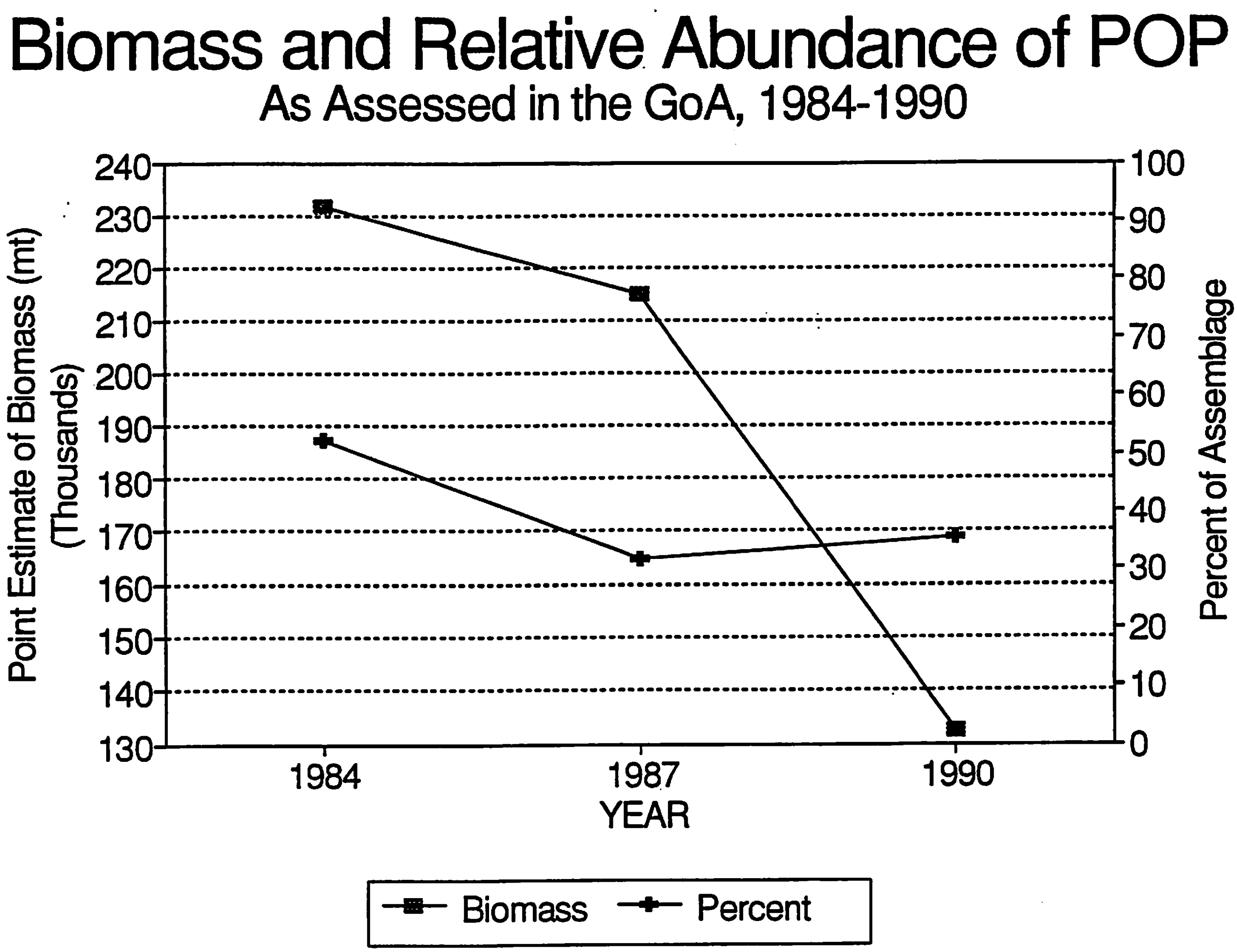
Biomass and Relative Abundance of POP
As Assessed in the GoA, 1984-1990
Point Estimate of Biomass (mt) (Thousands)
240
230
220
210
200
190
180
170
160
150
140
130
Percent of Assemblage
100
90
80
70
60
50
40
30
20
10
0
1984
1987
1990
YEAR
Biomass
Percent

Figure 3.

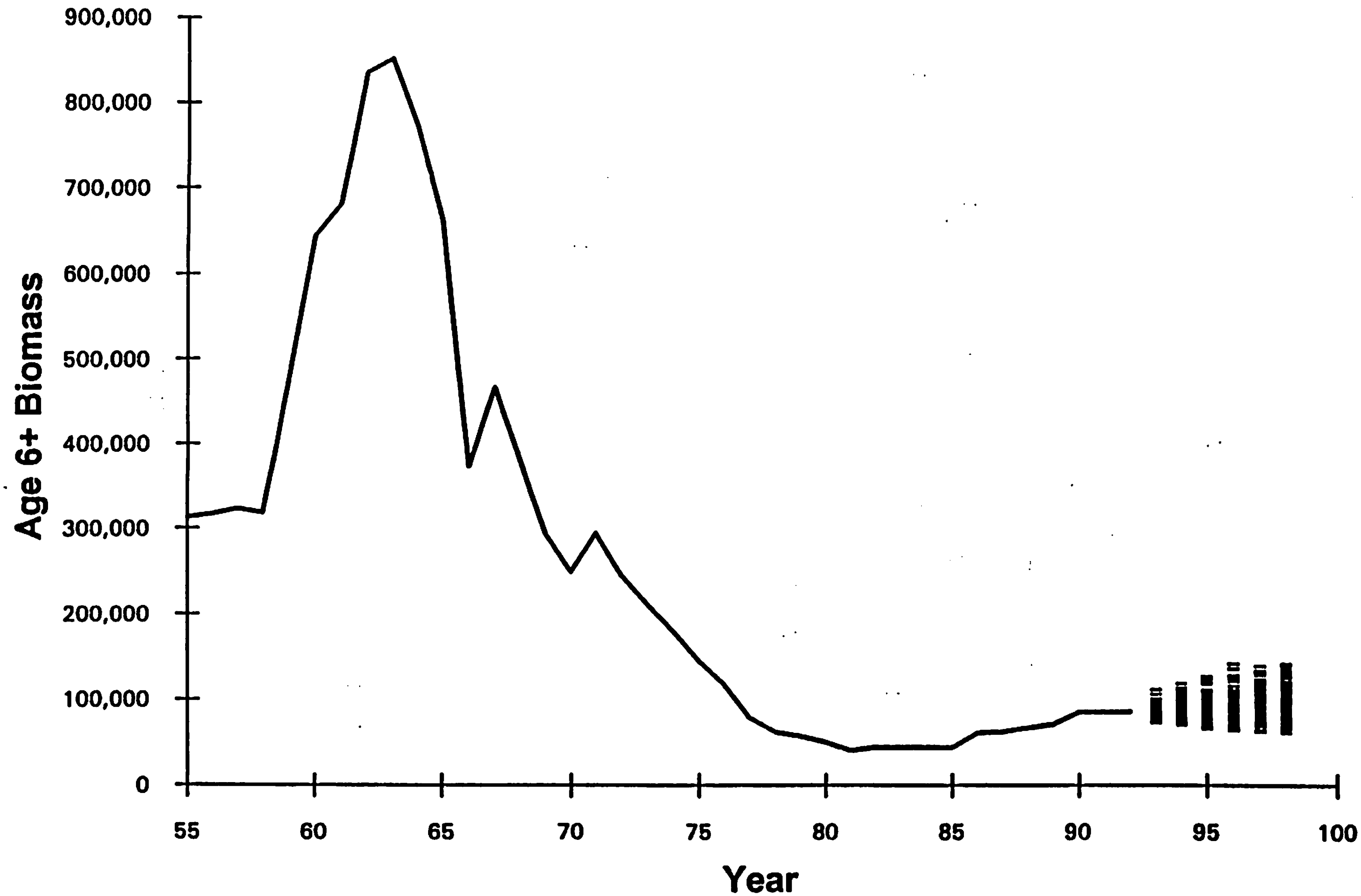

Figure 4. Exploitable biomass trajectory for model 4 and distribution of projections through 1998.

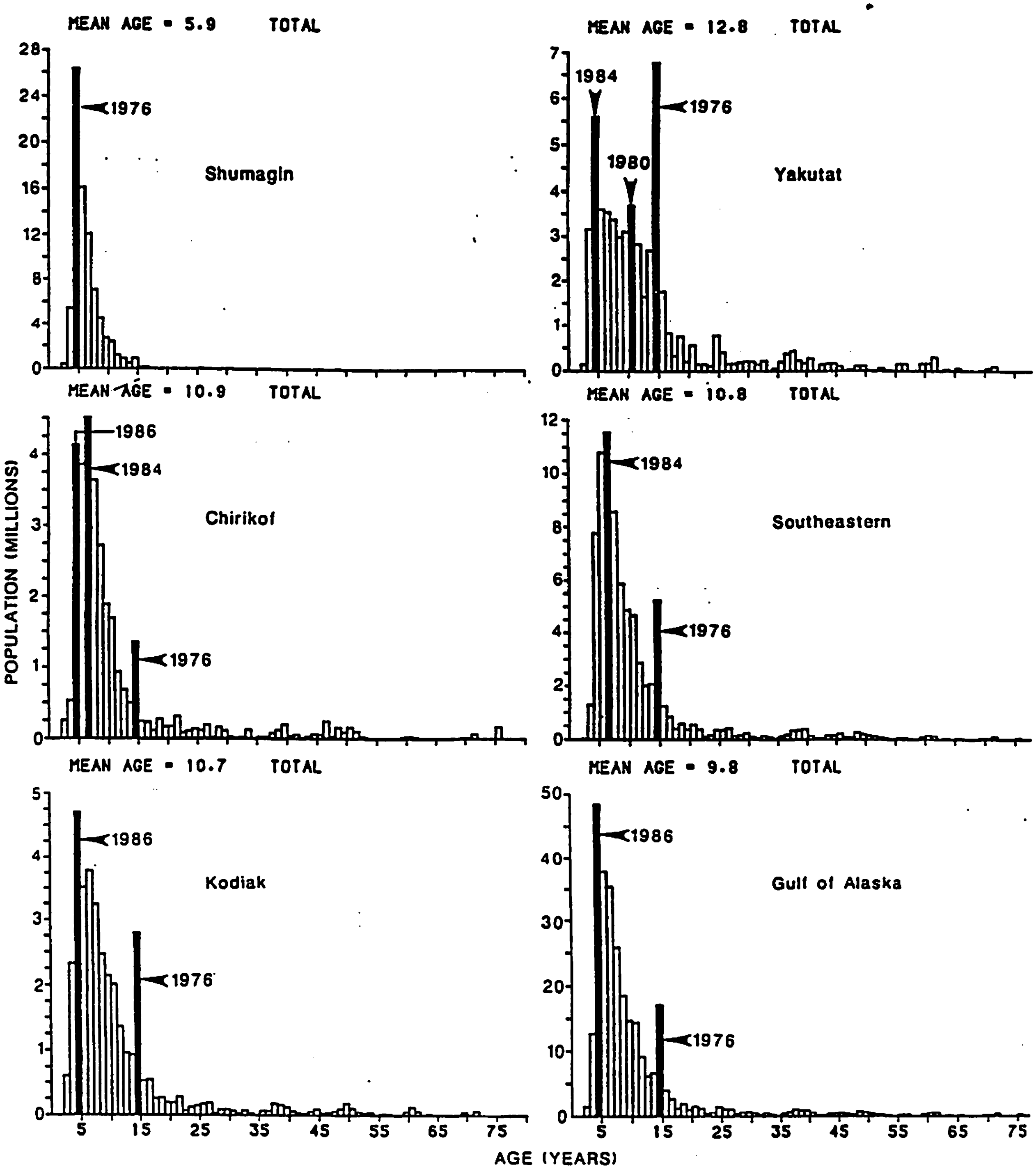

Figure 5.--Age composition of the estimated population of Pacific ocean perch, Sebastes alutus, in the Gulf of Alaska, based on otoliths collected in the 1990 triennial trawl survey. Dark bars identify four prominent year classes: 1976 (age 14), 1980 (age 10), 1984 (age 6), and 1986 (age 4).

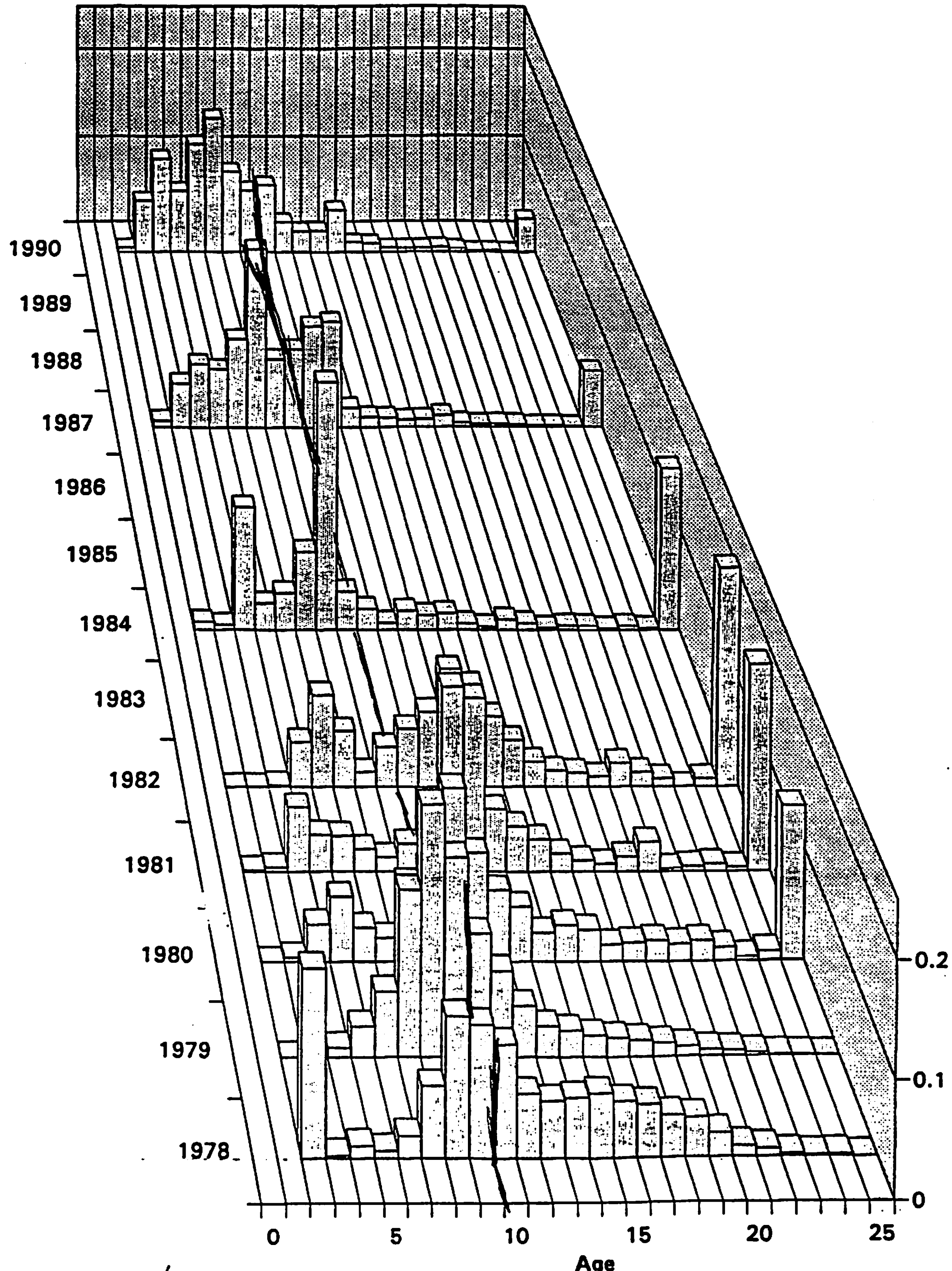

Figure 6. Biased age compositions from the 1978 and 79 U.S. surveys and unbiased age compositions for the 1980-90 surveys. Aged 25 and older fish were pooled.

