MEMORANDUM

TO: Council, SSC and AP Members

FROM: Clarence G. Pautzke
Executive Director

DATE: June 14, 1989

SUBJECT: Bering Sea/Aleutian Islands Groundfish Fishery Management Plan

ACTION REQUIRED

(a) NOAA Fisheries report on Bering Sea bycatch management for 1989 and plans for 1990. Further Council action as necessary in response to bycatch proposals.

(b) Receive report from AFTA on efforts to minimize herring bycatch.

BACKGROUND

Status of the Council's Bycatch Management Plan

The emergency rule to prohibit trawling in the Crab and Halibut Protection Zone took effect on March 15, 1989, and in April the Council voted unanimously to extend the emergency rule by 90 days until September 11, 1989. We expect this extension to appear in the Federal Register this week. The closed area covers waters north of the Alaska Peninsula bounded by 160°W, 163°W, and 58°N, though the Regional Director may allow trawling between 162°W and 163°W pursuant to an approved scientific data gathering and monitoring program.

The Amendment 12a package fully implementing the Council's bycatch management recommendations was submitted to the Secretary on March 30, 1989. A decision is due on or before July 7. If approved, the regulations could be in place by late July if the APA 30-day cooling off period is waived. Amendment 12a will remain effective through December 31, 1990, unless superseded earlier by an FMP or regulatory amendment.

Bycatch Management in 1990 and Beyond

In September 1988, the Council requested that NOAA Fisheries prepare a more comprehensive bycatch management framework for 1990 and beyond. This framework was to be based on the recommendations of the Council's Bycatch Committee and Ad Hoc Bycatch Group and was to provide bycatch controls for C. bairdi, red king crab, and halibut for all groundfish fisheries operating in the Bering Sea/Aleutian Islands. NOAA Fisheries will provide a status report on their development of bycatch management strategies for this year and the next, recognizing that in the absence of a comprehensive data collection program for monitoring bycatch it may be necessary to control bycatch using other management measures such as time/area closures.

Herring Bycatch

At the April meeting, a voluntary program to address herring bycatch was announced to the Council. I've asked Ted Evans to give the Council a progress report on the implementation of this agreement and clarify whether bycatch reports on salmon, crab, and halibut were included in the agreement (item D-3(a)).

North Pacific Fishery Management Council

John G. Peterson, Chairman
Clarence G. Pautzke, Executive Director

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May 5, 1989

Ted Evans, Executive Director
Alaska Factory Trawlers Assn.
4039 21st Avenue W., #400
Seattle, Washington 98199

Dear Ted:

We finally had a chance to transcribe the portions of the April 14 Council meeting concerning your agreement with Harold Sparck for AFTA vessels to control and report on the bycatch of herring in the Port Moller and Bogoslof fisheries. Our transcript and Harold's copy of the agreement with his additional remarks are attached for your reference. In summary, it appears you've agreed to the following:

For Port Moller:

1. In the summer cod fishery there will be 50% observer coverage on AFTA vessels with all tonnages of directed groundfish harvests and herring bycatch published. These observers will be paid for by the vessels involved as in the current data gathering program within the 25 fm exemption.

2. AFTA will hold a workshop for its companies to discuss and teach herring avoidance procedures.

3. Herring avoidance procedures will be defined for the fleet.

4. If AFTA associated vessels come across herring, they will move to an area in or outside the Port Moller area where there are no herring.

For Bogoslof fishery in Area 515:

1. AFTA vessels will participate in the ADF&G herring sampling program.

2. AFTA will identify how many vessels will participate in the Bogoslof fishery.

3. AFTA will agree to seek 20% observer coverage during the time when herring are present, mid-June through the end of July, a period of about 40 days. These observers will be supported by funds from the existing AFTA-industry-NOAA Fisheries observer fund.

4. This agreement does not affect the observer coverage for boats delivering shoreside.

5. AFTA vessels that encounter herring will move to another place in or out of the area during the program's operation.

Though the Council did not take any formal action on your agreement, I'm sure they are very interested in seeing it run smoothly and successfully. With the problems we've had over bycatch management the past few years, it's a cause for optimism when the industry volunteers to take actions without more regulations being placed on the fisheries.

After you've had a chance to review the above commitments to ensure they are correctly stated, I encourage you to distribute them widely to your fleet because our newsletter only addressed herring bycatch in the broader context of the Ad Hoc Workgroup report. I'd also like to request a program status report for the June and September Council meetings.

Thanks for your help.

Sincerely,

Clarence G. Pautzke
Executive Director

enclosures

cc: Harold Sparck

North Pacific Fishery Management Council

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May 19, 1989

Ted Evans, Executive Director
Alaska Factory Trawlers Assn.
4039 21st Avenue W., #400
Seattle, Washington 98199

Dear Ted:

I would appreciate your comments on the enclosed letter from Harold Sparck as our record is unclear on his point about reporting crab, salmon and halibut bycatch as well as herring. It might be easiest for you just to correspond directly with him and copy us.

Thanks. See you up here in June.

Sincerely,

Clarence G. Pautzke
Executive Director

enclosure

cc Harold Sparck

YUKON/KUSKOKWIM FISHERIES TASK FORCE

P.O. Box 267
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May 14, 1989

Mr. Clarence Pautzke
Executive Director
North Pacific Fisheries Management Council
P.O. Box 103136
Anchorage, AK 99510

Dear Clarence,

I received a copy of your May 5 letter to Ted Evans concerning the industry-industry agreement for the summer 1989 trawl fisheries in Port Moller and Bogoslof Area 515.

I agree with your summation, save Article 1 under Port Moller. The agreement that I had with Ted was for all tonnages being made public, which would include crab, salmon and halibut by catch in addition to herring. Please communicate with Ted on this issue.

Thank you for your attention to this issue.

in peace,

Harold

harold sparck, director

cc: RD Steve Pennoyer
ADFG, David Benton
Ted Evans, AFTA
Senator Johne Binkley
Representative Lyman Hoffman
Harvey Samuelson, WACMA
Mitch Kink, AFMA
Doc Nicholson, BBHMA
Val Angasaan, BBNA
Dean Paddock, BBDNA
Henry Mitchell, BSFA
Henry Ivanoff, Unalakleet
Arne Thompson, ACC

File:NPFMC2-5.89

Bycatch Management in the Bering Sea Groundfish Fisheries
NOAA Fisheries

EXECUTIVE SUMMARY

Red king crab bycatch management in Zone 1:

- Midwater trawl operations could be allowed to operate with observers throughout the area known as Zone 1 with the objective of a "zero" crab bycatch.

- Bottom trawl operations could be allowed to operate with observers in Zone 1 outside of a closed area where relatively high concentrations of red king crab exist. This closure would protect a major percentage of the red king crab stock and could be modified to reflect the most recent stock assessment surveys. A discussion is presented on one possible area closure between 161 and 164½W. longitude, south of 58½N. latitude. When an operation's observed weekly bycatch rate exceeds a fixed rate by 100 percent during any two weeks, Zone 1 would be closed to the operation for the remainder of the year.

C. bairdi and Pacific halibut bycatch management:

- Without observers, a fishery's bycatch can be estimated by applying bycatch coefficients (Appendix 1) against reported catch composition. When estimated bycatch reaches the fishery's portion of the PSC limit established by the Council for an area, that area would be closed to vessels of that fishery. C. bairdi bycatch limits would be established for Zone 1 and for a modified "Zone 2". A single halibut PSC limit would be established for the entire Bering Sea.

Other options with comprehensive observer coverage:

- Option 1: Observed bycatch for a fishery operation would be compared to its allowable bycatch estimated from applying bycatch coefficients against the species composition of its weekly groundfish harvest. Those operations having a smaller observed bycatch will have the savings "credited" to their operation. When estimated bycatch reaches the amount of PSC apportioned to a fishery in that area, the fishery would be closed except to those operations with bycatch "credit." These operations may continue fishing with observers until their bycatch "credit" has been taken.

- Option 2: When a fishery's estimated bycatch reaches 25, 50, and 75 percent of an established PSC limit, a fishery operation's observed bycatch would be compared to its estimated (i.e., allowable) bycatch as calculated by applying bycatch coefficients against the operations groundfish catch composition. If these "checkpoint" comparisons show an operation exceeded its allowable bycatch, the operation must cease fishing in the area for the remainder of the year. During any two weeks, an operation's observed weekly bycatch could be 150 to 200 percent of the allowable bycatch. If an operation's observed bycatch is at this level for a third week or during any one week exceeds 200 percent of the allowable bycatch, it would be excluded from the fishing area for the remainder of the year. Only those operations that have passed a previous checkpoint may continue fishing once 75 percent of the PSC has been reached. If an operation's observed bycatch exceeds the allowable bycatch during this period, that operation would be prohibited from fishing the following year until 25 percent of the PSC cap has been taken.

PSC Management in the Bering Sea

- NOAA, Fisheries Discussion Paper -

INTRODUCTION

At its January 1989 meeting, the Council requested that NOAA Fisheries develop a comprehensive bycatch management proposal for the Bering sea trawl fisheries and to present it to the Council at its June meeting for implementation in 1990 and beyond. The purpose of this paper is to respond to the Council's request and present to the Council some options for prohibited species bycatch management. These options are intended to provide some guidance for Council direction to its Bering Sea Plan Team in developing an amendment to augment the bycatch management scheme envisioned under Amendment 12a.

Adoption of a new prohibited species management plan for 1990 would require final Council action by the December meeting and even then, emergency action would be required to implement the plan earlier than June 1990. Adherence to this schedule would require that the Council direct its Plan Team to prepare an amendment package for consideration by the Council at its September meeting so that the amendment may be sent out for public review. The Council may wish to consider whether this schedule is realistic in light of other priorities and staff workloads.

The following discussion describes options for bycatch management of red king crab, C. bairdi Tanner crab, and Pacific halibut in the Bering Sea and Aleutians Islands area groundfish fisheries. A comprehensive, fishery-wide observer program, together with adequate recordkeeping and reporting of catch and discards, is essential for an equitable, effective bycatch management scheme. Although some level of observer coverage is likely for 1990, the actual extent of coverage is unknown. Thus options are presented both with and without the assumption of comprehensive observer coverage.

The assumed goals for bycatch management are to (1) assure that the bycatch of crabs and halibut do not cause biological harm to those resources, (2) provide for the harvest of the allowable catch of groundfish, and (3) minimize the wasteful bycatch of crab and halibut species.

BYCATCH MANAGEMENT

Without a comprehensive observer program, NMFS must rely on empirical methods to estimate bycatch. Methods have been developed for estimation of halibut and C. bairdi bycatch using observed rates in the 1986-1988 joint venture groundfish fisheries, but no method has been developed for accurately predicting red king crab bycatch (Appendix 1). When estimated bycatch levels for C. bairdi and halibut reach established PSC limits, area closures would be triggered to limit further take of these species. This method is not based on knowledge of the actual catch of prohibited species and thus does not allow management of these catches to any specific level.

Once comprehensive observer coverage is available for a particular fishery or area, actual bycatch amounts or rates can be monitored for fishery operations that would trigger area closures to those operations when established limits are reached. Bycatch management schemes with comprehensive observer coverage can monitor individual fishery operations and provide an incentive to reduce bycatch rates, i.e., those operations with reduced rates would be allowed to continue fishing in an area closed to other operations.

Red King Crab:

Since no method now exists to accurately estimate red king crab bycatch from catches of target species, any bottom trawl effort in much of the area now known as Zone 1 will have an unpredictable impact on red king crab. Therefore, it is proposed that a basic element of the red king crab management scheme is a closure to trawling of a portion of Zone 1. The size of this closure would be dependent on the proportion of the red king crab stock the Council wished to give absolute protection. Further modification of this closure could be made if mandatory observer coverage was instituted to ensure king crab bycatch was regulated. Figure 1 shows one example of a bottom trawl area closure in Zone 1 that, based on 1988 NMFS crab survey results, would protect 69 percent of the total red king crab stock and about 68 and 85 percent of the mature males and females, respectively. During 1988-1987, between 74 and 90 percent of the commercial red king crab harvest also came from this area. Although current information indicates this area closure would protect a significant portion of the red king crab stock, future surveys of crab stocks may indicate that the closure should be shifted to the west or east to reflect fluctuations in stock movements. Thus, any closure designed to protect king crab stocks should be allowed to shift, based on the most recent stock assessment surveys, so that the desired level of crab protection may be maintained.

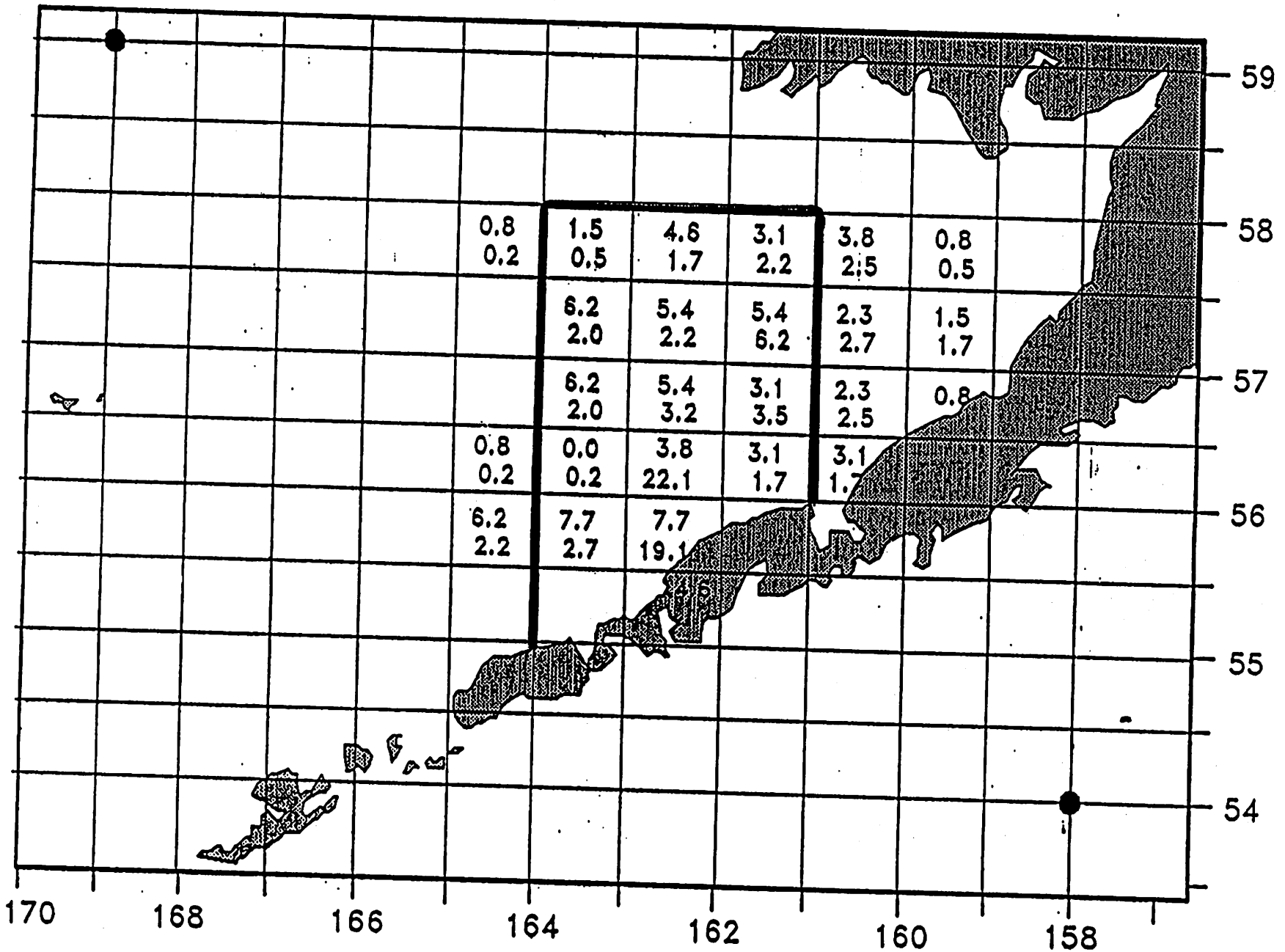

Figure 1. Example bottom trawl closure for red king crab protection based on 1988 NMFS crab survey. Numbers show percent (in numbers) of total stock by 1 x ½ degree blocks. Top numbers are percent of total mature male stock, bottom numbers are percent of total red king crab stock.

The following allowances for trawl gear could be made in Zone 1 provided that trawl operations have 100 percent observer coverage:

- Midwater trawl fisheries could be allowed to operate year-round throughout Zone 1. Observers would monitor these vessels, which must operate with the objective of a "zero" crab bycatch. Zone 1 would be closed to a vessel when observer data show an unacceptable bycatch of red king crab, indicating the vessel's trawl gear was fished on the sea bottom.

- The Port Moller Pacific cod fishery could be allowed within a straight line approximating the 25 fathom depth contour throughout Zone 1 provided that the fishery meets the bycatch rate provisions discussed below for other bottom trawl operations.

- Other bottom trawl operations could be allowed to operate in Zone 1 outside of closed areas where relatively high concentrations of red king crab exist. When an operation's observed weekly bycatch rate exceeds a fixed rate by 100 percent for any two weeks, Zone 1 would be closed to the operation for the remainder of the year. A bycatch rate rather than a PSC limit is advocated as an incentive to bottom trawl vessels to reduce red king crab bycatch rates to a more desirable level. This recommendation is made on the assumption that the bottom trawl area closure would already provide sufficient protection to most of the red king crab stock. The 1986-1989 joint venture observer data show the average red king crab bycatch rate in Zone 1 by all JV bottom trawl operations to be about 0.7 red king crab/mt groundfish. In 1989, the average bycatch rate was 0.96 red king crab/mt groundfish.

- Alternatively, with 100 percent observer coverage, a PSC limit for Zone 1 could be imposed on trawl fisheries outside of the closed areas. Once observer information indicates that the PSC limit has been reached, Zone 1 would be closed to further bottom trawl fishing.

A king crab closure area would force groundfish operations to relocate to other areas and additional operational costs due to seasonal modification of fishing patterns may be incurred by these operations as a result. Industry comment on this proposed amendment would give the Council information on the nature and magnitude of any such costs. The above allowances for the trawl fisheries, together with those currently provided for the Port Moller Pacific cod fishery should provide opportunity for the harvest of TAC in the Bering Sea area.

The potential importance of the example red king crab closure depicted in Figure 1 to selected target fisheries is shown in Table 1. The 1986-88 joint venture data indicate that 9 percent of the total JV harvest came from the closed area shown in Figure 1. When just the JV bottom trawl fisheries are considered, the area accounted for 19 percent of the total catch. If these fisheries were prohibited in the closed area, they would have to relocate to other productive fishing grounds outside the closed area to harvest their yellowfin sole and other flatfish allocations, although some seasonal adjustment in fishing pattern would probably be required. The JV flounder fishery demonstrated that this was possible when, in 1987 and 1988, all of Zone 1 was closed to directed fishing for yellowfin sole and other flatfish for bycatch control purposes on April 25 and March 8, respectively. The JV flounder fisheries relocated to areas north of Zone 1 and continued fishing until their allocation levels were reached.

Table 1. Potential displacement of groundfish operations as a result of the red king crab protection area shown in Figure 1 (based on 1986-88 JV observer data).

	Total 1986-88 JV groundfish harvest in closed area (mt)	Percent of total JV harvest in BSAI
Target Fishery:		
Midwater pollock	25,625	2.54
Atka mackerel	0	
Yellowfin sole/other flounder	98,690	24.73
Rock sole	3,601	34.22
Pollock bottom trawl	22,600	0.18
Other bottom trawl	21,500	0.08
*All bottom trawl fisheries	146,391	19.14
Total JV groundfish harvest	172,016	9.39

* Excludes midwater pollock

C. bairdi Tanner crab and Pacific halibut:

Without observers, a vessel's bycatch amount of C. bairdi and halibut can be estimated by applying existing bycatch estimators (Appendix 1) against the reported catch composition of groundfish harvests. When the estimated bycatch for these species reaches the PSC limits established by the Council, area closures would be triggered to reduce further take of halibut and C.bairdi in the groundfish fisheries.

NMFS recommends that the Council consider developing PSC limits based upon a fixed percentage of stock abundance, as determined during annual stock surveys, so that allowable bycatch amounts may change annually to reflect stock condition. These limits would be apportioned to the DAP and JVP flatfish fisheries and "other fisheries" based on those fisheries' proportion of the total TAC projected to be taken by bottom trawl gear. The most limiting PSC amount would determine when an area is closed to a fishery, regardless of PSC amounts that may remain for other bycatch species.

Unlike red king crab, C.bairdi are widely distributed throughout the Bering Sea shelf area, although several areas of the shelf can be identified as having greater concentrations of C.bairdi. Figure 2 shows two areas that have sufficient amounts of C. bairdi to warrant area closures for bottom trawl vessels when separate PSC limits established for these areas are reached. Based on 1988 crab survey data, 65 percent of the mature males and 37 percent of the total C. bairdi stock are distributed in Zone 1. A modified "Zone 2" contains 28 and 47 percent of the mature males and total stock, respectively. Closure of these two areas would protect 93 percent of the mature males and 84 percent of the total C. bairdi stock. The Council may consider closing a smaller portion of "Zone 2" around the Pribilof Islands (Figure 2) when estimated bycatch levels reach 50 percent of the PSC limit for "Zone 2." The Pribilof Island area contains a high density of C. bairdi (over 20 percent of the stock) and its closure to bottom trawling could sufficiently reduce total bycatch so that closure of all of Zone 2 becomes unnecessary, or at least delayed.

Closure of Zones 1 and 2 to bottom trawling would result in the relocation of the trawl fleet to northern slope areas of the Bering Sea. Concentrated trawl effort in this area could result in increased bycatch of C. opilio Tanner crab. Recent crab surveys indicate these stocks are in high relative abundance and increasing. Although the Council has not previously adopted specific bycatch measures for this species, an increased bycatch by the groundfish fleet could probably be tolerated by the stock. The likelihood of relocation of bottom trawl effort to more