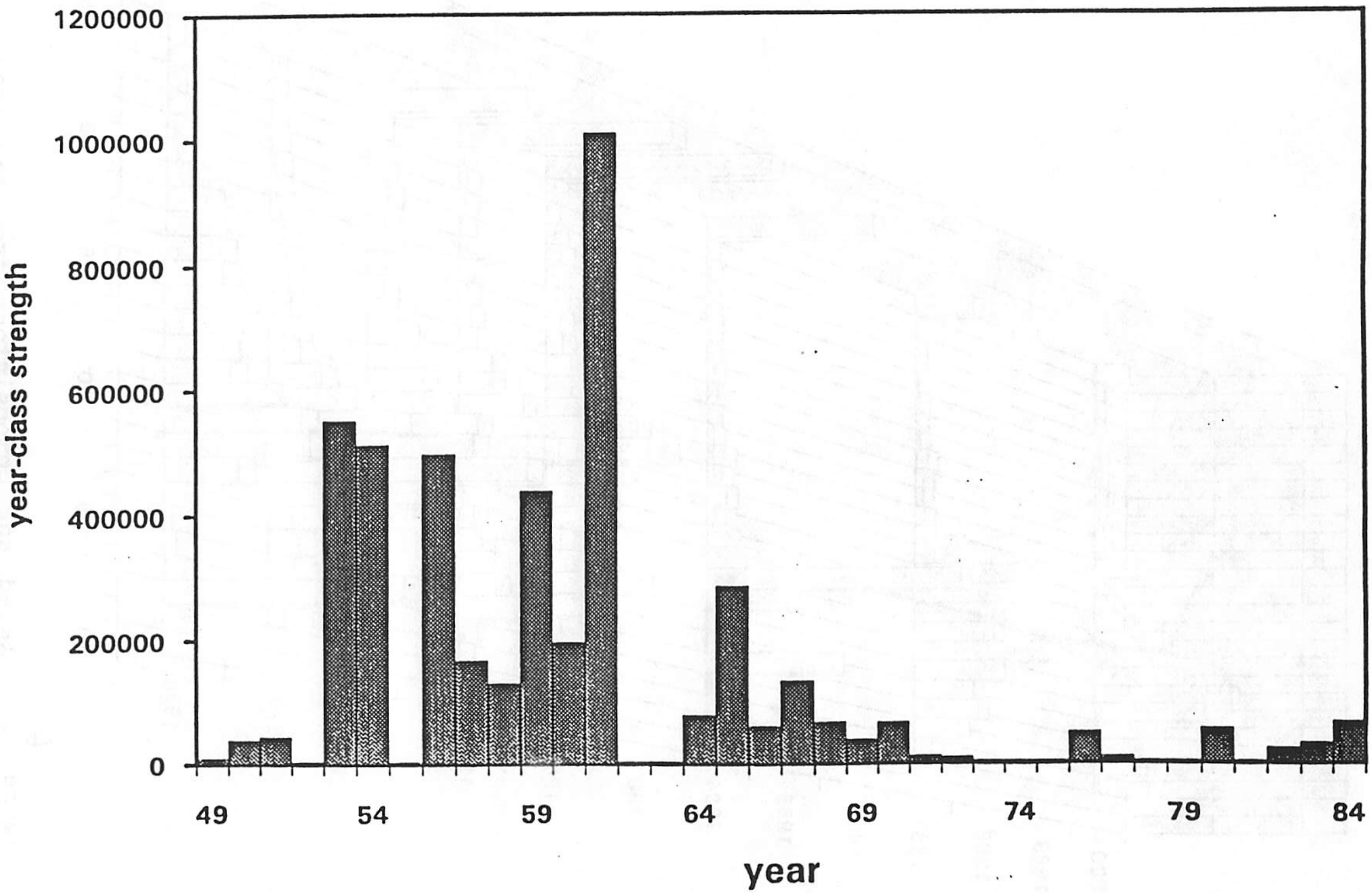

Figure 7. Estimated year class strength based on model 4.

ESTIMATES OF UNREPORTED DISCARDS OF SHORTRAKER, ROUGHEYE, AND THORNYHEAD ROCKFISH IN THE GULF OF ALASKA HOOK-AND-LINE SABLEFISH FISHERY

by

Barry Bracken
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and

Jessie Gharrett
NMFS, Juneau, AK

Since 1990 NMFS regulations have required that all groundfish taken in the federal waters be reported, regardless if they are retained or discarded. Nevertheless, information received from fishermen and testimony given at Council meetings over the past year suggest that at-sea discards in the unobserved portion of the longline fisheries may be under-reported by a substantial amount.

The most critical issue from a management standpoint is the need to determine total fishing mortality. This is particularly important for the fully utilized rockfish species which have very low ABC levels and are very sensitive to over-exploitation.

During 1992 ADF&G cooperated with IPHC to develop an estimate of the bycatch rate of demersal shelf rockfish in the halibut fishery. Results of that study indicated that only 1/3 to 1/2 of all DSR taken as bycatch are actually reported. The outcome of that study will be incorporated into the State's DSR management strategy for 1993. However, two additional species groups, shortraker/rougheye (SR/RE) and thornyhead rockfish, which are frequently taken as bycatch in the longline sablefish fishery are also suspected of being under-reported.

A recent letter from NMFS requested ADF&G to examine the problem of under-reporting of SR/RE and thornyhead rockfish over the next year and, if possible, to estimate unreported discards in the sablefish fishery. ADF&G agreed to cooperate to the extent possible. They also responded that some data which is already available may be useful for determining the magnitude of the problem and for providing preliminary estimates of unreported discards. The two available data sources are the limited on-board observer reports and the annual longline survey. During the Plan Team meetings in November, we consolidated available information to determine if estimates of unreported mortality could be calculated.

Results

Observer data for 1991 and 1992 were examined. At the time of this analysis information was available only for SR/RE. Also, the coverage in the hook-and-line sablefish fishery is very limited, with the observed catch of sablefish amounting to only 8.7% of the total reported catch for 1992. Confidentiality problems generated by the low rate of coverage require that results be reported gulf-wide even though there was a great deal of variability between management areas. The average of both years resulted in a bycatch rate of 4.4%. The annual rates are shown in Table 1.

The average observed catch of SR/RE in 1991 and 1992 was 4.4% of the total catch of sablefish while the reported catch in 1992 was only 1.5%. When the average is applied to the 1992 sablefish harvest, it appears that approximately 66% (575 mt) of SR/RE may have been unreported discard in 1992. Given that the 1992 observed catch rate of SR/RE (6%) was even greater than the 1991 rate (3.2%), using the average may in fact result in a low estimate of mortality for 1992. Using 1992 data alone would result in a total unreported discard of 892 mt of SR/RE, a discard rate of 75%.

The average 1991 AND 1992 relative population weight (RPW) of SR/RE was 4.3% of the RPW for sablefish. This is very close to the average bycatch rate from the 1991-92 observer data. Using the ratio indicated by the survey applied to the 1992 harvest data indicates that 65% (555 mt) of SR/RE was unreported discard.

Observer results are not yet available for thornyheads and RPW estimates were not available for 1992. Therefore, the 1991 RPW for the domestic longline survey was used as the best available estimate of the thornyhead bycatch rate in the sablefish fishery. The survey RPW for thornyheads in 1991 was 1.3% of the RPW for sablefish. However, the reported catch of thornyheads in 1992 was 2.5% of the reported catch of sablefish. This indicates that unreported discard of thornyheads is minimal and should not be considered to be a significant management problem based on these data. However, it is recommended that the 1991 and 1992 observer data and the 1992 RPW data also be examined to confirm the belief that most thornyheads taken in the sablefish fishery are being retained.

Conclusions

While preliminary, the results of this examination suggest that available data can be used as an estimate of unreported discards. It appears that the unreported discard of SR/RE can be approximated from observer and survey data and that unreported discards may pose a significant management problem for that species group. If the data is accurate, it can be presumed that between 29% and 46% of the 1992 DAP of 1,960 mt SR/RE was taken as unreported bycatch. Given that the 1992 reported catch exceeded the DAP by 188 mt (10%), and that DAP was set equal to ABC, this means that the actual catch of SR/RE may actually have been as great as

156% of the ABC. This is considered to be unacceptably high and may approach a level which poses a biological risk to this resource. Therefore, even though uncertain, we recommend that the estimated bycatch rates established from this examination be counted against the annual TAC of SR/RE until better information becomes available, or until such time as we can become certain that total catches in the hook-and-line fisheries are accurately reported.

The available data also suggests that discards of thornyheads is not a serious problem at this time. However, the data which was obtainable for this exercise was incomplete and efforts should be made to acquire the observer and survey data necessary to complete table 1. This will allow us to more accurately estimate the unreported discard of thornyheads. Attempts should also be made to assure that the total catch information required by regulation is collected from the industry so that approximations of unreported fishing mortality are no longer necessary.

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Table 1. Observed and survey rates of shortraker, rougheye, and thornyhead rockfish compared to reported rates from the fishery, 1991 and 1992.

YEAR	OBSERVED RATE		SURVEY RATE		CATCH RATE	
	SR/RE	THHD	SR/RE	THHD	SR/RE	THHD
1991	.032	--	.046	.013	--	--
1992	.060	--	.040	--	.015	.025
AVERAGE	.044	--	.043	--	--	--

COUNCIL ROCKFISH COMMITTEE REPORT

NOVEMBER 23, 1992

INTRODUCTION

The Council's Rockfish Committee met on Monday, November 23, 1992 at the Alaska Fisheries Science Center in Seattle, WA. The meeting began at 8:30 am and adjourned at 6:30 pm. Committee members in attendance were Dave Hanson (Chair), Linda Behnken, Dan Falvey, Raquel Goni, George Anderson, Dave Benson, and Vince Curry. Support staff present were Chris Oliver (NPFMC); Ron Berg and Jesse Gharrett (NMFS Region); Earl Krieger and Barry Bracken (ADF&G); John Heifetz and Jeff Fujioka (NMFS Auke Bay Lab); Dan Ito, James Ianelli, and Jim Hastie (NMFS Center). Jack Taggart of the Council's SSC was also present for the meeting.

The Council's groundfish Plan Teams had just finished their meeting the previous week on status of stocks and the Committee was provided with the current stock assessments for each of the Gulf of Alaska rockfish species/complexes. A paper by John Heifetz was also presented which provided stock projections of Pacific Ocean Perch (POP) under four different exploitation strategies. Additionally, the Committee received two draft working papers regarding stock assessment and management of rockfish. Steve Davis of LGL Alaska Research Associates provided a paper entitled Do Trawl Assessement Surveys Underestimate Rockfish Biomass?, which examined some experiences of rockfish managers in British Columbia. A second draft paper, entitled A Review of Rockfish Management in the Gulf of Alaska, was provided by Barry Bracken and discussed the history of rockfish management to date and provided recommendations for future management. A report from NMFS and ADF&G on discard rates of rockfish in various fisheries was also provided to the Committee. The Committee focus at this meeting was on Pacific Ocean Perch.

GENERAL DISCUSSION

The meeting began with a summary from the stock assessment scientists of the current status of stocks and recommended ABCs for the 1993 fishing year. Among the Plan Team recommendations for 1993 are (1) breaking black rockfish out from the pelagic shelf complex and setting the ABC for the remainder of the pelagic shelf complex based on the biomass of Dusky rockfish only, the predominant species in that complex, (2) breaking northern rockfish out from the 'other slope rockfish' complex and managing it separately, due to disproportionate targeting of this species, relative to its percentage of the biomass in this complex, (3) reduction of the natural mortality rate estimate for thornyheads, resulting in a lower exploitation rate for this species, and (4) use of a downward adjusted F35% exploitation strategy for POP.

Though the Committee noted the Plan Team recommendations for all rockfish species, the focus of the Committee was on POP. A considerable amount of time was spent discussing the most recent POP biomass and ABC estimates, based on the current stock synthesis modelling techniques employed. To summarize, the Committee recieved the Plan Team recommendation which applies an F35% strategy, the F at which the spawning biomass per recruit is reduced to 35% of the unfished level, then reduced by the ratio of current spawning biomass to B35% (B35% defined as 35% of the female spawning biomass which was estimated to be in existence in 1960). The result of this stock synthesis modelling is an estimated exploitable biomass of 153,600 mt and an ABC of 5,560 mt. This new methodology has an effect very similar to that employed by the SSC over the past two years, where they were applying a natural mortality rate, adjusted downward by the ration of current biomass to Bmsy. However, it was noted that the F35% adjusted represents a higher exploitation rate than the M/2 rate used over the past two years.

Discussion followed on the issue of trawl surveys and their accuracy in assessing rockfish (POP) biomass. Dan Ito reviewed the paper provided by LGL Alaska Research Associates which described experiences of the Canadians which indicated possible underestimates, despite the potential herding effects of the trawls. Mr. Ito noted that the Center's Rockfish Working Group is investigating this and other aspects of rockfish stock assessment and the Working Group does not yet have a position on this issue. He noted that they are looking at alternative survey designs as well as submersible observations and the possible use of hydroacoustic methodologies.

Stock rebuilding strategies for POP being employed by the Pacific Council were then discussed, in the context of whether the bycatch only strategy was successful. Mr Jack Taggart of the Council's SSC responded that, in the case of the bycatch only designation off the West Coast, the actual exploitation rate on the POP stocks has very likely not been reduced; therefore, no apparent (measurable) stock rebuilding has occured in that fishery. It was noted however, that any increase in biomass would have to be significantly large in order to be detectable. This discussion emphasized problems inherent in the bycatch only designation, such as the applicable directed fishing standards and trip limits with attendant discards, whether in a target fishery or a bycatch only fishery.

Mr. John Heifetz then reviewed for the Committee his paper on stock projections for POP under four different exploitation strategies. The analysis looked at the probabilities of achieving the target B35% (female spawning biomass) under four strategies, with a 30 year outlook: (1) a straight F35% rate, (2) the F35% downward adjusted rate being recommended by the Plan Team, (3) the F=M downward adjusted rate used by the SSC in the past, and (4) a bycatch only designation. The analysis also looked at the projected yields of each strategy over a 30 year horizon. Regarding Alternative 4, the bycatch only designation, the Committee was informed that this was likely an over-optimistic scenario because it was based on an estimate of necessary bycatch of 1,600-2,000 mt (current bycatch amounts). It was noted that the bycatch rate associated with this amount could increase as pressure was exerted on alternative rockfish species and that, as the POP stocks increased, the bycatch only designation might be lifted. Also, depending on the directed fishing standards in force, it might be possible to take the entire ABC even under a bycatch only designation.

The Committee spent considerable time discussing the stock projection analysis presented by Mr. Heifetz. The Committee noted that the exploitation strategy and ABC recommended by the stock assessment scientists and the Plan Team do not explicitly represent a rebuilding strategy. Although the stocks are projected to increase over time under this strategy, it was recommended as a biologically safe reference level, not as a rebuilding goal. In terms of stock projections, it was also noted that environmental factors may play a strong role in ultimate year class strength. The Plan Team feels that an explicit rebuilding strategy is a policy issue for the Council.

<u>RECOMMENDATIONS</u>

The Committee was unable to arrive at a consensus on any rebuilding goals for POP, but, came to the following recommendations for the Council:

1. For 1993, the B35% target level (of female spawning biomass) is considered appropriate for POP, and the F35% (adjusted downward) is an appropriate strategy for attaining this target biomass level. However, the Committee is concerned whether the F35% strategy is appropriate for a long-

lived, slow growing species like rockfish. The Plan Teams should strive to evaluate this strategy on an annual basis to determine if this is an appropriate strategy for rockfish. While the Committee could not agree that the B35% target does constitute rebuilding, it does represent, in the Committee's view, a reasonable position for 1993, based on current knowledge. The strategy employed by the Plan Team for 1993 is based on an estimate of virgin biomass in 1960; any exploitation strategy chosen may be vulnerable to the accuracy of this estimate.

2. The Committee recognizes that the stock projections provided are not guarantees and that shorter term harvests could be foregone without long-term benefits to the stock. However, the risk of the stocks going down are minimized by the recommended strategy. The Committee recommends to the Council that an economic analysis be conducted which examines the possible impacts and tradeoffs associated with the four exploitation strategies depicted in the paper by John Heifetz. The Council should identify specific goals with regard to this stock and develop full biological and economic analyses.

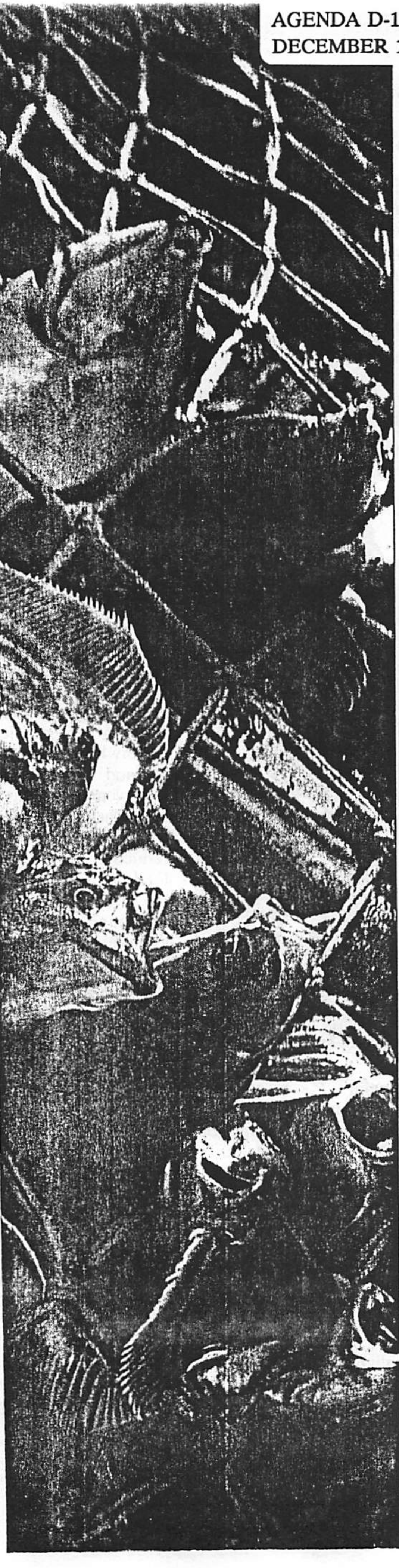
3. The Council should take all reasonable measures to insure that the ABCs are not exceeded, for rockfish as well as other species.