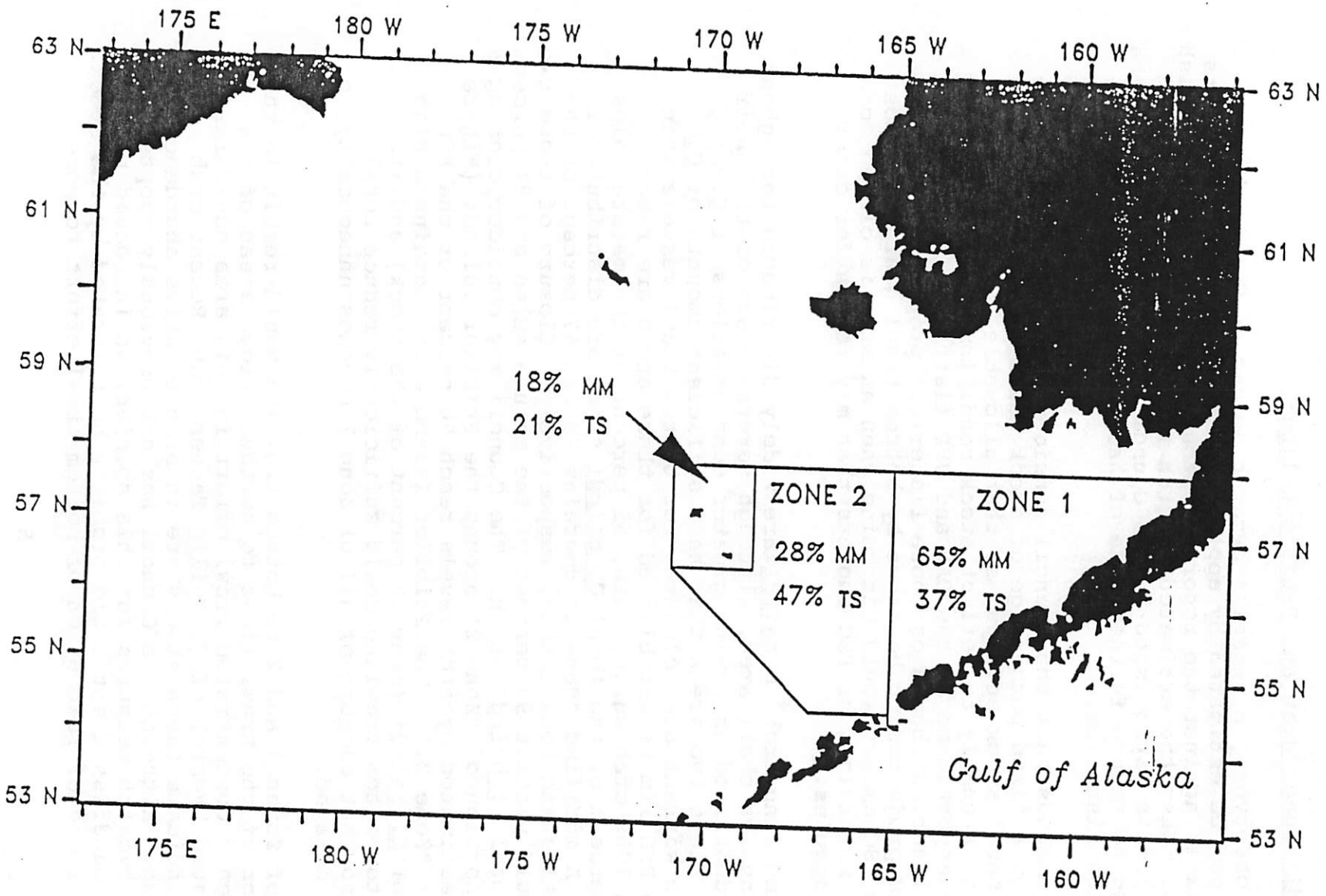

Figure 2. Example closures for C. bairdi based on 1988 crab survey. Numbers show % of mature males (MM) and total stock (TS) in each area.

northern fishing grounds and ensuing increase in C. opilio bycatch could be reduced with the two-stage closure of Zone 2 described above.

Unlike C. bairdi and red king crab, halibut bycatch rates do not appear to vary significantly with area. Once the halibut PSC limit is estimated to have been taken, therefore, area closures short of the entire Bering Sea will not provide a practical means to limit subsequent halibut bycatch. The Council could choose to close the entire Bering Sea in a two stage process as envisioned under Amendment 12a, although this action would not provide an incentive to reduce bycatch rates and limit halibut bycatch in areas that remain open.

Additional bycatch management options for C. bairdi and halibut with comprehensive observer coverage:

NMFS believes that all future bycatch management schemes should include at least some level of observer coverage to manage halibut and crab bycatch in the groundfish trawl and longline fisheries. The red king crab bycatch management scheme discussed above would provide observer information on C. bairdi and halibut bycatch in the Zone 1 trawl fisheries. A comprehensive observer program outside of Zone 1 is necessary if adequate incentive programs are to be implemented that would encourage individual groundfish operations to develop methods to reduce bycatch. Such incentive programs would monitor individual fishing operations and allow "clean" operations to continue fishing in an area closed to other operations. Programs of this type should limit the necessity of closing all or parts of the entire Bering Sea to groundfish operations.

-Option 1 (PSC "credit" option): Observed bycatch for a fishery operation would be compared to its estimated bycatch as derived from the updated estimators applied to species composition of its weekly groundfish harvest. Those operations having a smaller observed bycatch will have the savings "credited" to their operation. -When estimated bycatch reaches the amount of PSC apportioned to a fishery in that area, the fishery would be closed except to those operations with bycatch "credit." These operations may continue fishing with observers until their bycatch "credit" has been taken.

When practicable, a fishery operation would be defined as the level where first sorting of catch occurs, although several operations (e.g. catcher/processor vessels) under the same company may be identified as a single operation. Bycatch credits stay with the operation during the fishing season, although catcher vessels delivering to an operation would be free to go from one operation to another during the fishing season.

This option provides an incentive both to take observers and to fish cleanly throughout the fishing season. If observer coverage of fishery operations is less than 100 percent, it may be necessary to close a fishery when estimated bycatch levels reach a certain percentage of the established PSC limit for an area. This precaution would be taken to provide a bycatch allowance for those operations without observers that may have taken more bycatch than predicted. The allowance could change with the level of observer coverage, but without 100 percent observer coverage, NMFS recommends that an area be closed when estimated bycatch equals 90 percent of the established PSC limit for that area.

-Option 2 (PSC "checkpoint" option): This option would require 100 percent observer coverage of individual fishing operations. Observers would monitor bycatch amounts for individual fishery operations and would report those amounts on a weekly basis. Bycatch checkpoints would be established at 25, 50, and 75 percent levels of established PSC limits. When 25 and 50 percent of the PSC limits established for C. bairdi and halibut are reached, the fishery operations' observed bycatch up to that point would be compared against estimated bycatch based on species composition of groundfish harvests. If these comparisons show that an operation exceeded the estimated bycatch, the operation must cease fishing in the area for the remainder of the year.

During any two weeks, an operation's observed weekly bycatch could be 150 - 200 percent of the estimated bycatch. If an operation's weekly observed bycatch is at this level for a third week, or during any one week exceeded 200 percent of the estimated bycatch, it would be excluded from the fishing area for the remainder of the year. This could be implemented in combination with the checkpoints in paragraph one, or could form the basis for an independent management regime.

When 75 percent of a species' PSC limit for an area is reached, no new operation may commence in the area and only those operations that have successfully completed one or more previous checkpoints and have not been excluded from the area would be allowed to continue fishing until the PSC limit is reached. Any operation with an observed bycatch greater than its estimated bycatch during this period, would be prohibited from fishing in the area the following fishing year until after the first 25 percent of the PSC cap has been taken. This measure is intended to encourage vessels to maintain "clean" operations through the end of the year.

APPENDIX 1

The Use of Groundfish Catches to Estimate Bycatch

Suppose a group of boats fish, with the same target species, in the same subarea for a given week. Let y represent the total bycatch of a given species for the boats and x_1, x_2, x_3, and x_4 represent, respectively, the total pollock, pacific cod, yellowfin sole, and other flatfish catches. The goal is to use x_1, x_2 x_3, and x_4 to estimate y. We consider here an estimator of the form $b_1x_1+b_2x_2+b_3x_3+b_4x_4$. The determination of values for the coefficients b_1, b_2, b_3, and b_4 will be discussed later.

Consider the following 8 models:

M_1: the values of the b_i's depend upon the year, the subarea, and the quarter in which the x_i's are observed.

M_2: the values of the b_i's depend upon the year and the quarter in which x_i's are observed, but not on the subarea.

M_3: the values of the b_i's depend upon the year and the subarea in which the x_i's are observed, but not on the quarter.

M_4: the values of the b_i's depend upon the year in which the x_i's are observed, but not the quarter and subarea.

M_5: the values of the b_i's depend upon the subarea and the quarter in which the x_i's are observed, but not the year.

M_6: the values of the b_i's depend upon the quarter in which the x_i's are observed, but not the year and subarea.

M_7: the values of the b_i's depend upon the subarea in which the x_i's are observed, but not the year and the quarter.

M_8: the values of the b_i's depend upon neither the year nor the subarea nor the quarter in which the x_i's are observed.

If $(y_i,x_{1i},x_{2i},x_{3i},x_{4i})$ represents the i-th of n observations of the vector (y,x_1,x_2,x_3,x_4), for i=1,...,n, the n vectorial observations $(y_1,x_{11},x_{21},x_{31},x_{41})$, ...,$(y_n,x_{1n},x_{2n},x_{3n},x_{4n})$ may be used to select an appropriate model from among those just listed.

For a given model and a given observed prohibited species catch, y_j, we can calculate a "predicted" value for y_j as follows:

a. delete the vectorial observation $(y_j,x_{1j},x_{2j},x_{3j},x_{4j})$ from the data

b. use the remaining n-1 vectorial observations to estimate values for the parameters in the model

c. apply the model, with parameters replaced by their estimates, to $(x_{1j}, x_{2j}, x_{3j}, x_{4j})$ to get a predicted value for y_j.

A "predicted" value for each of $y_1, y_2, \ldots, y_n$ is obtained in this manner for each model being considered. Let $\hat{y}_{1M_h}, \ldots, \hat{y}_{nM_h}$ represent the predicted values of $y_1, \ldots, y_n$ for model M_h, h=1,...,8. Set

$$PRESAV(M_h) = \sum_{i=1}^{n} |y_i - \hat{y}_{iM_h}| ,$$

for h=1,...,8. To select an appropriate model, we examine the predition sum of absolute values (PRESAV) for the various models and look for those models which produce small PRESAV's.

The following values for prediction sum of absolute values were found when 1987 and 1988 JVP observer obtained weekly summary data were used:

	Prohibited Species		
Model	Halibut	Bairdi	Red King Crab
M_1	2785873	883891	243265
M_2	2051550	773516	284550
M_3	1982720	726718	228474
M_4	2207621	809114	273780
M_5	2076229	752599	169257
M_6	1929829	817961	263936
M_7	2195205	769056	210867
M_8	2089256	889060	255506

Thus these data indicate that reasonable models appear to be M_6 for halibut and M_5 for bairdi and red king crab.

The procedure for using a set of vectorial observations $(y_1, x_{11}, x_{21}, x_{31}, x_{41}), \ldots, (y_n, x_{1n}, x_{2n}, x_{3n}, x_{4n})$ to get estimates for b_1, b_2, b_3, and b_4 is an application of a technique developed by R. F. Kappenman ("Robust symmetric distribution location estimation and regression", Journal of Statistical Planning & Inference, 19(1988),55-72). We also use the constraint that $\Sigma y_i = \Sigma (b_1 x_{1i} + b_2 x_{2i} + b_3 x_{3i} + b_4 x_{4i})$. That is, estimates of b_2, b_3, and b_4 are the values of these constants which minimize

$$\Sigma v_i (z_i - b_2 w_{1i} - b_3 w_{2i} - b_4 w_{3i})^2$$

where

$$z_i = y_i - \frac{\Sigma y_i}{\Sigma x_{1i}} x_{1i}, \quad w_{1i} = x_{2i} - \frac{\Sigma x_{2i}}{\Sigma x_{1i}} x_{1i}, \quad w_{2i} = x_{3i} - \frac{\Sigma x_{3i}}{\Sigma x_{1i}} x_{1i},$$

$$w_{3i} = x_{4i} - \frac{\Sigma x_{4i}}{\Sigma x_{1i}} x_{1i}, \qquad v_i = \frac{1}{1 + \left(\frac{z_i - b_{20}w_{1i} - b_{30}w_{2i} - b_{40}w_{3i}}{d}\right)^2}$$

and $d = \text{median}\{|z_i - b_{20}w_{1i} - b_{30}w_{2i} - b_{40}w_{3i}|\}$. Here b_{20}, b_{30}, and b_{40} are the least absolute values estimates of b_2, b_3, and b_4. Once estimates of b_2, b_3, and b_4 are obtained, the equation

$$b_1 = \frac{\Sigma y_i - b_2\Sigma x_{2i} - b_3\Sigma x_{3i} - b_4\Sigma x_{4i}}{\Sigma x_{1i}}$$

is used to get an estimate of b_1.

The 1986, 1987, and 1988 JVP weekly summary data were used to get estimates of the parameters b_1, b_2, b_3, and b_4. These are, for halibut:

Quarter	b_1	b_2	b_3	b_4
1	1.1007	11.2288	0.9586	0.6760
2	2.3226	19.3926	0.4108	6.3910
3	3.1192	8.1258	4.6134	0
4	2.2913	24.4234	7.2488	0

For bairdi they are:

Quarter	b_1	b_2	b_3	b_4
1	0	2.3951	0.9307	1.2952
2	0	9.1384	0	1.5194
3	0.5658	0	0	2.3976
4	0.7548	0	1.6668	5.8105

These estimates and the 1989 JVP groundfish catches were then used to "estimate" observed 1989 JVP prohibited species catches corresponding to the groundfish catches. The actual total halibut bycatch was 508862 and the estimate of this total was 489578. The actual total bairdi bycatch was 208225 and the estimate of this total was 199107.

AGENDA D-3(a)
JUNE 1989
SUPPLEMENTAL

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INTERNATIONAL PACIFIC HALIBUT COMMISSION

ESTABLISHED BY A CONVENTION BETWEEN CANADA
AND THE UNITED STATES OF AMERICA

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June 12, 1989

To: Distribution

From: Donald A. McCaughran

Subj: IPHC proposal for Bering Sea halibut bycatch management

The IPHC Staff has concluded that the bycatch management for Pacific halibut in Amendment 12A to the Bering Sea-Aleutian Islands Groundfish Management Plan should not be adopted on a permanent basis. The concept needs to be modified to account for the possible limited observer coverage and the Olympic style DAP fishery. The present system could result in either a loss of groundfish production or unnecessarily high halibut bycatch.

The following report is our proposal for long term halibut bycatch management in the Bering Sea-Aleutian Islands. Our primary objective is to develop a process that would provide the maximum amount of groundfish harvest with the minimum disruption to the industry, while staying within a PSC limit set by the North Pacific Fishery Management Council. We believe that the concepts in this proposal will benefit both the groundfish and halibut longline industries, and will be compatible with bycatch management that may be developed for red king crab and Tanner crab. By distributing the report before the June Council meeting, we hope that our recommendations and supporting information will help the Council and its industry work groups come to a consensus position for halibut bycatch management to replace the plan in Amendment 12A. Bob Trumble will be available at the June Council meeting for discussion of this proposal. We request comments that will help us improve our proposal.

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RECOMMENDATIONS FROM THE INTERNATIONAL PACIFIC HALIBUT COMMISSION FOR LONG TERM MANAGEMENT OF PACIFIC HALIBUT BYCATCH IN THE BERING SEA

Robert J. Trumble and Stephen H. Hoag

June 1989

The International Pacific Halibut Commission manages the Pacific halibut resource as a single stock, because egg and larval drift and counter migration by juvenile fish apparently cause homogeneity in the resource that prevents development of separate populations. Unit management of the Pacific halibut justifies a single prohibited species catch (PSC) limit for the Gulf of Alaska and Bering Sea-Aleutian Islands (BSAI). In this way, effects of bycatch on the directed Pacific halibut fishery may be considered in a consistent way. Even so, the different natures of groundfish fishing in the Gulf of Alaska and BSAI will require some different bycatch management procedures.

The immediate Pacific halibut bycatch problem for Alaska waters is the temporary nature of Amendment 12A to the BSAI Groundfish Fishery Management Plan, which is due to expire no later than the end of 1990. A plan to replace 12A is due for discussion at the June, 1989 North Pacific Fishery Management Council meeting. This document is background for the IPHC Staff position on measures to control halibut bycatch. It contains justification for selecting a single Pacific halibut PSC value for Alaska waters, and management measures for controlling Pacific halibut bycatch in the BSAI. These bycatch management concepts are also appropriate for the Gulf of Alaska.

Pacific Halibut PSC Limit

Halibut are managed as a single population throughout their range, although catch is apportioned to management areas according to distribution of exploitable biomass. Bycatch in the BSAI affects directed halibut fishing in the Gulf of Alaska and areas to the south more than in the Bering Sea because of migration of juveniles out of the Bering Sea. We strongly recommend that future bycatch management be constructed for all Alaskan waters as a unit so that the bycatch impacts can be treated consistently.

Recent coast-wide halibut bycatch mortality has ranged from about 4,200 mt (round weight) in 1986 to a projected 8,300 mt in 1989 if the 5333 mt BSAI PSC limit experiences 100% mortality[1]. This bycatch range reduces the directed halibut harvest by roughly 6,600 mt to 13,200 mt. A portion of the reduction is applied to the Bering Sea, Gulf of Alaska, British Columbia, Washington, Oregon, and California waters. These bycatch values have a major effect on the directed

[1]The industry agreement that recommended 5333 mt of halibut bycatch was based on an assumed discard mortality rate of 75%, leading to a target mortality of 4000 mt. However, no scientific data have been presented in support of a 75% mortality rate. The IPHC and the BSAI Groundfish Team use estimates of 100% mortality based on characteristics of the DAP trawl fishery in the BSAI. These characteristics include large catches, sorting below decks, slow sorting, and long time on deck before discard.

halibut fishery.

We have recommended in previous correspondence that halibut bycatch mortality remain at status quo levels until objective criteria are developed to justify an increase or decrease. For the five years of 1983 to 1987, total halibut bycatch mortality in Alaskan waters has averaged about 4,700 mt, and averaged about 6,000 mt for the 10 years period 1978 to 1987. Of this mortality, the Bering Sea has accounted for 2,800 and 3,200 mt for the five and 10 year averages, respectively. Bycatch estimates for 1988 were not included because the high proportion of unobserved DAP bycatch makes estimates less certain. However, it appears that bycatch is approximately the same in 1988 as in 1987. Groundfish harvest and estimated halibut bycatch are presented in Table 1.

We believe that 6,000 mt of halibut bycatch mortality for Alaskan waters is too high, and that in no case should the Alaskan halibut bycatch mortality upper limit be higher than 6,000 mt. The halibut resource rebuilt and the directed fishery grew at this level of bycatch. The TALFF and JVP fisheries harvested their apportionments with bycatch significantly below 6,000 mt, a level that provides adequate bycatch for the domestic groundfish fisheries. Bycatch in the Gulf of Alaska and the Bering Sea is linked in its effect on the directed halibut fishery. Increases in one area should be balanced by reductions in the other, not to exceed whatever total bycatch cap the Council may set.

Bycatch Management Measures

Background. A report (attached) by Dr. William Clark, IPHC Biometrician, concludes that species composition is an important predictor of bycatch, and suggests that area-time restrictions are of limited value. Although further analysis may identify areas and times for which restrictions may be appropriate, the present analysis suggests that other options may be more useful in reducing bycatch. A model to predict bycatch from species composition of pollock, Pacific cod, yellowfin sole, and other flatfish (based on 1986-1988 JVP bycatch data) has been developed by a working group of NMFS and IPHC (report in preparation). The model determines coefficients to convert quantity of harvest by species into estimates of bycatch, and and converts groundfish catch (mt) into Pacific halibut bycatch (kg) according to the following formula:

Halibut = 2.9058*pollock + 11.0030*P.cod + 0.6456*YFS + 6.9681*other flat.

The model appears to be appropriate for both the JVP and DAP fisheries,although incomplete information on DAP discard of unutilized groundfish will detract from accuracy of the model results.

Applying species-specific coefficients from this model to 1989 TAC values set by the Council provides the following estimate of Pacific halibut bycatch (mt), using an extreme assumption that all groundfish will be harvested by bottom trawl:

Species	1989 TAC	Bycatch
Pollock	1,340,000	3,894
P. cod	230,681	2,538
YFS	182,675	118
Other flats	165,945	1,156
Total	1,919,301	7,706

The 1988 PacFIN data show that virtually the entire TAC was harvested, and that longline harvest was minimal:

Species	Trawl (mt)	Longline (mt)	Total (mt)
Pollock	1,359,955	93	1,360,048
P.cod	194,994	2,569	197,563
Other	416,921	6,345	423,266
Total	1,971,870	9,007	1,980,877

Two species are of special concern: 1) pollock because the large harvest volume by bottom trawling causes high bycatch in spite of moderate bycatch rates; and 2) Pacific cod because the high bycatch rates cause high bycatch in spite of moderate harvest volume. A large reduction of Pacific halibut bycatch would accrue from harvesting pollock by midwater trawl rather than bottom trawl. The following schedule demonstrates Pacific halibut bycatch reductions as pollock harvest shifts from 100% bottom trawl to midwater trawl:

% midwater	midwater harvest (mt)	bycatch reduction (mt)
10	140,000	407
25	350,000	1017
50	700,000	2034

A similar schedule shows Pacific halibut bycatch reduction from a TAC reduction in Pacific cod, or reduction in Pacific cod bycatch rates of Pacific halibut.

% Reduction	New TAC	New Bycatch	Bycatch Reduction
10	210,000	2310	220
25	170,000	1870	660
50	120,000	1320	1210

The IPHC staff has developed recommendations for controlling Pacific halibut bycatch that are designed to provide the maximum amount of groundfish for harvest, and the least disruption to normal operations, while staying within a halibut PSC limit set by the Council. The basic premise is to provide incentives for reduced bycatch rates, and rewards of increased harvest for operations that reduce bycatch. Rewards may take the form of additional fishing time within a fishery/gear PSC allocation, or shift from one fishery/gear to another that can demonstrate lower bycatch and mortality rates.

Recommendations.

1. Subdivide the BSAI pollock TAC so that a minimum of 50% will be harvested by midwater trawl. A fishery early in the year when pollock are schooled for spawning will encourage midwater trawling, and a requirement that the species composition be > 95% pollock will assure off bottom trawling. Pacific halibut bycatch will be reduced by about 2,000 mt by this action alone.

2. Provide "bycatch credit" and additional fishing time for operations that demonstrate low bycatch rates. Manage the BSAI bottom trawl fisheries for a halibut PSC limit set by the Council, allocated from the total Alaska PSC limit. Close the fishery when the model predicts the PSC limit is reached. If voluntary observers demonstrate that bycatch rates are less than average, those operations that take the observers may continue to fish until the Pacific halibut savings are accounted for. For example, an operation that fished at an observed rate such that 100 mt less halibut were caught than predicted by the species composition, could fish for an additional 100 mt of observed halibut bycatch. This provides an incentive both to take observers and to fish cleanly. To prevent exceeding the PSC limit, closing the groundfish fisheries before actually reaching the PSC limit (perhaps at 90% of the limit) is necessary. The operations without observers presumably fish at higher bycatch rates (take more bycatch than predicted) than operations that take observers, and raising the amount of bycatch in the observed group will increase the bycatch above the PSC limit. Redesigned bottom trawls can be made to reduce bycatch rates.

3. Manage fixed gear to minimize bycatch and discard mortality rates. If these rates produce less bycatch mortality than do bottom trawl rates, then shift TAC from bottom trawl in a manner consistent with Council allocation policies. For example, require longline fisheries for groundfish to use light gangions and

light hooks to reduce the bycatch rates of Pacific halibut. Similarly, groundfish pots equipped with Pacific halibut exclusion devices appear to fish with low bycatch rates. These fixed gear fisheries are minimal at present, but have potential for growth, especially for Pacific cod. A policy rewarding lowest bycatch mortality would encourage pot and longline fisheries to develop if they can demonstrate low bycatches, and would provide incentive for the trawl industry to fish at cleaner rates or with less discard mortality to prevent reallocation of TAC.

4. Additional restrictions may be necessary under two foreseeable conditions: 1) if the predictive model for estimating bottom trawl bycatch is determined to be inappropriate for regulatory closures, or 2) if the primary proposals do not reduce bycatch sufficiently to prevent closure of groundfish fisheries. We view the following measures as the best opportunity for reducing bycatch, but with increasingly severe restrictions:

a. Evaluate the species composition of target fisheries, use the predictive model to rank bycatch, and require mandatory observers for the fisheries with the highest bycatch. Fishermen would have the option of not taking observer by participating in low bycatch-rate fisheries.

b. Require mandatory observers for the first six months of the year. Fishermen would have the option of not taking observers by fishing in the second half of the year.

c. Require a minimum of 75% of the pollock fishery to occur with midwater trawl. This would probably make the directed pollock fishery midwater trawl, with the remaining 25% reserved as bycatch in other fisheries, but would reduce Pacific halibut bycatch by a substantial amount.

d. For the bottom trawl pollock and Pacific cod fisheries, require bottom trawl gear that has been demonstrated to reduce Pacific halibut bycatch rates. This requirement may cause a short term reduction of pollock and Pacific cod harvested because of time needed to develop and test the modified trawl.

e. Require that groundfish harvest by bottom trawl be sorted on deck, with Pacific halibut discarded over the side in 30 minutes or less. This would reduce bycatch mortality by about 50%.

f. Reduce TAC of species with high bycatch mortality to keep mortality within limits set by the Council.