4. The Committee strongly supports the efforts of the Center's Rockfish Working Group to further define the biological parameters for these species and to develop appropriate assessment methodologies. The Council should strive to facilitate the activities of this Group in any way that it can.

5 The Committee wishes to focus on the status of other rockfish stocks and appropriate management goals in future meetings.

AGENDA D-1(b) Supplemental
DECEMBER 1992

NATIONAL WILDLIFE Oct - Nov 1992



NET LOSS

Plenty of fish in the sea? Not anymore, and that could spell trouble for seafood lovers across the country

By Bill Lawren

On the pier at Scituate, Massachusetts—It's a rainy day in late spring, and all the boats are in. Frank Mirarchi would rather be out fishing—needs to be out fishing. Instead, he's using this bad-weather day to do some maintenance on his boat, the *Christopher Andrew*. And though it could use a little work, his boat is nothing compared to the horror show on the other side of the pier, where two vessels sit rusting away. "One of them hasn't been out in two years," Mirarchi points out. "It'll sink any time now." And a third, a small red-and-white trawler, tells this year's story in its name: *Hard Times*.

For Frank Mirarchi, these are indeed hard times. "In the 1970s," he says, "I was catching 4,000 to 5,000 pounds of good-sized cod a week. Day before yesterday, I caught two 30-pound cod. Two. And that was the end of it. We didn't see any more big cod that day, we hadn't seen any for weeks before and we probably won't see any for weeks more."

Relief seems just as elusive. "I'm caught in a downward spiral," he says. "My family and I can hang on, but we'll be living on next to nothing."

He's not alone. Many of Mirarchi's fellow New Englanders are selling their boats at a loss and looking for other work, however landlocked that work might be. Take, for instance, third-generation fisherman Joseph Brancaleone of Gloucester, Massachusetts: He now fishes for french fries as assistant manager of a local Burger King. And though New England is probably the hardest hit of the nation's traditional fisheries, songs of woe can be heard from sea to shining sea.

"Last year we lost $6 million in revenue," says Jim Johnson,

JEFF ROTMAN

In New England, a dragnet swells with flounder, once a mainstay of the region's economy. Today, as more and more fishermen pursue fewer and fewer fish, numbers of these and other popular commercial species have sunk to record lows.

a commercial fisherman in Oregon. "It could well be three times that this year."

"Red snapper fishermen are really in trouble," says Eleanor "Chickie" Dardar, a fish dealer from Dolan Meadow, Louisiana. "A lot of them are behind on their house and boat payments," she continues. "This year, 30 percent of the snapper fleet may go under."

While fishermen sometimes disagree, many scientists insist there's a simple reason for all this misery: Our saltwater fish populations are shrinking fast, victims, in large part, of relentless overfishing. Within just the past few decades, increasing numbers of fishermen have put unprecedented pressure on the ocean's bounty. Harvest regulations, unable to keep pace with the decline, are often either inadequate or poorly enforced.


JEFF ROTMAN

A worker prepares a frozen bluefin tuna for auction at a Tokyo fish market (above). In Japan, where the fish is prized for sushi and other dishes, a single bluefin can sell for $30,000.

Studies by the National Fish and Wildlife Foundation (NFWF) indicate that only 15 percent of the species currently fished in American waters are near their maximum population potential. At least 14 species of oceangoing fish—Atlantic salmon, yellowtail flounder, grouper, Spanish mackerel and Pacific perch, among others—have been so seriously depleted that it could take them 20 years to recover, even if all fishing were to stop tomorrow.

"Some stocks are at their lowest level since we've been keeping records," says David Crestin, deputy director of the U.S. Office of Fisheries Conservation and Management. "Forty-two percent of species [in American fisheries] are overfished." Democratic Representative Gerry E. Studds, whose constituents include many fishermen on the Massachusetts coast, echoes this concern. "If we do nothing," he warns, "we will see the fisheries disappear."

These opinions, of course, are far from unanimous. Some fishermen still distrust government fish censuses and resist efforts to manage fish resources by limiting catches or regulating trips a boat can make. "Fishermen are being unfairly held back based on numbers that may not be accurate," says Louisiana's "Chickie" Dardar. "It couldn't be as bad as the scientists say, or we would never have caught so many fish so fast."

Even so, growing numbers of fishermen are coming to see fish stocks as seriously depleted and government intervention as necessary or even vital. "I used to think that the government should stay out of the fisheries," says Mirarchi. "But I've come to see that things won't get better by themselves. Something's got to be done."

Mirarchi's conversion is one of many among the country's fishermen, most of whom are hauling in shrinking catches of smaller and smaller fish. A sampler of fish stories for individual species highlights the severity of the problem:

• *Groundfish*: For more than 200 years, bottom-dwelling species—cod, haddock, flounder, redfish and others—have been the foundation of the New England fishing industry. Now these groundfish seem to be in serious trouble. A 1990 report by the Massachusetts Offshore Groundfish Task Force—an alliance of fishermen, scientists and government officials—concluded that "since the early 1980s groundfish landings . . . have declined sharply, to record low levels." The primary cause, the report concludes, is overfishing. For instance, the haddock catch dropped from 28,000 metric tons in 1980 to 5,400 metric tons ten years later.

Frank Mirarchi has seen that decline reflected in his own harvests. "I used to catch thousands of pounds of haddock a year," he says. "Now I catch three or four fish a year—maybe 25 pounds."

• *Swordfish*: These beautiful leapers declined in North Atlantic fisheries by as much as 70 percent between 1980 and 1990, despite harvest restrictions. Meanwhile, commercial demand for the tasty fish sent even more boats out to chase them. Increased fishing pressure has meant a reduction not only in the total number of swordfish, but also in the size of the remaining fish: The average weight of swordfish has fallen from 115 pounds to only 60 pounds.

• *Bluefin tuna*: Its commercial value—a single bluefin can fetch $30,000 in Japan—has effectively marked this species for decimation. In western Atlantic fisheries alone, adult bluefin populations sank from more than 300,000 in 1970 to an estimated 30,000 in 1990, despite limits on their harvest. "The tuna are doomed," declares Richard Tobin of Newburyport, Massachusetts, a tuna fisherman for 25 years. "They'll be fished to extinction."

• *Red snapper*: A favorite on Southern dinner tables, the red snapper has for years been a staple of the vast fisheries in the Gulf of Mexico. But along the South Florida coast, the catch of red snapper declined from 253,000 pounds in 1983 to only 8,177 pounds in 1989. Although red snapper stocks may be on the rebound thanks to more rigorous law enforcement, "fishermen are still taking the juvenile fish," notes Wayne Swingle, executive director of the Gulf of Mexico Fishery Management Council. "And that hurts."

• *Pacific salmon*: Long a mainstay of the commercial fishing industry from Southern California to Alaska, the Pacific salmon is now in trouble as a result of overfishing and the damming of spawning rivers. Experts estimate, for example, that the number of coho and chinook salmon caught off the Oregon coast this year will be 67 percent lower than in 1991. This could mean limiting the state's salmon season to just two weeks. "We used to go from May through October," laments Oregon fisherman Jim Johnson.

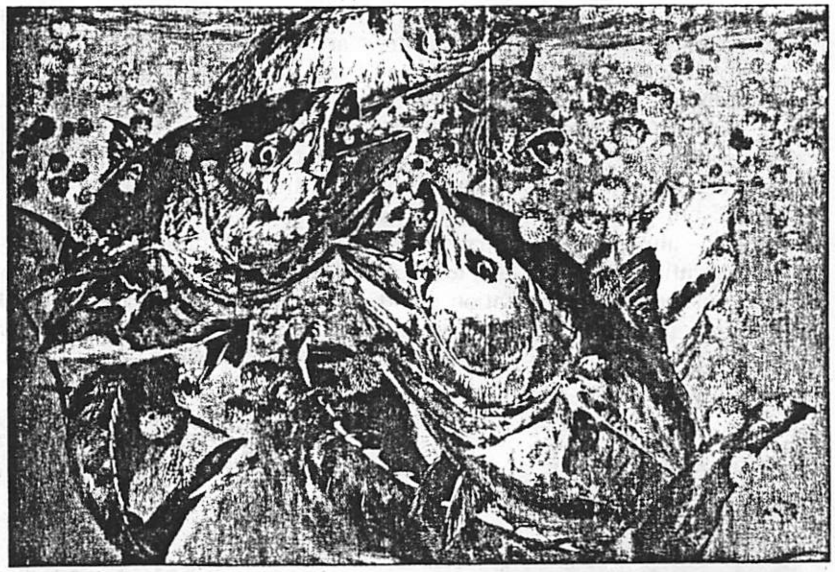
Where have all the fish gone? Most experts agree that some populations have been hurt by pollution of coastal waters. In San Francisco Bay, contamination may have contributed to reductions in striped bass populations, which have fallen by 60 to 80 percent. In North Carolina's Albemarle and Pimlico sounds, declining levels of oxygen have suffocated hundreds of thousands of striped bass.

Natural cycles and weather changes may also have taken a toll. Part of the decline among Pacific salmon has been blamed on coastal droughts that shrank spawning rivers, and on El Niño-warmed waters that reduced food supplies.

Onshore construction and development have also contributed to fish declines. Dams on the Connecticut River, for instance, have kept an estimated 40 percent of Atlantic salmon from reaching their upriver spawning grounds.

But as many researchers see it, the main problem is one of numbers: Too many fishermen taking too many fish. The American fishing fleet has grown dramatically just since 1976, when the Magnuson Fishery Conservation and Management Act effectively banned foreign boats from waters within 200 miles of U.S. coasts. Federal loan programs that encourage the building of new boats have provided yet more impetus. In New England alone, the number of groundfishing trawlers jumped from 590 in 1976 to more than 1,000 in 1984. "It's a rat race out there," says David Crestin. "Anyone can buy a boat—there are no restraints—so this is the natural conclusion: chaos."

At the same time, technological innovations have allowed the already expanded fleet to fish with near-savage efficiency. Electronic depth finders provide detailed images of the sea floor. Computers "re-



STANLEY MELTZOFF

Swimming across an artist's canvas, bluefin tuna feast on pufferfish.

Superfish Disguised as a Tuna

DASHING TO SPEEDS as fast as 50 miles per hour, able to travel a hundred miles in a single day, with muscles making up three-quarters of its 1,500-pound body—the adult bluefin tuna is without doubt one of the sea's true superfish.

In spring, after spawning in the Gulf of Mexico or Mediterranean Sea, the Atlantic bluefin begins its long migration, arriving in the frigid waters off Norway or Nova Scotia by late summer. Thanks to an ability to regulate its body temperature, rare among fish, a bluefin can pass comfortably from 80-degree F tropical seas to northern waters 40 degrees cooler.

An average body temperature higher than that of most fish quickens the creature's reflexes and enhances muscle coordination. Because of its high oxygen demand, the bluefin must swim constantly, mouth open to allow ram-jet ventilation of its gills.

Unfortunately, this superfish is also an increasingly popular supper fish. In Japan, where bluefin sells for as much as $25 a pound, diners savor the meat in dishes such as sushi and sashimi. (Most of the tuna sold in this country is yellowfin or albacore, not bluefin.)

Driven by this growing demand, legions of commercial and sport fishermen from the United States, Canada and Japan have reduced the western Atlantic bluefin's spawning population—giants eight or more years old—by more than 90 percent in just the past two decades. (Pacific populations are also depressed but not as severely.)

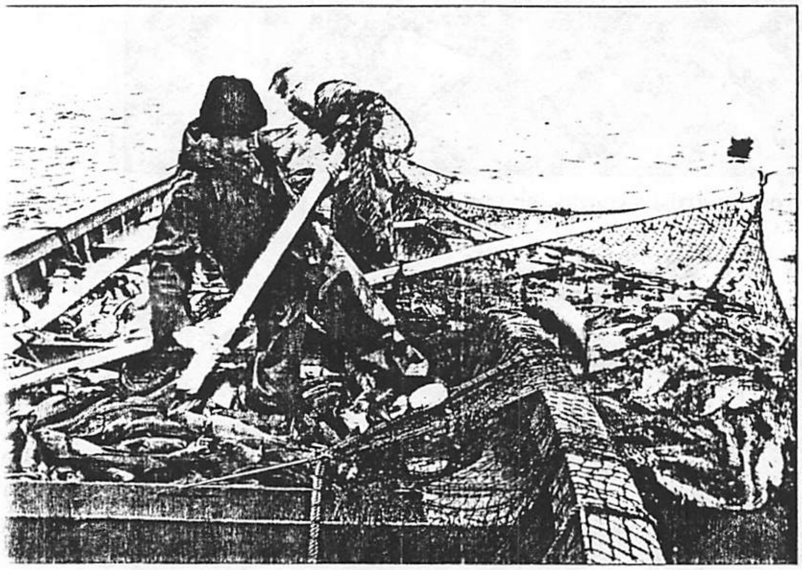
In 1981, a 22-country regulatory agency called the International Commission for the Conservation of Atlantic Tunas (ICCAT) imposed a catch limit of 2,660 metric tons per year on the species. To Richard Ruais, executive director of the East Coast Tuna Association, the ruling was "the first step on the bluefin's road to recovery."

But "recovery" isn't exactly how Michael Sutton, a Maine conservation specialist at the World Wildlife Fund, would characterize the bluefin's plight. "What we're seeing are signs of disaster," he says. Consider: In 1991 alone, the estimated number of spawning-aged bluefin in the western Atlantic declined 24 percent.

Last November, under pressure by conservation groups, ICCAT moved to trim the catch quota another 10 percent over the following two years. But according to Sutton and other experts—including ICCAT's own scientific advisory board—unless the bluefin harvest is stopped or at least cut in half, the superfish may soon become just a myth.—Laura Gemery member" the site of a previous good catch, then, using radio signals, help the boat home in to within 50 feet of that site.

Spotter planes and helicopters have enabled fishermen to hunt down large schools of tuna. And outside of U.S. waters, immense gill nets, some of them 40 miles long, sweep the seas, snaring not only tuna, but marlin, dolphins, sharks and sailfish—almost anything that swims.

Many scientists think the long-term effects of this ongoing exploitation could make today's problems seem trivial compared with tomorrow's. Of particular concern, they say, is the taking of juvenile fish before they reproduce, effectively short-circuiting that species' future. In New England, for example, the "spawning biomass" (the total weight of all reproducing fish species in the area) has dropped from 120,000 metric tons to less than 20,000. Stephen Murawski, a biologist with the Northeast Fisheries Center in Woods Hole, Massachusetts, says the problem is elementary: "If you've got no mother, you get no babies."



A fisherman in Newfoundland scoops cod, a vanishing bottom-dweller, from a trap (above). Even if fishing stopped today, species like the Atlantic salmon (right) would take 20 years to recover.

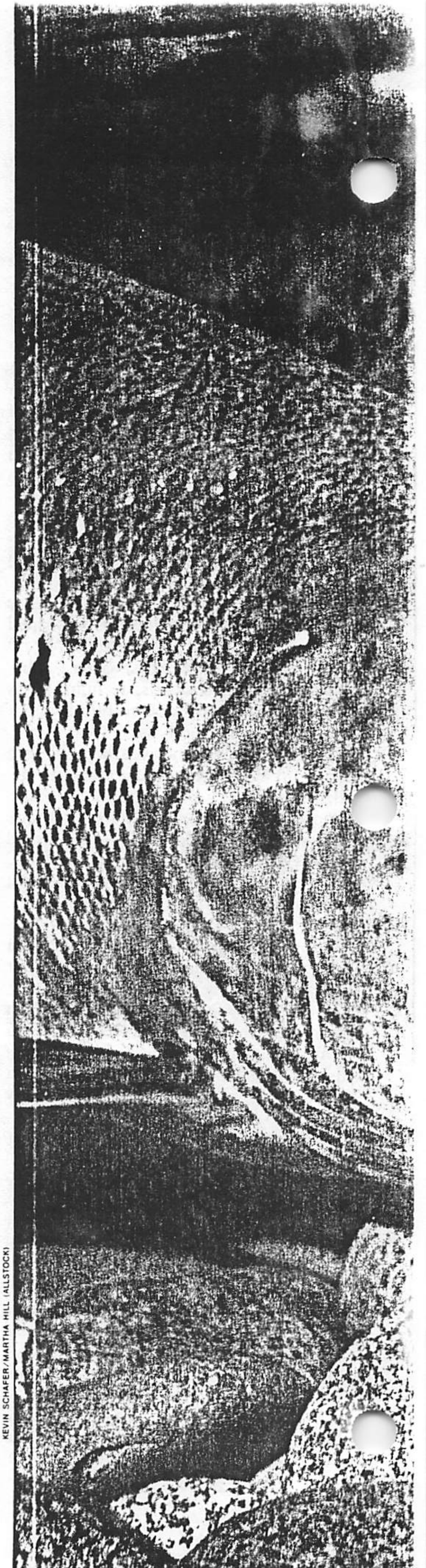
Ultimately, declines in fish populations can set off a chain of eco-disasters that affect not only the fish but also the animals that feed on them. Wildlife surveys in Alaska suggest this process has already started: Populations of Steller sea lions there have tumbled 70 percent since the early 1970s; red-legged kittiwakes, rare birds unique to the Bering Sea, have dropped by 50 percent; and harbor seals are declining in the Gulf of Alaska at a rate of 5 percent per year.