Summary

The IPHC Staff has recommended a 6,000 mt upper limit for the Pacific halibut PSC limit in Alaska waters, to be apportioned between the BSAI and the Gulf of Alaska. Time-area closures do not seem to provide sufficient control of bycatch, so bycatch management measures evaluated by the staff emphasize direct accounting. Without a comprehensive, mandatory DAP observer program, we recommend accounting for Pacific halibut bycatch in the groundfish bottom trawl fisheries with the predictive model developed by NMFS and IPHC Staff.

Our proposal strives to maximize groundfish harvest and minimize disruptions to the fishery for a given level of PSC set by the Council. We propose requiring that at least 50% of the pollock harvest occur with midwater trawl, that the bottom trawl fishery close when the model predicts that the PSC limit has been reached, and that bottom trawl operations with voluntary observers that demonstrate that bycatch rates are lower than predicted be allowed to continue fishing after the closure until the bycatch savings are used. Groundfish longline fisheries would be required to use light gangions and hooks, and pots would need halibut exclusion devises. Several additional measures were identified in case the predictive model is not used for closing the groundfish fisheries, or if additional halibut bycatch reductions are necessary. The additional measures will reduce bycatch, but we consider them to be less desirable because of difficulty in implementation or increased costs relative to our primary proposal.

Table 1. Groundfish catch and Pacific halibut bycatch mortality in the Gulf of Alaska and Bering Sea/Aleutian Island regions, 1978-1988. Data for 1988 are preliminary.

Year	Gulf of Ak. Groundfish Catch (mt)	Gulf Bycatch Mort. (mt)	BS/AI Groundfish Catch (mt)	BS/AI Bycatch Mort. (mt)	Total Groundfish Catch (mt)	Total Bycatch Mort. (mt)
1978	171,000	3,180	1,386,000	3,029	1,557,000	6,209
1979	173,000	4,545	1,289,000	3,269	1,462,000	7,814
1980	215,000	4,595	1,334,000	5,570	1,549,000	10,166
1981	255,000	4,095	1,366,000	3,865	1,621,000	7,960
1982	236,000	3,784	1,322,000	2,869	1,558,000	6,653
1983	299,000	3,134	1,383,000	2,575	1,682,000	5,709
1984	357,000	2,382	1,609,000	2,830	1,966,000	5,211
1985	329,000	1,133	1,766,000	2,538	2,095,000	3,671
1986	142,000	934	1,742,000	2,697	1,884,000	3,632
1987	142,000	2,061	1,708,000	3,168	1,850,000	5,230
1988	121,000	1,597	1,586,000	3,355	1,707,000	4,953
AVG 83-87		1,929		2,762		4,690
AVG 78-87		2,984		3,241		6,225

Regional and Seasonal Differences in Halibut Bycatch Rates in Joint Venture Bottom Trawl Fisheries in the Bering Sea

Bill Clark, IPHC
April 1989

Summary

Analysis of observer data on joint venture bottom trawling in the Bering Sea shows that the best single predictor of the halibut bycatch rate (defined as kg halibut/mt groundfish) is the proportion of cod in the groundfish catch. Once the cod effect is removed, little of the remaining variation in the data can be explained by differences in fishery type, area, or season. However, while not large there are some significant differences among areas and seasons, specifically higher than average rates in the fourth quarter and lower than average rates in the first quarter and in the western Aleutians. Because the differences in rates are mostly small, the potential effects of time-area closures on total halibut bycatch are fairly modest. Other measures, such as requiring off-bottom gear for catching roundfish, may be needed to limit bycatch to an acceptable level.

Introduction

Through 1988 the bycatch of halibut and crabs in the Bering Sea trawl fisheries was controlled by area limits on the total bycatch, called Prohibited Species Caps or PSC's. When this limit was reached for any prohibited species, that area of the the Bering Sea was closed to bottom trawling. For 1989 and beyond, alternative methods of controlling bycatch are under consideration, including a system of time-area closures that would allow the trawl fishery to take its groundfish quotas in times and places where bycatch rates are acceptably low. The aim of this study is to investigate the determinants of halibut bycatch rates, and in particular to identify time-area strata with very low and very high bycatch rates.

Basic Data

The largest data set available for investigating recent halibut bycatch rates is the 1986-88 joint venture observer data, assembled by NMFS. The data are aggregated into cells defined by week, area, and fishery type. The various fishery types are defined by gear and target species, namely: Atka mackerel, pollock bottom trawl, other roundfish bottom trawl, pollock midwater trawl, yellowfin sole bottom trawl, and other flatfish bottom trawl. For each cell the data file includes the catch of the various groundfish species as well as the bycatches of halibut, crabs, and salmon.

Bycatch *mortality* is something less than the bycatch amounts given in the data file, all prohibited species are returned to the sea and some proportion survives. It should

be understood that references to "bycatch" in this study refer to total bycatch *amounts* rather than bycatch mortality.

All of the pollock midwater trawl data were excluded from this study because the halibut bycatch rates in that fishery were very low: .07 kg halibut/metric ton of groundfish, compared with 1-10 kg/mt in the bottom trawl fisheries. Also excluded were all cells containing less than 50 mt of groundfish, so that the observed bycatch rates would not include wild values based on small catches. After the exclusions there were 638 cells in the data set.

Although there are some sparse patches and some gaps, the data are widely distributed among fisheries, areas, and seasons. (Table 1 and Figure 1. For this study NMFS statistical areas 521 and 522 were combined into area 520, and area 512 was treated as part of 511.) The average bycatch rates in weight (Table 2) are almost all between 1 and 10 kg/mt. Note that these are the arithmetic averages, within each quarter, of all the weekly rates in the data. They are different, but not very different, from the ratio of total bycatch to total groundfish catch in that quarter.

Average bycatch rates in number (Table 3) vary somewhat more among areas and seasons than do bycatch rates in weight, but not nearly as much as the bycatch rates in number reported for the foreign fishery in 1969-74 by Hoag and French (1976, p.10, Table 1, reproduced here as Table 4). The main difference between the two data sets is in the second half of the year, when in most areas foreign bycatch rates in 1969-74 were close to nil but joint venture bycatch catch rates in 1986-88 were about the same as in the first half of the year. The reason for the difference is unknown; it may result from different fishing strategies or a real change between the two periods.

Determinants of Bycatch Rates

If halibut bycatch rates varied systematically by area and season, so that bycatch rates were consistently high in some times and places and consistently low in others, most of the variation in the data set could be explained by fitting a model in which an average bycatch rate was computed for each area and quarter of the year. Or if bycatch rates depended primarily on the species composition of the directed groundfish catch, most of the variation could be explained by a multiple regression of bycatch rate on the component species proportions of the groundfish catch. Or if both were important, a mixed model would describe the data well.

Table 5 shows the results of fitting a large assortment of models to the data in an attempt to identify the factors most influential in determining bycatch rates, the candidates being fishery type, quarter, area, and the actual species composition of the groundfish catch. Where the model is described by a single factor, for example "fishery" (Model 4), a mean is computed for each category of that factor, in this case for each fishery type. Where two terms are crossed, as in "quarter * area" (Model 12), a mean is computed for each combination of categories (in the example, for each quarter-area combination).

Where species proportions appear in a model description, a regression is performed (e.g., "5 species"). Mixed models contain both constant terms for factors and regression coefficients for species proportions: "area * (k + 2 species)" contains a mean and two regression coefficients for each area.

The second column of the table gives the number of parameters in each model, and the last column indicates the goodness of fit, a smaller residual indicating a better fit. The inherent variability of the data is measured by the residual variance about the grand mean (Model 1), which is 31.2. The grand mean itself is 4.7 kg/mt.

The best single predictor of bycatch rates is the species composition of the groundfish catch. A single regression through the origin including all five groundfish species reduces the residual to 23.9 (Model 2), and a nearly equal reduction can be achieved with a constant term and the proportions for cod and for other flatfish (Model 3). Other single factors—fishery type, quarter, and area— hardly reduce the residual (Models 4-6), nor do they improve much on the regression in mixed models (Models 7-9). In pairs they do somewhat better (Models 10-12), but even the full factorial model (Model 16) with 59 parameters provides a fit no better than that of the 3-parameter regression. The best fits are obtained with two factors and the regression coefficients (Models 13-15), and even these are not much of an improvement over the simple regression model. In fact, the table as a whole shows that none of the models explains a great deal of the variation in the data set.

Extreme Values

A model with a separate rate for each area-quarter pair and an overall adjustment for the proportion of cod in the groundfish catch (Model 17) describes the data about as well as any model, and in particular almost as well as a much more detailed model in which fishery type is a third factor and the proportion of other flatfish (including rock sole) is a second covariate (Model 18). As a group these additional terms are not statistically significant. The proportion of other flatfish by itself is significant, but its effect is much smaller and much less consistent among areas and seasons than the effect of cod.

The simpler model (Model 17) describes the halibut bycatch rate (kg halibut/mt groundfish) as the sum of three terms:

$$(bycatch\ rate) = 2.8 + 12.8 \times (proportion\ of\ cod\ in\ catch) + (area\text{-}quarter\ effect)$$

The first term, 2.8 kg/mt, is the average bycatch rate that would be expected if there were no cod in the groundfish catch. The next term is the adjustment for cod; it signifies that in pure cod catches (proportion = 1.0), the average bycatch rate is expected to be 2.8 + 12.8×1.0 = 15.6 kg/mt. The actual proportion of cod in the groundfish catch varies among fisheries from 3% in the pollock bottom trawl fishery to 30% in the "other roundfish" bottom trawl fishery. Among area-quarter pairs it varies from almost nil to over 90%. Overall it is about 15%, and the actual average bycatch rate, unadjusted for [illegible], is therfore about 2.8 + 12.8 ×.15 = 4.7 kg/mt, as noted above. The implication of this term in the model is that cod catches entail a certain amount of halibut bycatch, no

matter when, where, or how taken. Other analysis has confirmed that the cod effect is in fact quite similar among areas and seasons.

The third and last term in the model is the area-quarter effect, which is the item of primary interest in this study. These effects sum to zero, and each one indicates the amount by which the bycatch rate in a given area-quarter differs from the overall mean, after adjusting for differences in the proportion of cod in the groundfish catch. Associated with each area-quarter effect is a standard error of the estimate, so that a simple t-test can be used to judge whether the effect is significantly different from zero and therefore whether the bycatch rate in that area-quarter is significantly different from the overall mean.

It turns out that most of the area-quarter effects are not significant (Table 6). Those that are suggest that bycatch rates are lower than average in the first quarter (although data are patchy for the first quarter) and in Area 540 (western Aleutians). Higher than average rates prevail in the fourth quarter (except in Areas 511 and 540).

For the first quarter as a whole, and for Area 540 as a whole, the data indicate bycatch rates of about 1.0 kg/mt of species other than cod. For the fourth quarter as a whole, the data indicate a bycatch rate of 4.6 kg/mt of species other than cod. These two values will be taken as representing the extremes in variation of bycatch rates among time-area strata. Neither is very different from the overall average of 2.8 kg/mt in absolute terms, but in relative terms the two extremes are quite different.

Potential Effects on Total Bycatch

The analysis above dealt with the observed bycatch rate in each cell without regard to the amount of groundfish catch in each cell, so the averages obtained are unweighted averages. The actual average rates in a real bottom trawl fishery are of course weighted by the catch, and can be higher or lower.

In the case of the joint venture data set, the overall cod effect (determined from a regression of bycatch *amounts*, rather than bycatch rates, on cod *amounts*, rather than proportions) is 11.0 kg/mt. As summarized in the table below, this implies that 2233 mt of the halibut bycatch in the joint venture data set is attributable to cod catches, leaving 3018 mt attributable to other groundfish species. The actual bycatch rate with respect to other species is therefore calculated to be 2.4 kg/mt, slightly less than the unweighted average of 2.8 kg/mt. Similarly the actual bycatch rate with respect to the total groundfish catch is calculated to be 3.6 kg/mt, substantially less than the 4.7 kg/mt average of the rates in each cell. Evidently joint venture fishing tended toward times and areas where halibut bycatch rates were lower than average. In particular, only a small proportion of the joint venture catch was taken in the fourth quarter (Table 7).

Joint venture data set	Groundfish catch ('000 mt)	Bycatch rate (kg/mt)	Bycatch (mt)
Cod	203	11.0	2233
Other species	1244	2.4	3018
Total	1447	3.6	5251

With these two rates (11.0 kg/mt of cod and 2.4 kg/mt of other species) serving as a standard, the range of potential effects of time-area shifts in the trawl fishery on total halibut bycatch, given the 1989 groundfish TAC's, can be calculated by substituting the extreme values obtained above. For this calculation it will be assumed that the bycatch rate with respect to cod cannot be reduced and that all of the groundfish TAC's will be taken by bottom trawling. (The latter assumption will lead to overestimates to the extent that some TAC's are not taken completely and some of the catches are taken with midwater trawls).

1989 Bering Sea Fishery (projected)	Groundfish TAC's ('000 mt)	Bycatch rate (kg/mt)	Bycatch (mt)
Cod	230	11.0	2530
Other species	1770	Best case: 1.0	1770
		JV actual: 2.4	4248
		Worst case: 4.6	8142
Total	2000	Best case: 2.2	4300
		JV actual: 3.4	6778
		Worst case: 5.3	10,672

This is obviously a rough forecast, but several features are worth noting:

(i) The actual joint venture rates applied to the 1989 TAC's imply a total bycatch (6778 mt) well above the limit agreed by the North Pacific Council (5300 mt), and well above the actual total bycatches in recent years. The projected increase in 1989 is due to an increase in the total groundfish catch (to the full 2 million mt) and the use of bottom trawls to take the entire catch.

(ii) Even in the best case, where time-area management reduces the bycatch rate with respect to species other than cod to 1.0 kg/mt, the total bycatch is only about a third less than with the status quo rates (4300 mt rather than 6778 mt).

(iii) Any increase in bycatch rates over the actual joint venture rates is likly to result in a bycatch considerably larger than what the Council agreed to for 1989, but probably not much more than 10,000 mt.

Discussion

It is unlikely that time-area management can succeed in lowering the overall bycatch rate with respect to species other than cod to 1.0 kg/mt, because that would occur only if the entire catch were taken in the first quarter (or in the western Aleutians), and only if the catch of other species could be taken without catching even more cod, which happens to be more common than usual in first quarter joint venture catches (Table 8). By the same token, it is unlikely that the bycatch rate with respect to other species would increase above 4.0 kg/mt, even with no time-area management, since that too would require taking the great bulk of the catch in only a few time-area strata. Any system of time-area management is therefore likely to result in a total bycatch not very different from that forecast with the actual joint venture rates.

This conclusion depends on two critical assumptions:

(i) *The joint venture data set provides an accurate measure of time-area differences in bycatch rates.* The data set reveals little variation, but there may be large regional differences within some of the NMFS statistical areas that are simply not detectable owing to the pooling of the data by area. It should be recalled that even the most detailed models explain only about a third of the variance in bycatch rates. It is less likely that a seasonal effect would be masked by data pooling, and in fact the joint venture data do show seasonal effects, but they are very small compared with the seasonal differences reported by Hoag and French (1976) for the foreign fishery. This leaves some doubt about the importance of seasonal effects.

(ii) *Bycatch rates in wholly domestic operations will be similar to joint venture rates.* In 1989 and beyond, the trawl fishery will be mostly domestic. If either the pattern or the level of domestic bycatch rates is different, then the recent performance of the joint venture fishery will not provide a good forecast of actual bycatch rates.

The second assumption is of special concern because even the joint venture rates result in a large total bycatch, likely to result in conflict and disruption of one fishery or another. If this is to be avoided, the rates will have to be reduced somehow, and since time-area closures do not appear to be a promising method, other methods should be considered, such as requiring off-bottom gear for catching roundfish, or reducing the cod quota for the purpose of limiting bycatch, or providing regulatory incentives for individual trawlers to fish in ways that result in low bycatch rates.

Literature Cited

Hoag, S.H., and French, R.R. 1976. The incidental catch of halibut by foreign trawlers. International Pacific Halibut Commission, *Scientific Report* No. 7, 24 pp.

Table 1. Distribution of 1986-88 joint venture halibut bycatch data. (A datum is a fishery-area-week, with catch and bycatch summed over vessels.)

Fishery	Qtr	Statistical Area					
		511	513	514	515	520	540
Atka mackerel	1						
	2						22
	3						18
	4						6
Pollock (bottom)	1	13	7				
	2	15	12			7	11
	3	12	17	1	1	10	6
	4	7	9			1	
Other roundfish	1	29	28		1		
	2	20	26	10	3	7	14
	3	9	20	7		14	18
	4	11	21		4	4	1
Yellowfin sole	1	13	13				
	2	10	26	20	1		
	3		11	15			
	4	2	17	14			
Other flatfish	1	10	4				
	2	7	17	11		4	
	3		2	6		11	
	4	1	1				

Table 2. Halibut bycatch rates in weight (kg/mt) in joint venture bottom trawling in 1986-88. The figures shown are the average ± one standard deviation. A standard deviation of "?.?" indicates a single observation.

		Statistical Area					
Fishery	Qtr	511	513	514	515	520	540
Atka mackerel	1						
	2						2.0±2.6
	3						2.0±.89
	4						.75±.50
Pollock (bottom)	1	1.7±2.7	1.2±1.3				
	2	2.3±2.7	2.5±2.6			2.2±2.2	2.8±3.3
	3	3.1±2.3	2.5±1.6	2.0±?.?	.59±?.?	1.5±2.2	2.7±2.5
	4	3.5±1.6	3.4±1.7			7.8±?.?	
Other roundfish	1	5.9±5.0	9.0±5.2		11.0±?.?		
	2	6.7±6.6	8.6±8.1	5.9±4.1	15.5±5.3	9.5±12.3	2.5±2.2
	3	4.6±1.5	3.0±1.8	2.2±4.3		3.5±3.8	4.7±3.1
	4	3.6±1.8	9.8±7.6		21.9±3.9	5.1±2.3	1.7±?.?
Yellowfin sole	1	3.1±4.0	2.6±2.2				
	2	3.0±4.6	4.5±4.7	2.4±2.7	.14±?.?		
	3		2.2±1.1	3.8±1.9			
	4	3.0±.75	5.5±5.1	9.2±4.3			
Other flatfish	1	4.2±3.8	1.6±.59				
	2	4.1±5.9	8.8±13.3	3.2±1.8		12.5±10.6	
	3		14.0±17.5	4.0±2.6		4.8±6.6	
	4	1.0±?.?	4.8±?.?				

Table 3. Halibut bycatch rates in number (no./mt) in joint venture bottom trawling in 1986-88. The figures shown are the average ± one standard deviation. A standard deviation of "?.?" indicates a single observation.

		Statistical Area					
Fishery	Qtr	511	513	514	515	520	540
Atka mackerel	1						
	2						.37±.44
	3						.41±.30
	4						.15±.10
Pollock (bottom)	1	.67±.87	.46±.61				
	2	1.1±1.3	1.2±1.6			.39±.31	.59±.58
	3	1.0±.81	.57±.37	.33±?.?	.14±?.?	.28±.38	.57±.84
	4	.98±.42	.90±.48			1.6±?.?	
Other roundfish	1	5.8±5.9	7.7±5.4		8.2±?.?		
	2	3.2±3.0	4.2±4.7	3.0±2.5	13.9±6.2	2.0±2.0	.71±.57
	3	1.5±.57	.75±.43	1.3±2.6		1.1±1.2	.77±.47
	4	1.1±.52	4.5±4.9		12.8±1.7	.99±.48	.30±?.?
Yellowfin sole	1	.80±.72	.55±.51				
	2	1.1±1.7	1.8±2.9	.75±.89	.03±?.?		
	3		.37±.26	.90±.64			
	4	1.9±1.3	1.2±1.4	1.9±1.3			
Other flatfish	1	5.8±6.2	.34±.31				
	2	3.9±5.5	3.5±5.7	1.3±.91		3.8±2.9	
	3		4.4±6.1	1.3±1.4		1.7±1.4	
	4	7.4±?.?	1.2±?.?				

Table 4. Halibut bycatch rates in number (no./mt) in foreign trawling in 1969-74, as reported by Hoag and French (1976, p.10, Table 1). See Figures 1 and 2 for the location of present NMFS statistical areas and the halibut regulatory areas (circa 1975) used by Hoag and French.

	Statistical Area					
Month	4A	4B	4C	4De	4Dw	4E
January			.054		.070	25.4
February	.163		2.79		.196	2.63
March	5.78	4.93	.476		.720	8.07
April	2.94	1.34	1.47		.012	2.52
May	7.15	6.98	1.02		.131	3.06
June		.000	1.16		1.11	1.99
July			.040	.013	.066	.000
August	.021		.157	.013	.103	
September	.008	.000	.187		.007	
October	.018	.000	.023		.037	.022
November	.064				.049	1.27
December	.014		.249		.074	27.6

Table 5. Results of fitting various models to the 1986-88 observer data on halibut bycatch rates. In the model descriptions, an asterisk "*" denotes a crossed model and a plus sign "+" an uncrossed one. The letter "k" denotes a constant term.

No.	Model Description	Parameters	Residual
1	k	1	31.2
2	5 species	5	23.9
3	k + 2 species (cod and other flatfish)	3	24.1
4	fishery	5	28.3
5	quarter	4	30.2
6	area	6	28.9
7	fishery * (k + 2 species)	15	22.6
8	quarter * (k + 2 species)	12	22.1
9	area * (k + 2 species)	18	23.1
10	fishery * quarter	19	26.7
11	fishery * area	21	25.8
12	quarter * area	21	27.0
13	fishery * quarter * (k + 2 species)	56	19.4
14	fishery * area * (k + 2 species)	57	19.5
15	quarter * area * (k + 2 species)	59	20.0
16	fishery * quarter * area	59	23.8
17	area * quarter + cod	21	21.7
18	fishery * area * quarter + k + 2 species	61	21.0

Table 6. Deviation of halibut bycatch rate, adjusted for the effect of cod in the groundfish catch, from the overall mean of 2.8 kg/mt, by area and quarter. The standard error of the estimate is also given. Deviations that differ significantly from zero are shown in bold type.

	Quarter			
Area	1	2	3	4
511	**−1.3±0.6**	0.3±0.7	0.2±1.0	−0.2±1.0
513	**−2.6±0.8**	**+1.6±0.5**	−0.7±0.7	**+1.8±0.7**
514		−0.9±0.7	−1.4±0.9	**+5.0±1.3**
515	−3.5±4.8	0.6±2.4	−2.5±4.7	**+9.3±2.5**
520		**+3.3±1.1**	−1.2±0.8	1.6±2.1
540		**−2.1±0.7**	**−1.4±0.7**	**−3.8±1.8**

Table 7. Proportional distribution by area and quarter of the halibut bycatch taken in observed joint venture bottom trawl operations in the Bering Sea, 1986-88.

	Quarter			
Area	1	2	3	4
511	.07	.10	.01	.02
513	.19	.19	.05	.05
514		.09	.05	.04
515	.00	.00	.00	.01
520		.02	.02	.01
540		.03	.04	.00

Table 8. Average proportion of cod in observed joint venture bottom trawl catches in the Bering Sea in 1986-88, by area and quarter.