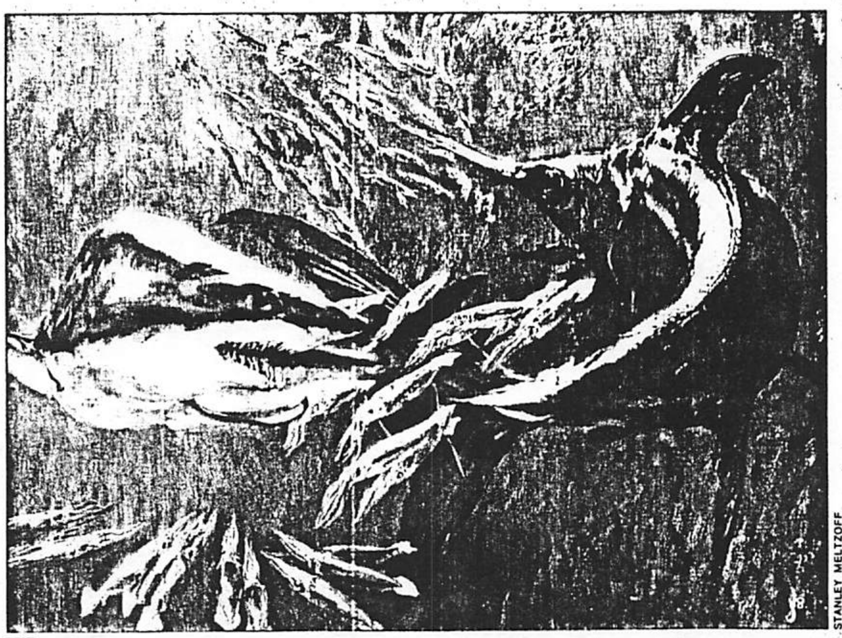
The Department of Commerce, acting through its eight regional Fishery Management Councils, has the authority to regulate the number and size of the catch of any given species in a variety of ways. Among them: limiting the number of days fishermen can go out, closing off certain areas (especially spawning grounds) and prohibiting sales of troubled species once the total allowable take is reached.

Unfortunately, application and enforcement of that authority has been spotty. In New England, the regional council imposed trip limits and catch quotas on groundfish in the late 1970s. But fishermen widely evaded the restrictions, especially catch quotas. "People would catch all the fish they could hold," says Frank Mirarchi. "They'd unload some of the fish—up to the official quota—at one port, then go down to another port and unload the rest." The council lifted the restrictions in 1982, and by 1989 catches of groundfish in New England waters had plunged by almost half.

In the Gulf of Mexico, by contrast, restrictions on the red snapper catch have been rigorously enforced. Fish dealers there must record and report every snapper purchase, and when the annual total quota of 2 million pounds is reached, the council closes the fishery for the rest of the year. The 1992 quota was met by the end of February, bringing howls of protest from snapper fishermen facing months of enforced unemployment.

Such incidents highlight an ongoing conflict between the scientists who count the fish and the fishermen who catch them. To arrive at figures for fish populations, staffers from the National Marine Fisheries Service research centers interview fishermen, then sample their catches both at sea and in port. They also take a sampling aboard government vessels. Multiplying catch tallies by the number of trips made by the entire fishing fleet yields the total catch, and from that the scientists





Vanishing speedster, a swordfish (right) shares squid with a mako shark.

The Power of the Sword

TO SPORT FISHERMEN looking for a challenge, nothing can match the swordfish, one of the swiftest and most combative fish in the ocean. Hooked on a line, a 12-foot adult swordfish is a 200-pound rocket of twisting, tugging sinew that fights back with powerful runs and high leaps that can go on for hours.

This sleek, enigmatic fish is a fitting metaphor for the power and mystery of the sea. Protruding from its beak is a flattened, bony "sword" that can grow to one-third the creature's full length. Scientists think this appendage may be used for tearing and impaling prey, or possibly as a weapon; broken swords have been found embedded in whales, sharks and even boats. No one knows, however, whether these collisions are the result of accidental run-ins or deliberate attacks.

Always on the run, swordfish are solitary and highly migratory creatures, traveling the world's tropical and temperate waters and dashing to speeds as fast as 60 miles per hour. They cruise near shore just below the surface, often in pursuit of schools of fish. Unfortunately, their proximity to shore and surface has also made swordfish easy targets for two-legged predators wielding nets and hooks.

In the early 1970s, the U.S. Food and Drug Administration found dangerous levels of mercury in swordfish and prohibited commercial fishing of the species. When the ban was lifted in 1978, demand for the tasty fish resumed, and the saga of the swordfish took a turn for the worse.

As commercial fishing fleets grew and became more efficient, swordfish numbers and catch sizes plummeted. By the beginning of this decade, the size of swordfish caught by U.S. commercial fishermen had dropped from the 1978 average of 115 pounds to just 60 pounds, and the spawning stock had declined 40 percent. Scientists worry that this overharvesting of young swordfish may take a toll on future reproducing generations.

Fishermen around the world kept up the assault until June 1991, when an international regulatory commission called ICCAT reduced the yearly harvest in the North Atlantic by 15 percent and set a minimum size requirement of 41 pounds. Enforcement, however, remains a problem.

Experts like Gerald Scott of the National Marine Fisheries Service see the new restrictions as only a beginning. "It's likely," he says, "that additional reductions will be necessary to maintain the stock at adequate levels and avoid collapse."—Laura Gemery

Safety in numbers? Not necessarily for red snapper, which are disappearing from U.S. waters. Off South Florida's coast, the red snapper catch declined by 97 percent between 1983 and 1989.

estimate populations for each species.

The debate over fish populations can obscure indications that strict regulation and management can mean the beginnings of recovery. In the mid-Atlantic region, for example, the catch of surf clams had dropped from a high of 50 million pounds to 12 million pounds by 1979. But after the Mid-Atlantic Fishery Management Council restricted catches of clams and closed certain areas, the harvest returned to the 50-million-pound level in just eight years.

Similarly, in the Gulf of Mexico, where populations of king and Spanish mackerel had declined drastically, a council restoration program begun in 1985 seems on the brink of success.

A growing number of fishermen agree, if reluctantly, that it will take some kind of regulation to resuscitate the industry. Some think the government should implement farmlike subsidy programs which would pay fishermen for not fishing. Most, however, concede that regulation means limiting the activities of fishermen. And in many regions, government agencies are responding with plans to do just that:

In New England, the Fishery Management Council has proposed new rules that would reduce fishermen's days at sea by 10 percent a year for the next five years. The rules would also limit haddock catches and require fishermen to throw back smaller, younger fish. And in the Pacific, the regional council is recommending that the salmon catch be reduced at least by half or suspended altogether. The search for solutions has spawned a few radical new approaches to fisheries management. A team of biologists in Florida, for example, has recommended setting aside 10 to 20 percent of all coastal waters as "reserves" where fishing is prohibited.

Will these efforts bring the fish back? Only time will tell. But more and more fishermen now face what seems to be an unavoidable fact: Unregulated fishing today means fewer fish tomorrow. "The fishing industry will never be unregulated again," says Frank Mirarchi. "It's like logging or drilling for oil—we have to have consideration for the larger world." ▣

Writer Bill Lawren lives in Massachusetts, one of the states hit hardest by fish declines.

AGENDA D-1(c)(1)
DECEMBER 1992

STATE OF ALASKA

WALTER J. HICKEL, GOVERNOR

DEPARTMENT OF FISH AND GAME

OFFICE OF THE COMMISSIONER

P.O. BOX 3-2000
JUNEAU, ALASKA 99802-2000
PHONE: (907) 465-4100

NOV 16 1992

November 10, 1992

Richard B. Lauber, Chairman
North Pacific Fishery Management Council
P.O. Box 103136
Anchorage, AK 99510

Dear Rick:

At the September North Pacific Fishery Management Council (NPFMC) meeting, the council set preliminary specifications for the groundfish resource off Alaska. I have noted for many years that the council has set total allowable catch (TAC) equal to acceptable biological catch (ABC) for many species. Considering the harvesting power of the fleets, I would request the council to implement a new policy which always sets an adequate buffer between TAC and ABC to ensure that ABC is not exceeded. This is particularly important for certain long-lived species such as rockfish.

It is evident that although TAC is a maximum limit to catch, particularly when TAC and ABC are equal, it is operationally approached as a harvest objective. This presents the National Marine Fisheries Service (NMFS) with a difficult problem. If TAC is a harvest objective, it must be achieved to maximize yield, thus maximizing national benefit. But there is a Catch 22 to such an operational approach in that it largely ensures that TAC will be exceeded. Setting TAC equal to ABC often results in the harvest exceeding ABC. If the council process in the North Pacific is to continue leading the way for the rest of the Nation's councils, I strongly believe that ABC should be separated from TAC and regarded as the maximum level of harvest allowed. My suggestion of adopting a policy which sets TAC less than ABC will make TAC a harvest objective which can be reached without exceeding ABC. I encourage the NPFMC members to unanimously adopt this policy prior to setting the final specifications for 1993, for those species where there are no buffers in place; for example, GOA rockfish, cod, and other species.

This policy becomes more critical when ABC also equals overfishing. Although reaching the overfishing level in a single year may not spell the demise of a stock, public perception of our management ability suffers when this occurs.

Lastly, by the council developing this policy, the NMFS will be taken out of the unenviable situation of having industry constantly encouraging them to achieve the maximum allowable harvest (old TAC) during the season. Rather, they will be managing to a legitimate harvest guideline (new TAC) which is much less likely to surpass the biologically acceptable harvest of any species.

Thank you for your consideration.

Sincerely,

Carl L. Rosier

Carl L. Rosier
Commissioner

ENVIRONMENTAL ASSESSMENT/REGULATORY IMPACT REVIEW/
INITIAL REGULATORY FLEXIBILITY ANALYSIS

FOR THE

PROPOSED CAREFUL RELEASE OF PACIFIC HALIBUT
CAUGHT OF GROUNDFISH HOOK-AND-LINE

IN THE GULF OF ALASKA
AND BERING SEA ALEUTIAN ISLANDS

1.0 INTRODUCTION

The domestic groundfish fisheries in the exclusive economic zone (EEZ) of the Gulf of Alaska (GOA) and Bering Sea and Aleutian Islands area (BSAI) are managed by the Secretary of Commerce (Secretary) in accordance with the Fishery Management Plans (FMPs) for Groundfish of the GOA and BSAI. These FMPs were prepared by the North Pacific Fishery Management Council (Council) under the Magnuson Fishery Conservation and Management Act (Magnuson Act). Theses FMPs are implemented by regulations appearing at 50 CFR Parts 611, 672 and 675. General regulations that also pertain to U.S. fisheries appear at 50 CFR part 620.

The environmental assessment/regulatory impact review/initial regulatory flexibility analysis (EA/RIR/IRFA) addresses rulemaking that proposes to implement a regulation requiring the careful release of Pacific halibut caught on groundfish hook-and-line gear in the Gulf of Alaska (GOA) and Bering Sea and Aleutian Islands Area (BSAI) to increase the bycatch survival rate of Pacific halibut.

A description of, and reasons for, this action follows:

2.0 CHANGE FISHING GEAR RESTRICTIONS IN THE BERING SEA-ALEUTIAN ISLANDS AND GULF OF ALASKA

2.1 Description of the problem and need for action.

2.1.1 Background. Fisheries in the BSAI and GOA are prosecuted with a variety of gear types. Each gear type causes different problems for bycatch of prohibited species. Prohibited species catch (PSC) limits are established that may be apportioned to gear groups and fisheries as bycatch allowances. Gear groups and fisheries that reach seasonal PSC limits are closed through specific time periods, and those that reach annual PSC limits are closed for the balance of the year, often with large amounts of uncaught total allowable catch (TAC) amounts remaining. The Council has taken bycatch management actions designed to reduce bycatch and maintain groundfish harvest. In the case of Pacific halibut, PSC limits are in terms of mortality rather than actual amounts of halibut caught. Mortality limits provide a two-pronged approach to bycatch management: first by actions that reduce bycatch rates, and second by actions that increase survival of discarded bycatch.

In the case of hook and line fisheries for groundfish, potential survival of discarded halibut is very high. Circle hooks and semi-circle hooks used by the majority of hook and line fishermen catch halibut in the mouth, and cause little inherent damage. However, inappropriate release methods cause severe wounds that lead to higher probability of death. Discard mortality rates estimated from 1990 observer hook and line data are 16%, much higher than the 2-5% mortality rates possible for properly released halibut. Impaling with gaffs, using hook strippers (crucifiers), and allowing halibut to linger on deck before discard are examples of actions that cause higher mortality. Current federal regulations at CFR 50 parts 675.20(c)(3) and 672.20(e)(2) are silent on halibut release methods, other than halibut must be returned to the sea with a minimum of injury.

Requirements for mandatory careful release techniques would increase the survival of discarded halibut, by reducing or eliminating the actions that cause increased mortality. Increased halibut survival would allow more groundfish harvest by hook and line fisheries while remaining within the same or even lower halibut PSC mortality limits. Fishermen may not be able to carefully release every halibut, because of occasional mistakes or slips. NMFS's enforcement division recognizes the need to establish a standard that prevents a scenario where a fisherman becomes an instant bandit by inadvertently failing to shake, straighten a hook, or cut a gangion. This standard called "substantial compliance" means that if a person has taken reasonable steps or has made substantial efforts to comply, then inadvertent or minor violations of law would not be cited as a violation.

Enforcement and monitoring of the careful release regulations would be easier to achieve in the BSAI than in the GOA because observer coverage is significantly higher in the BSAI. Hook and line fishing in the GOA is conducted with a large number of vessels less than 125 feet in length that require only 30% observer coverage, and vessels less than 60 feet that do not require observers. On the average, about 18% of the longline groundfish in the GOA is caught aboard observed vessels. In the BSAI, most of the hook and line vessels are greater than 125 feet and require 100% observer coverage. On the average, about 90% of the longline groundfish in the BSAI is caught aboard observed vessels.

Applying careful release regulations to observed or unobserved vessels would have important implications. Fishermen on unobserved vessels would be required to comply with the regulations. Giving them credit for full compliance would underestimate true discard mortality. Conversely, giving credit only to observed vessels would cause a cost to those unobserved vessels that do comply but would provide them no benefit. Different application of careful release regulations to observed and unobserved vessels would need to be balanced against compliance concerns and the need to provide a regulatory incentive to reduce halibut handling mortality.

2.1.2. <u>Discard mortality rates for careful release.</u>

Discard mortality rates for halibut by hook and line fisheries are calculated from 1990 observer data (Williams and Wilderbuer 1992) as 16% for all fisheries and areas, and from 1991 observer data (Williams and Wilderbuer in prep) as 16-25% in the GOA and 20% in the BSAI. These calculations derive from the distribution of condition factors (an index of survival) determined by on-board observers aboard fishing vessels. Williams and Wilderbuer estimated the discard survival rate for excellent condition fish at 95-98% (2-5% mortality) from data in Peltonen (1969), and for poor condition fish at half the excellent rate from data in Myhre (1974). No dead condition fish are assumed to survive. In 1991 approximately 70% of the discarded BSAI halibut were in excellent condition, 24% in poor condition, and 6% in dead condition. An IPHC tagging study of carefully released halibut and halibut released with a crucifier tallied hook injuries (Steve Kaimmer, IPHC, pers. comm). Halibut discard mortality caused by use of crucifiers is estimated at more than three times that of carefully released halibut. "Horned" halibut, impaled with the gaff and held against the roller until the hook tears free, experience even higher discard mortality. Even though the tagging study did not use the same condition factors as used by observers, about 93% of carefully released fish were in the equivalent of excellent condition. Poor condition fish accounted for about 6% of the releases, and dead fish about 1%. Results from the tagging study suggest that the upper range of discard survival is about 93%, or a 7% discard mortality rate. Lower compliance or less skilled rollermen would lower the average condition factor. At values in the BSAI midway between those of 1991 and the tagging study--82% excellent, 15% poor, and 3% dead--the discard mortality rate would be 14%. These results suggest a probable range of discard mortality rate from a careful release regulation of 7-14%.

While a range of discard mortality rates may be reasonable, we cannot predict actual condition factors and discard mortality rate in advance for a careful release regulation. The level of compliance and actual observer data will be major factors in determining discard mortality rates. As an alternative to a preset discard mortality rate, an inseason rate may be calculated if observers transmit weekly tallies of condition factors to the National Marine Fisheries Service with weekly reports of other required data. Weekly data would be aggregated until June (or some other month), 1993 by the IPHC for a recalculation of the discard mortality rate. A mid season recalculation would provide a feedback to fishermen on the effectiveness of their efforts, and would offer a reward (or penalty) for good (or poor) compliance.

2.1.3 Need for mandatory action.

If analysis shows that net benefits accrue from carefully releasing halibut from hook and line vessels, why are mandatory regulations necessary, and why shouldn't the fleet take these actions voluntarily? Careful release to reduce halibut bycatch mortality is in the best interest of the group as a whole, but causes some costs to individuals. If all individuals participate, then all benefit. If only some participate, they would accrue costs that nonparticipants do not, yet the nonparticipants would also benefit. Mandatory action lets the individual's best interest more closely coincide with the group's interest. The North Pacific Longline Association, a group of primarily BSAI freezer-longliners, has endorsed the careful release concept.

2.2 The Alternatives.

The alternatives are available for the BSAI and the GOA. However, each area is managed under a different Fishery Management Plan. The Council and NMFS may choose a different alternative in each area, or may choose different alternatives for separate fisheries within an Area.

2.2.1 Alternative 1: Do nothing - maintain the status quo.

Adoption of this alternative would maintain the current requirement for releasing halibut in "good condition" but would not specify release techniques.

2.2.2 Alternative 2: Amend the Federal Regulations to require that halibut caught on groundfish hook and line gear be released outboard of the roller by cutting the gangion as close to the hook as possible.

Adoption of this alternative would provide a quantifiable method of releasing halibut to increase survival of discards. Gangion cutting is the most observable and subject to the least interpretation by observers as to adequate compliance with the regulation.

2.2.3. Alternative 3: Amend the Federal Regulations to require that halibut caught on groundfish hook and line gear be released outboard of the roller by cutting the gangion as close to the hook as possible or by carefully removing the hook with a gaff in a way that does not add injury to the halibut, and without penetrating the halibut with the gaff.

Adoption of this alternative would provide fishermen with flexibility to use the method best suited to each vessel for releasing halibut to increase survival of discards. Careful removal with the gaff could take the form of rolling the hook out of the lip using the gaff, or hook straightening using the gaff.

2.3. Biological and environmental impacts of the alternatives.

Few biological or environmental impacts would occur by adopting any alternative. If halibut PSC limits currently set by the Council remain at status quo and are reached by the fishery, then the amount of dead halibut would not change as a result of any alternative. However, if discard mortality rates are reduced as anticipated, the amount of dead halibut would decline for a given amount of Pacific cod harvest, and more halibut would be available for harvest in the directed fishery. Most of the groundfish caught by hook and line gear in the BSAI in 1991 was Pacific cod, and the Pacific cod harvest by all gears in 1992 is expected to exceed the TAC. Therefore, no additional Pacific cod harvest would result from either alternative. Lower halibut discard mortality rates for hook and line gear from Alternatives 2 or 3 may change the distribution of Pacific cod harvest among fishing gears.

Released halibut experience some probability of mortality regardless of the release technique. Release mortality for halibut with the hook carefully removed is about 2-5%, based on underwater pen holding experiments with tagged halibut (Peltonen 1969). Halibut dropping to the water surface may be stunned at contact and experience a slightly increased mortality. A requirement for cut gangions would cause halibut to be released with hooks still in the mouth, which may interfere with feeding. Reduced feeding effectiveness is expected to be small and to have an unmeasurable effect on prey species. Attacks on hooked fish by amphipods (sand fleas) cause some unknown level of mortality that should not differ by release technique. In the aggregate, the maximum mortality of carefully released fish in the BSAI should be 14% or less based on 1991 data or 11% or less based on 1990 data. Either is below the BSAI 1990 discard mortality rate of 16% and the 1991 rate of 20%.

Obtaining condition factor data with which to estimate discard mortality rate for the new regulation would be critical. The fishermen would be in compliance by releasing the halibut to the sea outboard of the roller, unless they violate the existing regulation requiring release with minimum of injury. The observer would need to assess the condition factor of released halibut and must assign condition factor in part by how well the fisherman releases the halibut. Roughly shaking the hook from the halibut would cause higher mortality than would result from smooth shaking.

2.3.1 Biological effects to marine mammals

Interactions between marine mammals and hook-and-line gear are not frequent, but do occur. Steller sea lions and killer whales are known to intentionally interact with hook-and-line gear, and feed on hooked fish and discards from vessels. Marine mammals feeding on halibut released by cutting the gangions may be at risk of physical injury from ingested hooks. From this standpoint, Alternative 3 is preferable since it would result in a reduced number of halibut released with hooks. Alternative 2, which requires mandatory cutting of all gangions, would result in a greater number of halibut released with hooks, and could result in a higher number of hooks ingested by marine mammals. Alternative 3 would reduce the possible adverse effects on marine mammals while accomplishing the goal of reducing halibut mortality.

2.4. Socioeconomic impacts of the alternatives and regulatory impact review of proposed alternatives

Alternative 1, the status quo, would involve no change in industry costs or in management costs. The current discard mortality rates in the hook and line fishery would continue to be higher than necessary. Observer data from 1991 hook and line fisheries indicate that discard mortality rates are even higher than in 1990. If the halibut PSC limit is reached before the directed fishing allowance for Pacific cod is harvested, opportunity to fish for remaining amounts of Pacific cod may be foregone and economic loss to the hook and line fishery would occur. Adopting Alternatives 2 or 3 should reduce discard mortality rates to between 7 and 14%.

In 1991 and 1992, the BSAI hook and line fishery for all targets harvested 61,418 and 90,010 mt of Pacific cod, respectively, and accounted for 464 and 1,102 mt of halibut bycatch mortality based on the 16 percent mortality assumption derived from 1990 data. In 1992, a 750-mt halibut mortality limit was implemented for the BSAI non-trawl fisheries. The effective date of the mortality limit was delayed, however, until after the Pacific cod TAC had been harvested. A 900-mt mortality limit is proposed for the BSAI non-trawl fisheries in 1993 under Amendment 21 to the FMP. In spite of these restrictions, the Pacific cod TAC is expected to be harvested given the trawl and non-trawl fleet capacity to harvest this species and a recommendation from the Council to exclude the 1993 pot gear fisheries from fishery closures implemented under halibut bycatch restrictions.

Hook-and-line harvest of Pacific cod in 1993 is difficult to predict, and depends to a large degree on the ability of the trawl and pot fisheries to compete for Pacific cod and associated halibut bycatch. For demonstration purposes, assume that the hook and line Pacific cod harvest and the halibut bycatch rates would be in the 1991-1992 range. A reduction of the discard mortality rate from 16% to 10% would lower halibut mortality by 38% (or the equivalent to about a 60% increase in PSC limit), while a reduction to 8% would reduce halibut mortality by half (the equivalent of doubling the PSC limit).

Careful release of halibut would impose cost to the hook and line fishing industry. Cutting gangions would cause loss of hooks, and would require replacement of hooks and gangions. At a bycatch rate of approximately 14 halibut per mt of Pacific cod (Gregg Williams, IPHC, pers. comm.), approximately 840,000-1,400,000 hooks and gangions would need replacing during a fishing year for a harvest of 60,000-100,000 mt by the hook and line fishery. At a cost of about $0.15 per hook and gangion (Jim Beamon and Don Iverson, North Pacific Longline Association, pers. comm.), cutting gangions would add $126,000-210,000 to equipment cost. Replacing a hook and gangion takes about 30 seconds, but would not add labor cost to the fishery because fishermen tend to work for a share rather than a wage. Replacing several hooks per day would be added to the daily work load, and total about 9,000 hours annually.

Careful shaking would cause no increased gear cost, but may require slower retrieval of hook and line gear during occasions of halibut bycatch. Hook straightening would cause some hook and gangion loss, but most hooks can be reshaped several times. On a rolling boat in rough seas, cutting gangions potentially could impose safety concerns to the fishermen. Accidental cutting of the groundline also could occur. Significant lost time would accrue searching for and retrieving the lost gear, and some gear would not be found. The probability of cutting a groundline or slowing the retrieval process depends on the skill of the fishermen involved, and cannot be predicted in advance.

Opportunity cost (gross wholesale value minus variable costs of harvesting and processing) of halibut ranges from $2,200 to 2,900 per mt (Joe Terry, Alaska Fishery Science Center, pers. comm.). At about 6 kg average weight of halibut in the longline bycatch (6.2 kg in 1990, 5.4 kg in 1991), $2.60

per kg of halibut, and 16% discard mortality (84% survival), each released halibut represents $13.10 in halibut value. At reduced discard mortality rates of 10% or 8% (90% and 92% survival), each cut gangion represents $14.04 and $14.35, respectively, in halibut value, or $0.94 and $1.25 of increased value.

For PSC limits to constrain the longline fishery with the lower discard mortality rates, longline harvest of groundfish (mostly Pacific cod) must increase. An increase in cod harvest would come at the expense of trawl-caught cod. If so, the Pacific cod fishery would not use its full PSC allotment, which would them be available for other trawl fisheries.

The cost of hooks and gangions and possibly slower retrieval would be offset by the lower discard mortality rate for halibut (roughly half of the present value). If the longline fishery uses all the halibut PSC mortality limit set by the Council, then their groundfish harvest would increase (roughly double). The halibut fishery would not benefit in this case. If the longline groundfish harvest remains about the same, the halibut mortality would decrease (about half the present value) and the savings will be available to the halibut fishery. The groundfish fishery would not benefit in this case. A middle case of increased groundfish harvest and increased halibut catches is possible. In all cases, the increased value of groundfish or halibut exceeds the cost of lost hooks and gangions or slower retrieval.

Under alternatives 2 or 3, additional indirect costs could be incurred by management agencies, particularly if inseason adjustments to assumed mortality rates were routinely implemented. Observers would have to summarize halibut viability data (number in excellent, poor, and dead condition) and include this in inseason catch messages. This would take time away from the observers' duties and produce an increase workload. Additionally, data management programs currently are not set up to handle this information, and would need to be revised. Inseason adjustments of assumed mortality rates would also require NMFS and IPHC staff time to assess inseason observer data and inform and respond to industry inquires on any action NMFS may take to adjust mortality assumptions.

Under alternatives 2 and 3, observers would have to observe and make a judgement on the condition of the released halibut while they are sampling. If a vessel's crew routinely appears to be in violation of the regulation, then the observer would need to take time from the normal sampling duties to document the number and percentage of halibut that were observed to be mishandled, and describe how the halibut were handled. Observer Program staff would be involved in evaluating the extent of the mishandling and overseeing the writing of the affidavit, if necessary. NMFS Enforcement and General Counsel staff would be involved in processing the case as a violation of the fishing regulations. The amount of effort expended by the observers, the Observer Program, NMFS Enforcement, and General Counsel is dependent on the degree of compliance by the vessels.

OTHER EXECUTIVE ORDER 12291 REQUIREMENTS

Executive Order 12291 requires that the following three issues be considered:

(a) will the proposed action have an annual effect on the economy of $ 100 million or more?

(b) will the proposed action lead to an increase in the costs or prices for consumers, individual industries, Federal, State, or local government agencies or geographic regions?

(c) will the proposed action have significant adverse effects on competition, employment, investment, productivity, or on the ability of U.S. based enterprises to compete with foreign enterprises in domestic or export markets?

Regulations impose costs and cause redistribution of costs and benefits. If the proposed regulations are implemented as anticipated, these costs are not expected to be significant relative to total operational costs. This regulatory amendment is not expected to have an annual effect of $ 100 million.

None of the alternatives would lead to a substantial increase in the price paid by consumers, local governments, or geographic regions since higher prices would be associated with higher value products and not with the same products, and because no significant quantity changes are expected in groundfish markets.

None of the alternatives considered would have significant adverse effects on competition, employment, investment, productivity, innovation, or on the ability of U.S. based enterprises to compete with foreign enterprises in domestic or export markets.

IMPACT OF THE AMENDMENT RELATIVE TO THE REGULATORY FLEXIBILITY ACT

The Regulatory Flexibility Act (RFA) requires that impacts of regulatory measures imposed on small entities (i.e., small businesses, small organizations, and small governmental jurisdictions with limited resources) be examined to determine whether a substantial number of such small entities will be significantly impacted by these measures. Fishing vessels are considered to be small businesses. Over 1000 vessels may be used to deploy hook-and-line gear to fish for groundfish off Alaska in 1993, based on Federal groundfish permits issued by NMFS. All of these vessels potentially could be affected by measures considered under alternatives 2 and 3.

FINDING OF NO SIGNIFICANT IMPACT

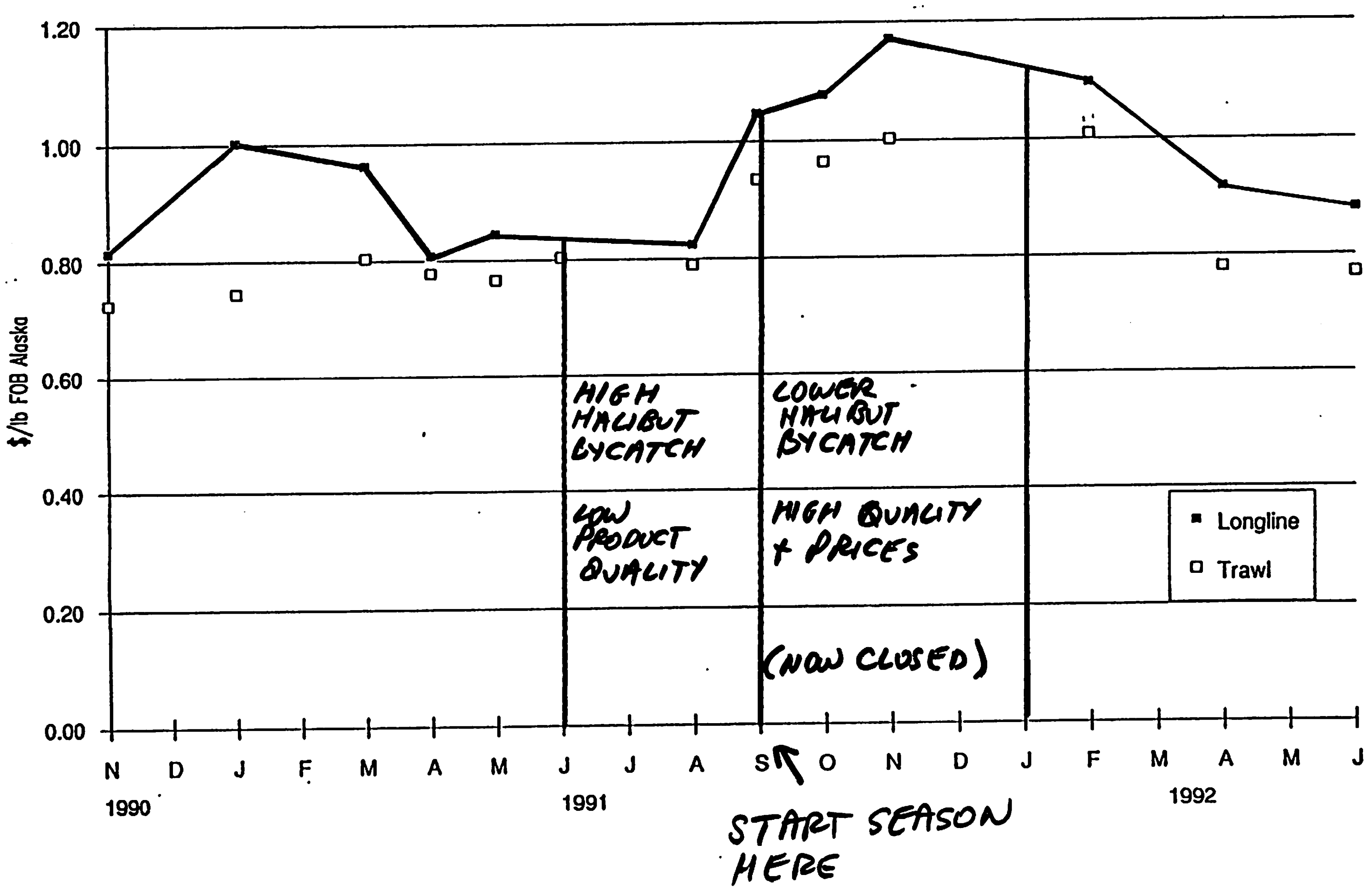
For the reasons discussed above, neither implementation of the status quo, Alternative 2, or Alternative 3 would significantly affect the quality of the human environment, and the preparation of an environmental impact statement on the final action is not required under Section 102(2)(c) of the National Environmental Policy Act or its implementing regulations.

EFFECTS ON ENDANGERED AND THREATENED SPECIES AND ON THE ALASKA COASTAL ZONE

Steller sea lions, a threatened species, occasionally interact with hook-and-line gear, and may ingest hooked fish as well as fish discarded from vessels. None of the alternatives considered to reduce halibut mortality is expected to result in any adverse effects to Steller sea lions. The NMFS Regional Director has determined that formal consultation under Section 7 of the Endangered Species Act is not required prior to implementation of any of the alternatives.