	Quarter			
Area	1	2	3	4
511	.21	.10	.06	.06
513	.43	.16	.08	.19
514		.16	.15	.11
515	.91	.65	.02	.76
520		.09	.14	.10
540		.13	.15	.15

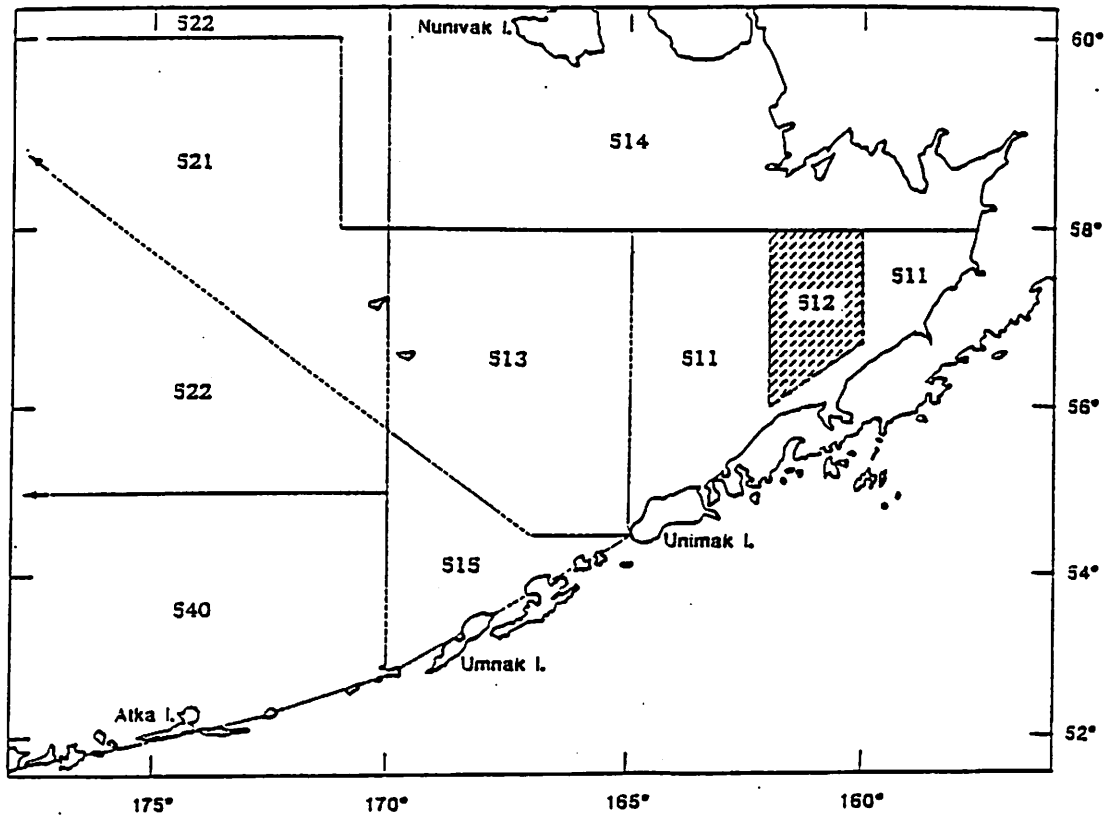


Figure 1. NMFS statistical areas in the Bering Sea.

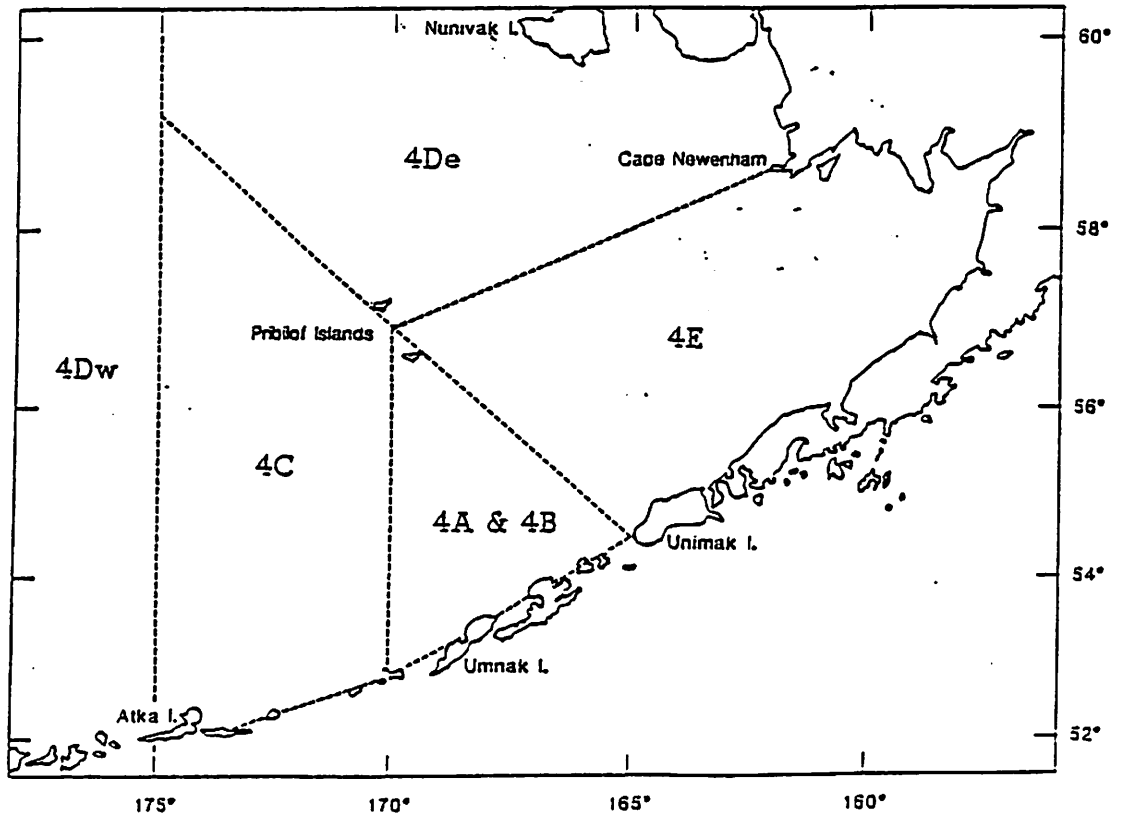


Figure 2. IPHC regulatory areas in the Bering Sea in 1975.

IPHC Rpt

REVISED
6/16/89

Table 1. Groundfish catch and Pacific halibut bycatch mortality in the Gulf of Alaska and Bering Sea/Aleutian Island regions, 1978-1988. Data for 1988 are preliminary.

Year	Gulf of Ak. Groundfish Catch (mt)	Gulf Bycatch Mort. (mt)[1]	BS/AI Groundfish Catch (mt)	BS/AI Bycatch Mort. (mt)[1]	Total Groundfish Catch (mt)	Total Bycatch Mort. (mt)[1]
1978	171,000	3,180	1,386,000	3,029	1,557,000	6,209
1979	173,000	4,545	1,289,000	3,269	1,462,000	7,814
1980	215,000	4,595	1,334,000	5,570	1,549,000	10,166
1981	255,000	4,095	1,366,000	3,865	1,621,000	7,960
1982	236,000	3,784	1,322,000	2,869	1,558,000	6,653
1983	299,000	3,134	1,383,000	2,575	1,682,000	5,709
1984	357,000	2,382	1,609,000	2,830	1,966,000	5,211
1985	329,000	1,133	1,766,000	2,538	2,095,000	3,671
1986	142,000	934	1,742,000	2,697	1,884,000	3,632
1987	142,000	2,061	1,708,000	3,168	1,850,000	5,230
1988	151,000	2,245	1,982,000	3,755	2,133,000	6,000
AVG 83-87		1,929		2,762		4,690
AVG 78-87		2,984		3,241		6,225

[1]Bycatch mortality is from all fisheries, i.e. pot, longline, trawl.

D-3(a)
NPFVOA

BYCATCH MANAGEMENT IN THE BERING SEA/ALEUTIAN ISLANDS REGION

INDUSTRY CONSIDERATIONS RELEVANT TO THE MANAGEMENT OF RED KING CRAB, C. BAIRDI TANNER CRAB, AND HALIBUT BYCATCH

The bycatch of crab and halibut in fisheries conducted in the Bering Sea/Aleutian Islands region is one of the most important problems facing all sectors of the North Pacific fishing industry. Recognizing the seriousness of the bycatch problem, concerned industry groups have been meeting in regards to the issue for the past several months. These meetings have involved crabbers, longliners, and trawlers and have been extremely productive. New ideas and fresh approaches to bycatch management have been developed. This short discussion paper is intended to brief the Council on these ideas as well as summarize the bycatch management approaches being considered at the industry bycatch meetings. In short, these ideas include:

** New bycatch management areas including closed and/or conditionally closed areas for red king crab, C. bairdi Tanner crab, and halibut;

** Observer coverage at a statistically-acceptable level is necessary. Additional coverage may be useful on certain vessels;

** Given the size of the king crab closed and conditionally closed areas, a king crab bycatch ceiling is not necessary;

** No bottom trawling in King Crab Area A;

** 25 fathom inshore boundary on King Crab Area A;

** 100% observer coverage in King Crab Area B;

** An acceptable and enforceable definition of midwater trawling necessary;

** Area closures apply only to bottom trawlers;

** No objection to 1% bairdi bycatch ceiling;

** Pot storage area necessary

A more complete description of the above ideas follows:

New Bycatch Management Areas

Perhaps one of the most important aspects of the industry meetings has been the consideration of new bycatch management areas. The areas presently under discussion (Attachment 1; Figures 1 and 2) provide both closed and conditionally closed areas for crab and/or halibut. King Crab Area A (Figure 1) is closed to

bottom trawling year around. King Crab Area B is conditionally closed to bottom trawling. Bottom trawling in Area B is conditioned upon trawlers meeting acceptable bycatch criteria. King Crab Areas A and B would shift according to the results of annual NMFS crab surveys but would never exceed 3 degrees latititude. A conditionally closed bairdi/halibut area also was suggested. This area would be closed to bottom trawling when BS/AI bairdi/halibut ceilings are reached. Finally, a halibut subarea was defined within the larger bairdi/halibut area. The halibut subarea would be subject to a winter/spring trawl closure after a BS/AI halibut bycatch threshold was reached.

Observer Coverage Necessary

Industry members agreed that on-board observer coverage is necessary for any effective bycatch management system. As such, observer coverage should exist at a statistically-acceptable level on all fisheries operating in the aforementioned areas. In order to collect additional useful bycatch information, some higher level of observer coverage may be necessary on trawl operations conducted in the defined areas. Because of the importance of King Crab Area B to both crab and trawl fishermen, observer coverage in this area should be at 100%.

Area Closures Apply Only to Bottom Trawl Operations

Industry members recognized that bycatch rates associated with midwater trawl operations are extremely low, often approaching zero. Thus, it was felt that area closures should not apply to vessels using midwater trawls. In addition, industry representatives agreed that an acceptable and enforceable definition of what constitutes a midwater trawl must be developed.

King Crab Area A

Several specific management alternatives relevant to King Crab Area A were considered by industry representatives. These include the use of the 25 fathom line as the inner boundary to King Crab Area A and the closure of the area to bottom, but not midwater, trawl operations. Additionally, given the size of King Crab Areas A and B, a king crab bycatch ceiling is not necessary;

Other Issues

Bairdi and halibut bycatch ceilings were discussed by industry representatives present at all of the bycatch meetings. These industry representatives did not object to the use of a 1% (of population abundance) bycatch ceiling for bairdi crab. Moreover, industry members agreed that a crab pot storage area is necessary, perhaps best located in the top corner of King Crab Area B.

Given the success of the industry bycatch meetings, these discussions will be broadened and continued in the future. In the meantime, industry representatives are eager to discuss the ideas which have emerged from the bycatch meetings with any interested party. Through such continued interactions, long-term solutions to the complicated bycatch problem may be realized.

ATTACHMENT 1: BYCATCH MANAGEMENT AREAS UNDER CONSIDERATION AT INDUSTRY BYCATCH MEETINGS

KING CRAB AREA A

King Crab Area A -- The area bounded on the west by 16300W, north of the 25 fathom line, and the coordinates 16000W,5630N, 16130W,5714N, and 16300W,5630N, north of the 25 fathom line, will be closed year round to bottom trawling.

KING CRAB AREA B

King Crab Area B -- Bottom trawling shall be permitted in the area bounded by 16130W,5714N; 16200W,5730N; 16500W,5630N; and 16300W, 5630N provided that vessels in King Crab Area B meet bycatch and onboard observer coverage criteria

AREA MOBILITY

If the annual crab survey shows that the major concentration of crab has moved one-half degree or more west of 16300W or one-half degree or more northeast of the line connecting 16000W, 5630N with 16200W, 5730N king crab areas A and B shall move accordingly, but the movement shall be limited to one-half degree and at no time shall the zone include more than three degrees longitude.