Each of the alternatives discussed above would be conducted in a manner consistent, to the maximum extent practicable, with the Alaska Coastal Zone Management Program within the meaning of Section 307(c)(1) of the Coastal Zone Management Act of 1972 and its implementing regulations.

Figure 1. Weighted average FOB Alaska prices for medium H&G cod harvested by U.S. factory trawl and longline vessels and sold at the Japanese Ishinomaki market



THORN SMITH

ED WYMAN

ANALYSIS OF TRAWL + HALIBUT PSC RELATIONSHIP FOR 1992 + 1993

			MORTALITY RATE		HALIBUT MORTALITY
1992	HALIBUT BYCATCH	1612 MT	X 75%	=	1,209 MT

IF 60% MORTALITY RATE IS USED ON 1992 BYCATCH:

1612 MT X 60% = 967 MT

RATIO OF COD CAUGHT TO HALIBUT MORTALITY

1992 TRAWL CATCH 66,232 MT COD

RATIO @ 75% MORTALITY = 55 : 1

RATIO @ 60% " = 68 : 1

1993 AP TRAWL PSC = 950 MT HALIBUT

IF TRAWL PSC = FIXED GEAR PSC = - 825 MT HALIBUT

125 MT

USING A 60% MORTALITY AND A RATIO OF COD CATCH TO HALIBUT MORTALITY OF 68:1

125 MT HALIBUT

x 68 : 1 RATIO

8,500 MT DIFFERENCE IN EST. TRAWL CATCH

- 637 MT DISCARD SAVINGS AT 7.5%

7,863 MT NET DIFFERENCE

1992 TRAWL COD DISCARDS - DIRECTED = 5,349 MT

FIS 11/19/72 1992 OBSERVER COD DISCARDS BSAI TRAWL

TAR	GFISH tot R.O.	obs add. cod disc	total	%add dis	% BY TAR
ATKA	49125	1100	50225	2.19%	4.48%
BPOL	161201	829	162030	0.51%	3.38%
PPOL	1002655	9378	1012862	0.93%	38.21%
* — PCOD	66199	5349	71548	7.48%	21.80% — *
FLAT	28276	567	28843	1.97%	2.31%
RKFH	16183	327	16510	1.98%	1.33%
RSOL	52107	2459	54566	4.51%	10.02%
YFIN	153419	4533	157952	2.87%	18.47%
TOTA	1529163	24542	1554534	1.58%	1

AS A PROPORTION OF THE TOTAL (TOTAL REPORTED, PLUS OBS DISC) THE PACIFIC COD TARGET HAD THE HIGHEST PROPORTION OF ADDITIONAL COD DISCARDS (7.5%). ROCK SOLE WAS NEXT.

OF THE TOTAL COD DISCARDS REPORTED BY OBSERVERS, MOST WAS THE "PELAGIC" POLLOCK TARGET FISHERY; SECOND MOST IN COD.

FIRST COLUMN FROM LATEST REPORTS, SECOND FROM GALEN TRUMBLE. NUMBERS HAVE NOT BEEN RUN THROUGH A BLEND PROCEDURE BUT PROPORTIONS ARE CLOSE.

FIS
10/30/92

BERING SEA/ALEUTIAN ISLANDS PACIFIC COD TARGET FISHERIES

	1990			1991			1992*		
	H & L	POTS	TRAWL	H & L	POTS	TRAWL	H & L	POTS	TRAWL
GROUNDFISH MT	51,007	1418	178,075	69,792	4,361	94,287	104,740	12,077	66,232
PACIFIC COD %	92.6%	N/A	53.9%	88.1%	N/A	76.0%	85.9%	96.3%	60.4%
PACIFIC COD MT	47,232	N/A	95,982	61,511	N/A	71,661	89,948	11,632	39,982
HALIBUT MT	1,723	22	3,135	2,559	38	1,838	6,346	88	1,612
HALIBUT MORT %	16%	10%	100%	16%	10%	100%	16%	10%	75%
HALIBUT MORT. MT	276	2	3,135	409	4	1,838	1,015	9	1,209
CHINOOK SALMON N	7	N/A	4,466	41	0	3,675	53	0	401
RED KING CRAB NO.	N/A	N/A	N/A	76	2,713	178	2,769	142	128
B. TANNER CRAB NO.	N/A	N/A	N/A	8,286	52,482	364,851	17,201	197,796	167,050

*Preliminary Final

NOTES: CATEGORIES USED ARE DEFINED AS FOLLOWS:

1990 "O" - Pollock and Pacific cod >= 50%, Pacific cod >= 5% of retained catch
1991 "C" - Pacific cod is >= 45% of groundfish catch.
1992 "C" - Pacific cod is dominant species in retained catch

BYCATCH NUMBERS ARE EXTRAPOLATED NUMBERS USED BY NMFS INSEASON

SOME NMFS REPORTS ARE INCOMPLETE OR UNAVAILABLE

December 4, 1992

Mr. Richard B. Lauber, Chairman
North Pacific Fishery Management Council
P.O. Box 103136
Anchorage, Alaska 99510

Dear Mr. Chairman and Council Members:

This letter addresses the most recent (1991) information on halibut mortality rates in directed Alaska groundfish fisheries and the allocation of halibut and crab PSC amounts to the Bering Sea/Aleutian Islands groundfish fisheries for 1993 management.

In arriving at our recommendations, we have given this issue a great deal of thought and have negotiated among the diverse industry groups signing this letter. Please understand that we consider the issues of mortality rates and PSC allocations inseparably linked and that our recommendations stand only as a package.

Halibut Mortality Rates

In a September 11, 1992 letter to you, Mr. Pennoyer and Mr. Pautzke, Steve Hughes provided an analysis of 1991 halibut mortality for the Bering Sea/Aleutian Islands and the Gulf of Alaska trawl cod fishery (Attachment 1). That analysis concluded the 1991 halibut mortality rate was 58.0% in the Bering Sea/Aleutian Islands cod fishery and 52.5% in the Gulf of Alaska cod fishery. Subsequently, the International Pacific Halibut Commission (IPHC) responded to a request for peer review of this analysis, and in a November 1992 document by Williams and Wilderbuer they reported 1991 halibut discard mortality rates for virtually all Bering Sea/Aleutian Islands and Gulf of Alaska fisheries (Attachment 2).

Consistent with IPHC recommendations[1] and the above analyses of the 1991 observer data, we strongly endorse management of 1993 groundfish fisheries by the following groups of fisheries and their associated halibut mortality rates:

Trawl
Midwater pollock: 80%
Atka mackerel, rock sole, and other flatfish: 70%

[1]Bering Sea/Aleutian Islands 1993 SAFE Appendix C, pg. 6.

Pacific cod, bottom trawl pollock, and rockfish: 60%
Arrowtooth flounder, Greenland turbot, and "other species": 40%

Gulf of Alaska Trawl
Midwater pollock: 75%
Rockfish, shallow water flatfish, and "other species": 60%
Pacific cod, bottom trawl pollock, and deep water flatfish: 55%

Bering Sea/Aleutian Islands Hook and Line
All targets: 20%

Gulf of Alaska Hook and Line
Pacific cod and rockfish: 16%
Sablefish: 25%

Bering Sea/Aleutian Islands and Gulf of Alaska Pots
All targets: 5%

PSC Allocations

By use of the above recommended halibut mortality rates, we believe the trawl industry will be best served by allocation of its 3,775 mt of halibut mortality among fisheries as shown in the table below. Next to the column labeled "Mortality Cap" we have provided a column labeled "Allowable Halibut Bycatch" because earlier management was based upon halibut catch rather than mortality:

Derivation of Secondary Halibut Cap

Fishery Group	% Mortality	Mortality Cap	Allowable Halibut Bycatch
Yellowfin Sole	0.7	551	787
May 1-Aug 2		(214)	(306)
Aug 3-Dec 31		(337)	(481)
Rocksole/O flat	0.7	548	783
Jan 1-Mar 29		(398)	(569)
Mar 30-June 28		(75)	(107)
June 29-Dec 31		(75)	(107)
Turbot/Arrow/Sable	0.4	125	318
Jan 1-June 28		(0)	(0)
June 29-Dec 31		(127)	(318)

Fishery Group	% Mortality	Mortality Cap	Allowable Halibut Bycatch
Rockfish	0.6	187	312
Jan 1-Mar 29		(0)	(0)
Mar 30-June 28		(75)	(125)
June 29-Dec 31		(112)	(187)
Pacific cod		1192	1987
Jan 1-June 28		(1192)	(1987)
June 29-Sept 27		(0)	(0)
Sept 28-Dec 31		(0)	(0)
	0.6		
Pollock/A mack/Other		1170	1950
A Season		(292)	(487)
B Season		(878)	(1463)
TOTAL	0.6	3775	6137

In conclusion, we emphasize the importance of the Council's adopting the IPHC recommended fisheries specific halibut mortality rates rather than again using the outdated generic rate. The new rates are reflective of fisheries which have either responded, or not responded, to the call to do a better job of saving halibut. Rewards and penalties for past practices should be applied to 1993 management. The PSC allocations we have recommended are only for the 3,775 mt of halibut mortality allocated to the trawl fishery. We believe this recommendation can best be made by those who must live with it and we have not suggested allocations by fishery within other gear groups.

We hope these recommendations and our unity behind them will be of assistance in your decisions.

Sincerely,

Midwater Trawlers Cooperative

American Factory Trawlers Association

American Independent Fishermens Association

Alaska Draggers Association

American High Seas Fisheries Association

Alaska Groundfish Data Bank

Pacific Seafood Processors Association

Peninsula Marketing Association

ATTACHMENT 1

Midwater Trawlers Cooperative

4055 21st Avenue West • Seattle, Washington 98199

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Yankee Fisheries
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MEMBER VESSELS
AJ
AMBITION
BAY ISLANDER
BLUE FOX
CAPE FALCON
CAPE KIWANDA
CARAVELLE
COHO
EXCALIBUR
EXCALIBUR II
HAZEL LORRAINE
JE LEE
SA MELINDA
MARATHON
MISS BERDIE
MISS LEONA
NEW JANET ANN
NEW LIFE
OCEAN SPRAY
PACIFIC CHALLENGER
PACIFIC FUTURE
PACIFIC RAM
PATIENCE
PATSY B
PEGASUS
PERSEVERANCE
PERSISTENCE
PIONEER
RAVEN
ROSELLA
ROYAL AMERICAN
SEADAWN
SEEKER
VANGUARD
RN DAWN

September 11, 1992

Mr. Richard B. Lauber
Pacific Seafood Processors Association
P.O. Box 21625
Juneau, AK, 99802

Mr. Steven Pennoyer
Regional Director
Alaska Region
NOAA/NMFS
P.O. Box 21668
Juneau, AK 99802-1668

Mr. Clarence Pautzke
Executive Director
North Pacific Fishery Management Council
605 West 4th Avenue
Anchorage, AK 99501

Dear Rick, Steve, and Clarence:

This letter addresses a September 1992 publication by Williams and Wilderbuer of the IPHC/NMFS on discard condition and mortality of halibut in Alaska groundfish fisheries, and provides some simple calculations by yours truly showing that the halibut mortalities in the 1991 trawl codfish fishery were 52.5% in the Gulf of Alaska and 58.3% in the Bering Sea. By comparison, assumed halibut mortality rates were 50% for "Gulf trawl fisheries (including cod)" in 1991, and 65% in 1992. Bering Sea/Aleutian Islands halibut mortality rates for trawl fisheries were assumed to be 100% in 1991, and 75% for 1992.

It is requested by MTC that the NPFMC recommend and that the NMFS implement, procedures for 1993 which will 1) manage the BS/AI and GOA halibut bycatch taken in these respective codfish fisheries areas as separate entities, and 2) assign halibut mortality rates in these two fisheries consistent with the IPHC/NMFS analysis of the 1991 observer data from codfish fisheries reported by Williams and Wilderbuer.

BACKGROUND

As all three of you are aware, I have stated before the council many times, that the use of 100% then 75% assumed halibut mortality rates for many trawl fisheries was total nonsense and inconsistent with data collected. Unfortunately, the first proof of this has just become available to the public via Williams's and Wilderbuer's September 1992 document which analyzed halibut discard condition fishery by fishery. While MTC had asked that this be done in prior years, it was not done, and as a result BS/AI and GOA codfish fisheries and all other trawl fisheries were simply assigned a generic halibut mortality rate for the BS/AI and another one for the Gulf. Although this practice has probably not cost GOA trawlers and processors substantial monitory losses, the cost to BS/AI trawlers and processors has conservatively exceeded 100,000 MT of cod valued at $50 million in round weight and $125 million at the wholesale level, just during the past 2-3 years. It is indeed a shame that a couple of NMFS biologists couldn't complete a fishery by fishery analysis using the observer data which the trawl industry so dearly pays for.

1991 HALIBUT CONDITION DATA

Williams and Wilderbuer reported the following conditions of halibut caught in GOA and BS/AI trawl fisheries for cod:

Area	Number of tows sampled	Condition of Halibut Bycatch		
		% Excellent	% Poor	% Dead
GOA	1213	34	33	34
BS/AI	2331	27	31	42

As you probably know, halibut viability used to be judged on a 5 category scale which has since been reduced to the three above categories, i.e. excellent, poor, and dead. Because of the merging of 5 categories into 3, not all halibut judged to be in excellent condition survive, and not all halibut judged to be dead, stay dead.

Dr. Trumble of the IPHC reports that the percentages of trawl caught halibut which actually survive that are judged to be excellent, poor, and dead are 83%, 46%, and 12% respectively.

1991 MORTALITY RATES

Following Williams's and Wilderbuer's reported GOA and BS/AI halibut conditions when discarded from codfish fisheries, and Dr. Trumble's reported survival noted for each condition, the following survival and mortality rates resulted from 1991 cod trawl fisheries:

Area	Discard Condition %	Survival Rate	Survive (%)
GOA	34% Excellent	.83	28.2
	33% Poor	.46	15.2
	34% Dead	.12	4.1
		TOTAL	47.5

% Mortality = 100 - Survival = 100 - 47.5 = 52.5%

Area	Discard Condition %	Survival Rate	Survive (%)
BS/AI	27% Excellent	.83	22.4
	31% Poor	.46	14.3
	42% Dead	.12	5.0
		TOTAL	41.7

% Mortality = 100 - Survival = 100 - 41.7 = 58.3%

ACTIONS FOR 1993 MANAGEMENT

Both GOA and BS/AI cod fisheries are extremely important to shore based trawlers, factory trawlers, shoreplants, and the health of the domestic cod marketing system, through the consuming public. Cod trawlers have clearly been getting a bum rap by NMFS here to fore by failure to calculate fishery specific halibut mortality rates, even though the data existed, by using halibut mortality rates which were excessive for cod fisheries and by allowing cod trawl fisheries to be prematurely closed leaving millions of dollars of cod uncaught.

To ensure an end to this predicament, we ask that the following actions be taken:

1. This letter be provided to the SSC and the IPHC for peer review and further analysis if deemed appropriate.

2. That the practice of assigning generic halibut mortality rates to GOA and BS/AI trawl fisheries end in favor of assigning fishery specific rates, or assigning rates to groupings of similar fisheries as recommended by Williams and Wilderbuer.

3. That halibut mortality rates applied against halibut bycatch caps in trawl codfisheries for 1993 be 52.5% for GOA and 58.3% for BS/AI.

4. That Williams and Wilderbuer be complimented on their work and that their attached document be updated annually for public review and council consideration, during the September-December period.

In conclusion, I am providing copies of this letter and the attached study to industry components who have been impacted by past halibut bycatch management practices, and who may be interested in joining with MTC in testifying on this subject during the September/December meetings. Our goal will be to ensure that fisheries specific halibut bycatch mortality rates be applied to the 1993 cod fisheries as a priority, and other fisheries as a second priority. Your comments, ideas, and support for implementing these changes in the NMFS management system are appreciated.

Sincerely,

MIDWATER TRAWLERS COOPERATIVE

Steve

Steven E. Hughes
Technical Advisor

cc: MTC membership
Joe Blum, AFTA
John Iani, PSPA
Kate Graham, AHSFA
Chris Blackburn, ADB
Al Burch, ADA
Dick Pace, UniSea
Rich White, UniSea
Alex Brindle, Alyeska
Greg Baker, Westward
Chuck Bundrandt, Trident
Phil Chitwood, Arctic Alaska
Ron Jensen, Arctic Alaska
Rudy Petersen, North Pacific
Dave Stanchfield, Aleutian Speedwell
Stan Simonson, Golden Age
Bob Breskovich, Golden Alaska
Beth Stewart, Peninsula
Wally Pereyra, ProFish
Stan Hovik, Arctic Storm
Kjell Rokke, American Seafoods
Steve Finley, Emerald Seafoods
Bob Watson, Bering Sea Marketing Assn.
David Galloway, Premier Seafood
Jim Salisbury, Supreme Alaska Seafoods
Bob Trumble, IPHC
Gregg Williams, IPHC
Tom Wilderbuer, NMFS Sand Point
Rich Marasco, NMFS Sand Point

ATTACHMENT 2

Table 3. Comparison of 1990 and 1991 calculated discard mortality rates.

Fishery	1990 % Exc	1990 % Poor	1990 % Dead	1990 Discard Mortality Rate	1991 % Exc	1991 % Poor	1991 % Dead	1991 Discard Mortality Rate
BSAI TRAWL								
MWT Pollock	7	10	83	81	7	13	81	81
Atka mackerel	16	27	57	69	9	30	61	73
Rock sole	36	19	45	58	17	29	54	68
O. flatfish	16	16	68	73	19	9	72	74
Pacific cod	20	22	58	68	27	31	42	60
BT Pollock	25	22	53	65	30	29	42	59
Rockfish	27	28	45	62	39	27	35	54
Arrowtooth	34	25	41	57	62	16	22	41
Grnld. turbot	38	16	46	58	62	24	14.	.38
Other sp.	63	30	7	36	84	8	9	:29
GOA TRAWL								
MWT Pollock	30	17	53	63	12	22	66	74
Rockfish	26	32	42	61	21	29	50	65
BT Pollock	23	27	50	65	25	46	29	56
Shall. flatfish	26	29	46	62	28	28	44	61
Other sp.	12	54	54	63	30	29	41	59
Pacific cod	28	28	44	61	34	33	34	55
Deep flatfish	39	16	46	57	45	18	37	52
BSAI H&L								
Pacific cod	78	16	5	15-18	69	26	5	20-22
Sablefish	85	12	3	11-14	82	8	10	16-19
Rockfish	72	26	3	17-20	67	15	19	28-30
GOA H&L								
Pacific cod	84	13	3	11-14	79	15	7	16-18
Sablefish	88	9	3	9-12	61	29	11	27-29
Rockfish	82	14	5	13-16	75	15	10	19-21
BSAI POT								
Pacific cod	93	6	1	7	97	1	2	3
GOA POT								
Pacific cod	90	4	6	10	95	2	3	5

ATTACHMENT 3
CRAB PSC ONLY

AP recommended 1993 Preliminary PSC Bycatch Allowances for the BSAI Trawl Fisheries

Fishery Group	Halibut, Primary (mt)	Halibut, Secondary (mt)	Herring (mt)	Red King Crab Zone 1	C. bairdi Zone 1	C. bairdi Zone 2
Yellowfin sole May 1 - Aug. 2 Aug. 3 - Dec. 31			391	40,000	175,000	1,225,000
Rocksole/other flatfish Jan. 1 - Mar. 29 Mar. 30 - June 28 June 29 - Sept. 27 Sept. 28 - Dec. 31			0	80,000	475,000	200,000
Turbot/arrowtooth/sablefish Jan. 1 - Dec. 31			0	0	0	0
Rockfish Jan. 1 - Mar. 29 Mar. 30 - June 28 June 29 - Sept. 27 Sept. 28 - Dec. 31			10	0	0	25,000
Pacific cod Jan. 1 - June 28 June 29 - Sept 27 Sept. 28 - Dec. 31			29	40,000	175,000	400,000
Pollock/mackerel/"o. species" Jan. 1 - April 15 April 16 - May 31 June 1 - Dec. 31			210	40,000	175,000	1,150,000
7 MW Pollock (Herring)			1,668	n/a	n/a	n/a
TOTAL			2,308	200,000	1,000,000	3,000,000

Sept. 24, 1992

Trawl	LL
Wally	Hegge
Mace	Alverson
Milliken	Behnken
Lauber ?	
Dyson	

Mitchell
one of a kind

Pannoyer

Clem

COMMENTS ON FINAL 1993 PLAN TEAM RECOMMENDATIONS AND SUGGESTIONS FOR ROCKFISH MANAGEMENT IN THE GULF OF ALASKA

by

ADF&G STAFF

December 1992

Rockfish management has received a great deal of attention over the past several years. Concerns have been frequently expressed regarding both the condition of rockfish stocks and the way the fisheries are managed. Some stocks are thought to be severely depleted and in need of rebuilding. Individuals have suggested that the ABC levels may be set too high for some species to sustain viable populations, much less provide for MSY. Others have exhibited concern over ABCs being exceeded and the potential effects that may have both on the rockfish populations and on fisheries for other species. Still others have suggested that current survey techniques may underestimate rockfish abundance. The issues have become so complex that the Gulf of Alaska Groundfish Plan Team devoted more than a full day discussing rockfish management during the November Plan Team Meetings; and many members stayed over to attend the Council's Industry Rockfish Committee meeting on the following Monday.

In addition to the final Stock Assessment Fisheries Evaluation (SAFE) chapters, the Team also reviewed and discussed several other sources of information during their deliberations. These included:

(1) a draft report by Steve Davis of LGL Alaska Research Associates entitled, "Do trawl surveys underestimate rockfish biomass?",

(2) a draft report by John Heifetz and Jeff Fujioka of the NMFS Auke Bay Laboratory entitled, "Stock projections of Pacific ocean perch in the Gulf of Alaska based on different harvest strategies,"

(3) a revised draft report by John Heifetz and Jim Ianelli of NMFS entitled, "Assessment of Pacific ocean perch in the Gulf of Alaska using the stock synthesis model,"

(4) a draft report by Barry Bracken of ADF&G entitled, "A review of rockfish management in the Gulf of Alaska."

(5) excerpts from an in-press report by Ken Krieger of NMFS Auke Bay Lab entitled, "Distribution and abundance of rockfish determined from a submersible and by bottom trawling."

Two additional draft reports involving rockfish management considerations were presented at the Industry Rockfish Committee meeting on November 23. Both dealt with bycatch estimates of rockfish in fisheries for other groundfish species. The first, "Bycatch of Pacific ocean perch (POP) and shortraker/rougheye rockfishes (SR/RE) in 1992 Gulf of Alaska (GOA) trawl fisheries," written by NMFS staff, estimates the bycatch needs of POP and SR/RE rockfish in trawl fisheries for other groundfish species based on 1992 weekly production reports. The second report, "Estimates of unreported discards of shortraker, rougheye, and thornyhead rockfish in the Gulf of Alaska hook-and-line sablefish fishery" was written by Barry Bracken of ADF&G and Jessie Gharrett of NMFS. That report uses limited observer data and the annual longline survey data to estimate the probable catch rates of SR/RE and thornyhead rockfish and compares them with the reported catch rates to estimate the total fishing mortality. Both of these reports present the data as Gulf-wide rates and more information is needed to determine the potential effects by regulatory district.

ADF&G is encouraged by the amount of attention focused on rockfish management and is generally supportive of the Plan Team recommendations for setting ABCs for 1993. However, there are other factors that the Council should consider when setting the final 1993 specifications.

The following is a species by species review of management recommendations made by the Plan Team with comments regarding additional short and long term management considerations.

Slope Assemblage

Pacific Ocean Perch (POP)

We agree with the ABC of 5,560 mt derived by applying an adjusted $F_{35\%}$ exploitation rate adjusted to achieve a spawning biomass equal to 35% of the estimated 1960 level ($B_{35\%}$). While ADF&G supports the adjusted $F_{35\%}$ approach to managing POP, we believe additional measures may be warranted to conserve and rebuild POP stocks. We strongly encourage further evaluation of this exploitation strategy because of the current low biomass and young age-structure of the POP population.

There is also concern with the current estimated biomass level. Though the Stock Synthesis Model appears to be a much more reasonable approach to estimating biomass than previous methods, it is very sensitive to input parameters. The Plan Team reviewed contradictory information regarding the appropriateness of using trawl surveys to assess POP stocks. Davis reported that British Columbia scientists have concluded that surveys tend to underestimate rockfish biomass. On the other hand, Krieger's data indicates that trawl surveys may overestimate POP biomass. The AFSC has proposed that trawl surveys be redesigned to address problems of estimating rockfish biomass. Although we strongly support these efforts to improve rockfish assessments, conservative methods should be used for managing rockfish until these other approaches are tested and their accuracy confirmed.

ADF&G is also concerned with the life history parameter assumptions used in the model. The natural mortality estimate currently used for Gulf of Alaska POP stocks is the mid-point of the estimates for various British Columbian stocks as reported by Archibald, et. al. in 1981. The maturity schedule is based on a length at age conversion from maturity data reported by Chikiuni in 1977. Fecundity data is estimated from a variety of sources. Catch at age is estimated from length frequency data obtained by on-board observers applied to age samples collected during the triennial surveys. Examination of life history parameters using data from current Gulf of Alaska populations should be a high rockfish research priority. Both future surveys and the on-board observer program should be considered as potential sources of valuable life history data.

In recent years, the ABC for POP has been exceeded, and this year, the overfishing level set at the beginning of 1992 was also exceeded. ADF&G supports the concept of managing all rockfish species such that total fishing mortality never exceeds the established ABC. ADF&G has recommended that TAC be set below ABC to allow for bycatch and discard mortality as well as management imprecision.

A recent evaluation by NMFS staff indicates that, based on actual 1992 retained trawl catch and current directed fishing standards, the sum of all 1992 TACs of POP for the entire Gulf of Alaska regulatory districts would be required as bycatch if TACs for other species were fully taken. In fact, other species TACs were not taken and actual 1992 trawl catch of other groundfish species would require 1,640 mt of POP as bycatch if there was no incentive for retaining POP. But, if the groundfish harvest increased by 50%, the Gulf-wide POP bycatch needs would increase to 2,360 mt. Through the actual bycatch needs by regulatory area are not known, these data demonstrate that a significant portion of the POP ABC is necessary as bycatch in fisheries for other species. Furthermore, bycatch is likely to increase significantly if a larger amount of the groundfish TACs are taken. This factor needs to be considered when setting harvest strategy for the directed rockfish trawl fisheries.

Rebuilding schedules for POP were discussed by the Plan Team and the Rockfish Committee at some length. There is some level of rebuilding implicit in the adjusted $F_{35\%}$ level; however, the Council may establish an even lower harvest rate to facilitate rebuilding for this species. The report by John Heifetz and Jeff Fujioka is a useful tool for examining the potential yield and projected stock levels for several potential exploitation rates, including the adjusted $F_{35\%}$ exploitation rate recommended by the Plan Team.

Short-term

(1) Accept the Plan Team ABC recommendation of 5,560 mt for 1993.

(2) Develop in-season management strategy to account for and assure that total mortality (directed catch + bycatch + discards) does not exceed ABC. Set the TAC in the directed fishery with an appropriate buffer to ensure that projected total mortality does not exceed ABC.

(3) Develop quarterly apportionment of TAC to facilitate accounting for total mortality and increase management precision.

Long-term

(1) Establish stock rebuilding goals and schedule. Determine appropriate exploitation rates to rebuild POP stocks.

(2) Improve catch reporting, bycatch and discard monitoring system to

provide for in-season management and to ensure that TAC/ABC are not exceeded.

(3) Continue efforts to develop better survey techniques.

(4) Work toward obtaining better life history data for this population from the Gulf of Alaska. This should include better estimates of catch at age, better estimates of natural mortality, size, age of maturity, and fecundity schedules. Surveys and the observer program could be used to facilitate this research.

Shortraker/Rougheye Rockfish

The 1993 recommended ABC of 1,960 mt for shortraker and rougheye (SR/RE) rockfish is the same as the 1992 ABC, and is based on an F=M exploitation rate applied to the mid-point biomass estimate of the 1987 and 1990 trawl surveys. This may not be appropriate for two reasons. First, the 1990 survey results were substantially lower than the 1987 survey results and the validity of the 1987 biomass estimate is in question. The revised fishing power correction factor for the survey reduced the POP estimate in the 1987 trawl survey by 39%. This same correction factor has not yet been applied to the other rockfish species. Secondly, these two species are not adequately assessed in trawl surveys, and results of the annual longline survey are quite variable and inconsistent. Applying the F=M exploitation rate to the 1990 trawl survey biomass estimate would provide a more defensible short-term approximation of ABC until those problems are resolved.

ADF&G urges that measures be taken to assure that ABC is not exceeded for these species. Bycatch estimates by Bracken and Gharrett indicate that catches of shortraker and rougheye rockfish may be under-reported by considerable amounts in the hook-and-line sablefish fishery. The average 1991 and 1992 Gulf-wide bycatch rates determined from the limited observer data and the annual longline survey were very close, at .044 and .043 of all sablefish respectively. Applying calculated bycatch rates to the actual catch of sablefish indicates that between 555 mt and 890 mt of bycatch discard of SR/RE may have been unreported in 1992. If this is true, then nearly 45% of the ABC may be taken as unreported discard in the sablefish fishery alone. In addition, approximately 300 mt of shortraker and rougheye rockfish were reported as retained catch in the sablefish fishery. Further, Gharrett estimated that between 220 and 300 mt were necessary as bycatch in trawl fisheries for other species at the 1992 level of harvest and that the entire ABC would be needed if all TACs were fully realized. Therefore, the total nondirected shortraker/rougheye catch may reach or exceed the recommended ABC of this species group. In fact, there may be no way of maintaining the harvest within the current ABC level without curtailing other target fisheries. These data must be further evaluated, particularly by regulatory area, and taken into consideration when defining management strategies for this species group.

Short-term

(1) Adopt an ABC of 1,390 mt based on F=M applied to the exploitable biomass of both species as indicated by the 1990 trawl survey.

(2) Develop in-season management strategy to assure that total mortality (directed catch + bycatch + discards) does not exceed ABC.

(3) Relegate this species group to bycatch only and develop reasonable directed fishing standards which will encourage full utilization while discouraging "topping off".

Long-term

(1) Continue efforts to develop better survey techniques, apply the fishing power correction factor consistent with that done for POP when calculating future biomass estimates for this species.

(2) Improve catch reporting, bycatch and discard monitoring systems to provide for better in-season management and to ensure that TAC/ABC are not exceeded.

(3) Work toward obtaining better life history data for this species from the Gulf of Alaska. This should concentrate on obtaining better estimates of natural mortality and catch at age for Gulf of Alaska stocks.

Northern Rockfish

The Plan Team recommended separating northern rockfish from the other slope rockfish management group. This action was taken because the catch in recent years has been disproportionately high relative to the abundance of this species in the "other slope" rockfish complex. The recommended ABC of 5,760 mt is based on a tenuous natural mortality estimate applied to the average of the point estimates of the 1987 and 1990 triennial trawl surveys. ADF&G supports setting a separate ABC and TAC for northern rockfish. However, as was stated above, the revised fishing power correction factors for the surveys have not yet been applied to the other rockfish species and it is unknown how that might effect the 1987 biomass estimate for northern rockfish. We propose using only the 1990 survey biomass estimate as a more appropriate value until that situation is resolved.

It should be noted that the recommended ABC for northern rockfish is even higher than the recommended ABC for POP and may promote a major new directed trawl fishery in the Western and Central Gulf. Although northern rockfish are know to segregate by depth, a directed fishery on northern rockfish will likely result in high bycatch levels of other slope species including smaller adult POP and juvenile rougheye rockfish. Potential bycatch should be considered when setting the TACs for northern rockfish and other slope rockfish species.

Short-term

(1) Adopt the Plan Team recommendation for an ABC of 5,760 as a provisional ABC for 1993.

(2) Develop in-season management strategy to account for and assure that total mortality (directed catch + bycatch + discards) does not exceed ABC.

Set the TAC in the directed fishery with an appropriate buffer to ensure that projected total mortality does not exceed ABC.

(3) Monitor the fishery in-season to determine how "clean" the directed fishery for northern rockfish will be.

(4) Identify an appropriate bycatch rate trigger and take action to reduce harvest if high bycatch of other slope rockfish including POP and shortraker/rougheye is observed.

Long-term

(1) Continue efforts to develop better survey techniques, apply the fishing power correction factor consistent with that done for POP when calculating future biomass estimates for this species.

(2) Improve catch reporting, bycatch and discard monitoring system to provide for in-season management and to ensure that TAC/ABC are not exceeded.

(3) Obtain better life history information for this species including estimates of catch at age, better estimates of natural mortality, size and age of maturity, and fecundity schedules. This is particularly important because northern rockfish may develop into a major target fishery and so little is know about the species.

<u>Other Slope Rockfish</u>

The ABC for "other slope rockfish" was derived by applying an average natural mortality estimate to the cumulative sum of the average point estimate biomass levels of all remaining slope rockfish species as determined by the 1987 and 1990 triennial trawl surveys. ADF&G is concerned with this approach for several reasons:

(1) It may not be appropriate to manage the entire assemblage as a sum of its component parts. Such an approach has resulted in new target fisheries occurring on individual species within the complex in the past with the resulting harvest disproportionate to the biomass of the individual species. Long-lived species are particularly susceptible to over-exploitation if harvest rates cannot be constrained to sustainable levels.

(2) The natural mortality estimates are quite variable among the species involved and range from 0.04 to 0.10. These are then applied to the biomass estimates of the individual species within the group and then summed to determine ABC for the entire complex. Not only are the natural mortality estimates based on insufficient data, but this method introduces the risk that a species with a low natural mortality may become the primary target species and will experience exploitation rates which are higher than the natural mortality of the individual species.

(3) The biomass estimates were derived from an average of the 1987 and

1990 triennial trawl surveys. This estimate was made without applying the fishing power correction factors to the 1987 survey data and should be viewed with caution.

(4) There is little if any evidence that species within this group can be fished at any level without significant bycatch of other fully utilized rockfish species. Silvergrey and redstripe are closely associated with DSR many of the "other slope" rockfish species occur with POP along the shelf break. It is doubtful that targeted fisheries on "other slope" rockfish species could occur without significant bycatch of DSR and POP.

The Plan Team summary includes the warning, "In setting TAC for other slope rockfish, consideration should be given to the potential misreporting or misidentification of species, the high degree of uncertainty about biomass trends for these species, and (the potential) for targeting on individual species in the group."

ADF&G agrees with that concept, but advises that those same factors and the others listed above should also be considered when setting ABC. Using the lower natural mortality estimate of the major species (0.04) applied only to the most populous species would be a more appropriate method for determining ABC for the entire group.

Short-term

(1) Consider reducing the ABC to a lower level. This may be done by using the lowest natural mortality of any species within the group as an exploitation rate applied to the biomass of the most abundant species in the group.

(2) Develop in-season management strategy to account for and assure that total mortality (directed catch + bycatch + discards) does not exceed ABC. Set the TAC in the directed fishery with an appropriate buffer to ensure that projected total mortality does not exceed ABC.

(3) Monitor the catch in-season to determine if new "target fisheries" develop within this group and to determine the bycatch of other fully utilized rockfish species taken while fishing for "other slope" rockfish.

(4) Compare the weekly production reports to the observer reports on a regular basis to verify the accuracy of species reporting.

Long-term

(1) Continue efforts to develop better survey techniques, apply the fishing power correction factor consistent with that done for POP when calculating future biomass estimates for these species.

(2) Improve catch reporting, bycatch and discard monitoring system to provide for in-season management and to ensure that TAC/ABC are not exceeded.

(3) Obtain better life history information for these species including estimates of catch at age, better estimates of natural mortality, size and age of maturity, and fecundity schedules.

Pelagic Shelf Rockfish

Two substantial changes were recommended by the Plan Team for 1993. First, an individual ABC of 570 mt was recommended for black rockfish based on the actual reported Gulf-wide catch of that species during 1991. Second, for 1993 the Plan Team recommended setting the ABC for the remaining pelagic shelf species based only on the abundance of dusky rockfish which is by far the most abundant species in the group.

The ABC of 6,740 for other pelagic rockfish was derived by applying the estimated F=M rate to the average of the point estimates of Dusky rockfish in the 1984, 1987, and 1990 triennial trawl surveys. The very high estimate for the 1987 survey raised the three-year average by a considerable amount. It is uncertain whether the high 1987 survey or the much lower 1984 and 1990 surveys better estimate the actual abundance of dusky rockfish. The apprehension regarding use of survey results as an estimator of rockfish biomass is elevated for dusky rockfish. This is because this species is know to reside in mid-water at times and may not always be vulnerable to the trawl gear. As one would expect, the results were highly variable over the course of the three surveys. Better methods for stock assessment need to be developed for this species.

ADF&G supports the Plan Team recommendations for setting ABCs for black rockfish and dusky rockfish in 1993. We caution, however, that since the estimated ABC for black rockfish was derived using the default definition under the FMP, ABC equals overfishing for that species. That factor needs to be taken into account when setting the TACs and when developing in-season management strategy for black rockfish.

Black Rockfish

Short-term

(1) Adopt the Plan Team recommendation to establish a separate ABC of 570 mt.

(2) Set overfishing equal to ABC.

(3) Set TAC below ABC to allow for management imprecision.

Long-term

(1) Work toward obtaining better biological and stock status information for this species.

(2) Work toward an in-season management framework such as that in place for DSR to reduce the risk of localized depletion.

Other Pelagic Rockfish

Short-term

(1) Adopt the Plan Team's recommendation of 6,740 mt based only on dusky rockfish as a provisional ABC for 1993.

(2) Continue to evaluate the uncertainty surrounding the biomass estimates for this species with particular regard toward determining the risk of overestimation in the 1987 survey.

Long-term

(1) Work toward obtaining better abundance and distribution data for this species.

(2) Work toward obtaining better biological information for this species.

Demersal Shelf Rockfish

The Plan Team accepted ADF&G's recommended ABC for DSR. The ABC of 800 mt for the eight-species assemblage is derived by applying an F=M exploitation rate to the lower 90% C.I. of the biomass estimate for the predominant species, yelloweye rockfish, as determined from submersible observations. Using the lower 90% C.I. was justified because of the newness of the survey approach and the uncertainty of the density relationship over the expanded area.

ADF&G has worked with the IPHC during the past year to estimate unreported discard mortality of DSR in the halibut fishery. Subtracting the 1992 estimated unreported mortality from the recommended 1993 ABC results in a level very similar to the ABC previously derived from the average reported catch. ADF&G proposes applying the bycatch mortality rate to actual halibut catches in-season to estimate total mortality.

Although ABC has not been exceeded for this species in the past, as with other rockfish species, we suggest providing a buffer between ABC and TAC to account to possible management imprecision. Given the extensive in-season control over the directed DSR fishery, a 10% buffer should be adequate to remain within the ABC for this assemblage.

Short-term

(1) Adopt the recommendation of 800 mt for DSR which was based only on the estimate of yelloweye rockfish abundance.

(2) Encourage the managers to continue evaluating the unreported mortality in fisheries for other species and to manage such that the total mortality does not exceed ABC.

(3) Set TAC 10% below ABC to allow for imprecision in management or reporting.

Long-term

(1) Improve catch reporting, bycatch and discard monitoring systems to provide for in-season management and to ensure that TAC/ABC are not exceeded.

(2) Expand the surveys into other areas to better determine the density/habitat relationships over the entire area.

(3) Work toward obtaining better bathymetric data to facilitate extrapolation to unsurveyed areas.

Thornyhead Rockfish

The Plan Team accepted the SAFE chapter author's ABC recommendation of 1,180 mt for thornyhead rockfish for 1993. This is a decrease from the level accepted in 1992 but above the level set for 1990. The ABC was derived by applying an $F_{35\%}$ exploitation rate to the point estimate of the biomass as determined in the 1990 trawl survey. Earlier surveys were not included because of uncertainty in the fishing power correction factors used. In addition, the annual longline survey indicated a decrease in abundance between the 1988 and 1990 suggesting the more recent trawl survey estimate may be more accurate.

ADF&G endorses this approach as a short-term measure, but is still concerned with the lack of biological data available for this species, particularly since the natural mortality estimate has such a large impact on the derivation of optimal F for this species. In the past an M of 0.07 was assumed based on a single sample taken off Cape Ommaney in the early 1980's. The estimate of M used by the Pacific Council on the west coast is 0.03. The Plan Team accepted the author's recommendation to average the two numbers to come up with an temporary working estimate of M=0.05 for Gulf of Alaska stocks until better data becomes available.

Other life history parameters are also poorly understood. What little data is available for thornyhead rockfish in Alaska is based on the same single sample used for estimating natural mortality. This may not be appropriate. For example, preliminary aging conducted by ADF&G suggests that growth rates may differ greatly for this species within a rather small geographic area. We recommend that greater effort be devoted to determining better estimates of natural mortality and other biological parameters for this species.

As of November 8, 1992, 1,660 mt of thornyheads had been reported from the Gulf of Alaska. There is little evidence of target fisheries for thornyheads, although they are a very valuable component of the catch in target fisheries for other deep-water species. Approximately 495 mt of thornyheads were reported as bycatch in the hook-and-line sablefish fishery in 1992, with the remainder taken in the various trawl fisheries, primarily those for slope rockfish. There does not appear to be a problem with unreported bycatch mortality for this species, so the reported catch figures are probably representative of the total fishing mortality.

It is important to note that the 1992 harvest of 1,660 mt was 41% above the recommended 1993 ABC of 1,180 mt and also well above the recommended 1993 overfishing level of 1,440 mt. It thus appears that all of the thornyhead ABC is necessary as bycatch. There is also a very real likelihood that the recommended overfishing level might be reached in the course of fisheries for other species unless measures are adopted to reduce the take of thornyheads.

Thornyheads lack a gas bladder and, if not damaged by the gear, survive ascent to the surface even from great depths. Therefore, there is a potential for successful return, with some survival, if directed fishing standards are imposed. However, data has not been quantified to determine the rate of survival or bycatch needs and there may not be any rational way of determining appropriate directed fishing standards for the various fisheries, at least in the near term. Perhaps another way of assuring that the overfishing level is not reached would be to set the TAC less than ABC and implement PSC status once the TAC is achieved. This would increase the buffer between TAC and overfishing.

Short-term

(1) Adopt the recommended ABC of 1,180 for 1993.

(2) Set TAC below ABC to reduce the risk that ABC will be exceeded.

(3) Relegate this species to bycatch only.

(4) Monitor the catch in-season with the intent of developing reasonable directed fishing standards.

Long-term

(1) Improve catch reporting, bycatch and discard monitoring systems to provide for in-season management and to ensure that TAC/ABC are not exceeded. In particular, attempt to determine discard mortality rates either through observation or tagging studies to evaluate the effectiveness of PSC strategies in reducing total mortality.

(2) Work toward obtaining better biomass and life history information for this species. Particular attention should be paid toward obtaining a natural mortality estimate for Gulf of Alaska stocks since the current model is so sensitive to this parameter.

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December 4, 1992

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ROCKFISH MANAGEMENT: CONCERNS AND RECOMMENDATIONS

Members of the Alaska Longline Fishermen's Association (ALFA) would like to submit the following concerns and recommendations on rockfish management for the Council's consideration during the December meeting. Although ALFA recognizes that the review of rockfish management will be an ongoing process, we feel that there are immediate actions the Council can take to improve long-term management of these species. For clarity, these concerns and recommendation will be reviewed below by species.

Pacific Ocean Perch

Concerns

*Overharvest in past: Pacific ocean perch (POP) are the only species managed by the NPFMC that are considered depleted. POP were over-exploited during the 1960s and remain at 10-16% of historic abundance.

*Uncertain abundance trend: although population models show slight increases in POP, abundance since 1982, recent trawl surveys indicate population declines and recent biomass estimates have been consistently revised downward.

*Changes in age class composition: lightly exploited POP stocks exhibited a significantly higher average age and contained a much higher spawner to recruit relationship than current populations.

*History of fishery reaching and exceeding TACs and ABCs.

Recommendations

1. ALFA urges the Council to commit to rebuilding POP stocks. Explicit rebuilding goals and schedules should be established, along with a strategy for achieving those goals that has a high probability of success.
2. ALFA endorses the Plan Team's recommended methodology of adopting an exploitation strategy that seeks to re-establish a healthy spawner to recruit relationship, but urges continued scrutiny to determine the appropriateness of the F35% exploitation rate and B35% adjustment factor (i.e., given the longevity and life history parameters of POP, a higher spawner to recruit relationship relative to historic levels may be necessary to ensure stock health and maximize long-term yields.)
3. Unavoidable bycatch in other historic fisheries should be determined and subtracted from quotas before directed fishery guidelines are established. Buffers between ABC and TAC should be established to prevent exceeding ABC, the size of the buffer being determined by the manageability of the POP fishery and current stock status.

Rougheye/Shortraker

Concerns

*Possible overharvest in past.

*Declining abundance trends: although current trawl surveys may not be accurate methods for determining biomass, results from the surveys show markedly downward trends for these species between 1982 and 1990 (shortraker: 82%; rougheye: 40%).

*Assemblage management: in the directed fishery for this complex, shortraker are harvested disproportional to their relative abundance. This could result in depletion of the shortraker component of the assemblage.

*Unreported bycatch: SR/RE are taken incidental to the trawl rockfish fishery and the longline sablefish fishery. SR/RE are discarded by some vessels during sablefish openings, and once placed on "prohibited status" are discarded by both trawl and longline vessels. Total removals may be underestimated.

Recommendations

1. Given declining abundance trends and current uncertainties in biomass estimates, conservative biomass estimates and exploitation rates should be adopted.
2. Revise directed fishing guidelines to reflect true, unavoidable bycatch of other fisheries. Current bycatch standards may allow "topping off."
3. The unavoidable bycatch needs of historic fisheries should be deducted from the quota before directed fishery guidelines are established. This will minimize the risk of exceeding quotas and alleviate conservation problems associated with the disproportional harvest of SR during directed fisheries.
4. Mandatory retention: in order to eliminate the waste associated with discarding rockfish and to obtain a more accurate accounting of RE/SR removals, the Council should consider prohibiting discards of rockfish in all fisheries.

Other Slope Rockfish

Concerns

*Uncertain biomass estimates.

*Significant habitat overlap with POP, DSR and SR/RE.

*Assemblage management: Disproportional harvest of Northern rockfish relative to abundance within complex.

Recommendations

1. Conservative exploitation strategies should be applied until better information on stock status and biological parameters becomes available.
2. Directed fishing standards should be revised to reflect unavoidable bycatch.
3. In establishing quotas for this complex, the Council should take into consideration the likely high bycatch levels of POP, RE/SR and DSR that would be associated with prosecution of the "other slope rockfish" fishery. Development of a fishery for this complex could undermine rebuilding or conservation efforts for other rockfish species.
4. ALFA endorses the Plan Team recommendation to separate Northern rockfish from the "other slope" complex. The Council should consider adopting the "greatest common denominator" approach used in the demersal shelf complex, setting the ABC based on the predominant commercially exploitable species remaining in the complex.

Demersal Shelf Rockfish

Concerns

*Uncertain biomass estimates: ADF&G has developed a survey technique for this complex that employs submersible transects to estimate yelloweye (the most abundant DSR species) density and expands these observations to identified DSR habitat. Although well suited to cryptic, habitat-specific species such as rockfish, the technique is new and submersible observations limited.

*Unreported bycatch: DSR are taken as bycatch in the halibut fishery. Most of these vessels are too small to carry observers, therefore bycatch removals are estimated and may not be accurate.

Recommendations

1. Until additional submersible observations are available, biomass estimates and exploitation strategies should be conservative. ALFA supports the ADF&G and Plan Team recommendation that the lower bound of the 90% confidence interval be adopted as the most appropriate biomass level for the complex. Biomass estimates for the entire complex should continue to be based solely on yelloweye abundance, with all removals counted against the TAC for the complex.
2. Bycatch needs of historic fisheries should continue to be deducted from the DSR quota before directed fishery guidelines are established. Trip limits should be retained to ensure that the fishery remains manageable and continues to remain below annual TACs.
3. Mandatory retention: Although retaining all DSR taken during halibut "derbies" will be difficult for small vessels where deck and hold space are limited, prohibiting DSR discards will eliminate waste and provide for a better accounting of removals.

Pelagic Shelf Rockfish

Concerns

*Uncertain biomass estimates: difficulties in assessing off-shore and near-shore components with current survey techniques.

*Assemblage management: possible over and under-harvest of species within complex due to unreliable surveys.

Recommendations

1) The near-shore component of the pelagic shelf complex are not assessed during the triennial trawl survey. A new survey technique must be developed to assess both near-shore and off-shore pelagic rockfish populations.

3) Although information on black rockfish biomass is minimal, ALFA endorses the Plan Team recommendation to remove this species from the pelagic complex. Attention should be focused on developing a survey technique so that appropriate biomass estimates and quotas can be established. Intensive management, with hot spot authority and sub-area closure such as is employed in the DSR fishery, may be necessary to prevent localized depletion.

Thornyhead Rockfish

Concerns

*Uncertain biological information and appropriateness of exploitation rate.

*Uncertain biomass estimate.

*Unreported bycatch.

Recommendations

1. Additional information on thornyheads is necessary to determine maximum age and natural mortality rate.
2. While biological information and biomass estimates remain limited, a conservative view of stocks status and a conservative exploitation rate should be adopted (e.g., adopting the lower bound of the 90% confidence interval in estimating biomass).
3. Mandatory retention: to eliminate waste and determine total removals, the Council should prohibit discards of thornyhead rockfish.

CONCLUSION

In closing, ALFA offers the following general recommendations for rockfish management:

1. Clarify rebuilding goal for POP, defining parameters for "healthy" population based on stock recruitment relationship.
2. Establish buffers between ABC and TAC, basing the size of the buffer on the manageability of the fishery (e.g., history of exceeding quotas) and vulnerability of the species.
3. Where appropriate, break species out of management complexes or manage complexes with "greatest common denominator" approach for the predominant commercially exploited species.
4. Review bycatch standards and determine true, unavoidable bycatch in order to prevent "topping off" from undermining rebuilding or conservation efforts.
5. Determine and subtract from quotas unavoidable bycatch needs of historic fisheries before establishing directed fishery guidelines.
6. When biological information or biomass estimates are uncertain, adopt conservative abundance estimates and harvest strategies.
7. Require full retention of all *Sebastes* and *Sebastolobus.*