BAIRDI/HALIBUT AREA

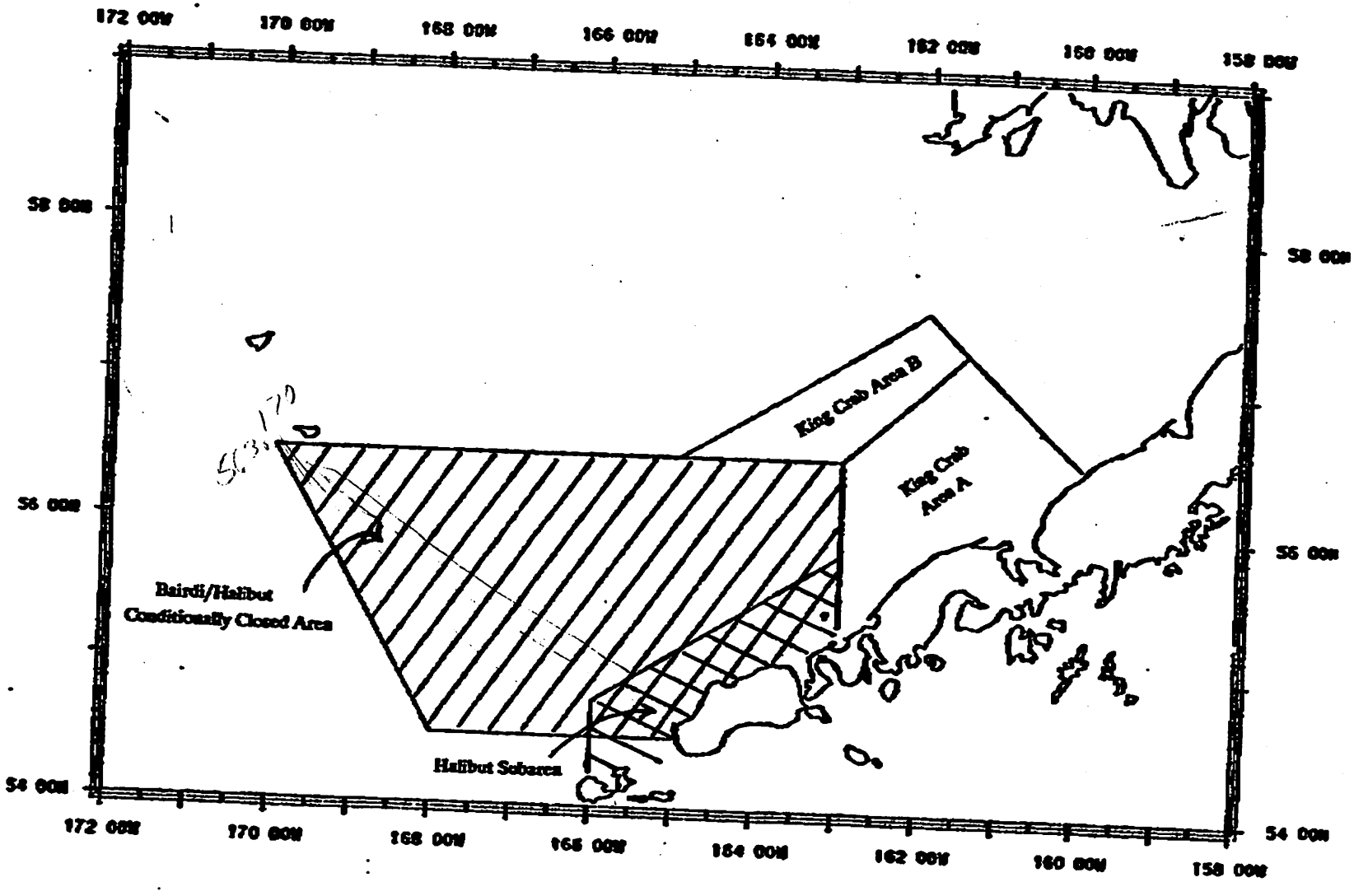
Bairdi/Halibut area -- The area west of 16300W, south of the line connecting 16300W, 5630N with 17000W,5630 N east of the line connecting 17000W, 5630 N with 16800W,5430N and north of 5430N will be closed to bottom trawling once halibut and/or bairdi ceilings are reached.

This closure does not include the area south of the thirty fathom contour.

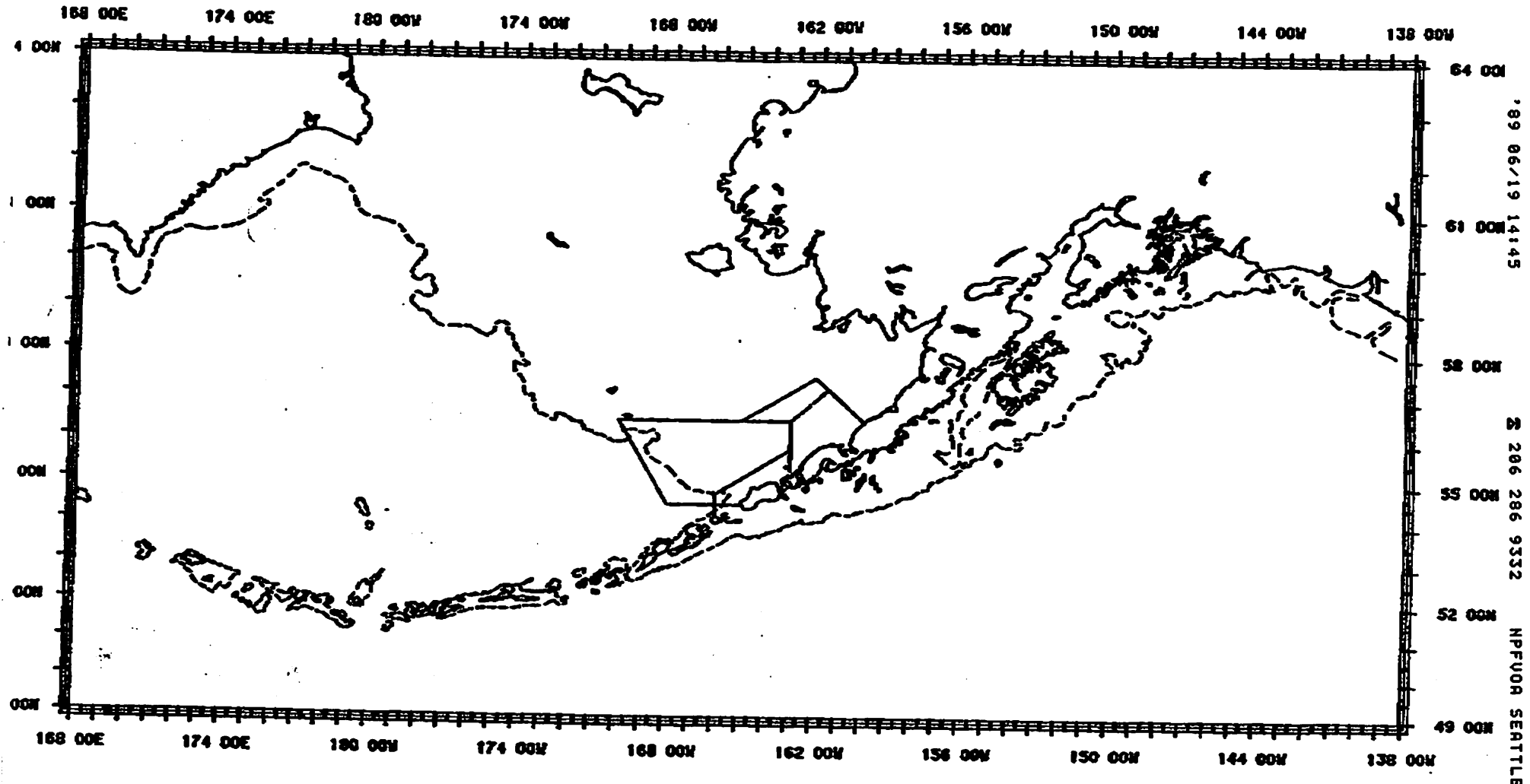
HALIBUT SUBAREA:

The area bounded by the coordinates 5415N, 16600W; 5445N, 16600W; 5550N, 16300W; and 5533N, 16300W shall be subject to a winter/spring trawl closure once a BS/AI halibut bycatch threshold is reached.

Industry Discussed Bycatch Management Areas



Industry Discussed Bycatch Management Areas



AGENDA D-3(a)
SUPPLEMENTAL

FISHING VESSEL OWNERS' ASSOCIATION
INCORPORATED

ROOM 232, WEST WALL BUILDING • FISHERMEN'S TERMINAL
SEATTLE, WASHINGTON 98119

SINCE 1914

Our 75th Year Serving the Pacific Longline Fleet

May 23, 1989

Mr. Steve Pennoyer, Director
National Mairne Fisheries Service
P. O. Box 1668
Juneau, AK 99802

RE: Emergency Bycatch Restriction - Bering Sea

Dear Mr. Pennoyer:

I would like to express at this time a concern I have for fishing operations in the Eastern Bering Sea area which occur in Zone 1 defined in the emergency bycatch regulations. The bycatch cap in this area was set at 200,000 red king crab.

The N.M.F.S. observer information for joint venture operations in Zone 1 is confirmed to show a current bycatch level at 180,000 red king crab. I know that the N.M.F.S. has expended numerous hours attempting to extrapolate the king crab bycatch for DAP operations and have had some difficulties.

It has been frustrating to the members of the industry not being able to have a timely accounting of these bycatch rates; however, I understand N.M.F.S. and I.P.H.C. have completed an analysis for Bairdi, King Crab and halibut which will be made public at the June Council meeting. Even at modest bycatch rates for the DAP fleet, (3 crab/MT) the cap of 200,000 was probably exceeded in April when you include DAP activities.

I request that the N.M.F.S. close those areas of Zone 1 critical to King Crab management. I believe at a minimum, the current closure should be from 160 to 163 plus the area from 163 to 165 bordered on the North by 57 degrees. This area should be closed to all bottom trawling and if the bottom trawl restrictions cannot be monitored, an observer program in this area should be made a condition of fishing.

I believe this area is critical to the red king crab at this time for the following reasons:

(1) The 1988 survey indicates a shift westward of 163°of a significant part of the king crab biomass, particularly females.

FAX
(206) 283-3341
LATITUDE: 47° 39° 36' NORTH

DIAL "A VESSEL"
(206) 283-7735
LONGITUDE: 322° 22' 58" WEST

(2) ADF&G statistics indicate 50 to 70 percent of the commercial catches occurred in the area between 163 and to 165.

(3) Bob Otto was quoted in the Alaska Fishermen's Journal indicating "dwindling survey results hit rock bottom last year," "the trend is downward so it would not surprise me if there was no new season this year." (Meaning 1989).

Steve, I believe the action of the Council and N.M.F.S. regarding the king crab cap mandates action within Zone 1 whenever the information is available to N.M.F.S. that the cap has been reached. I hope I have been helpful in expressing my concerns.

Very truly yours,

Robert D. Alverson
Manager

RDA:cb

Enclosure (1)

cc: John Peterson, Chairman, NPFMC
Joe Blum

Alaska Fisherman's JOURNAL, June 1989

Things Look Bleak For B. Bay King Crab

Record low recruitment stocks of king crab may cause fishery managers to close the Bristol Bay king crab season this year.

According to National Marine Fisheries Service shellfish biologist Bob Otto, dwindling survey results hit rock bottom last year forcing fishery managers to reduce the 1988 quota and to extend areas closed to trawlers this year.

"The trend is downward so it would not surprise me if there was no season this year," Otto said.

The Bristol Bay fishery was closed for the first time in 1983 when crab harvest suddenly plunged from 130 million in 1980 to a paultry 3 million two years later.

Even then recruit and pre-recruit levels were higher than those discovered during last year's survey. The 1983 survey that produced a season closure estimated a male potential recruit population of 10.4 million crabs, 1.5 million legal crabs and a record low of 9.7 mature females.

Potential or pre-recruit crabs are those that will be large enough for harvest in one or two years. Re-

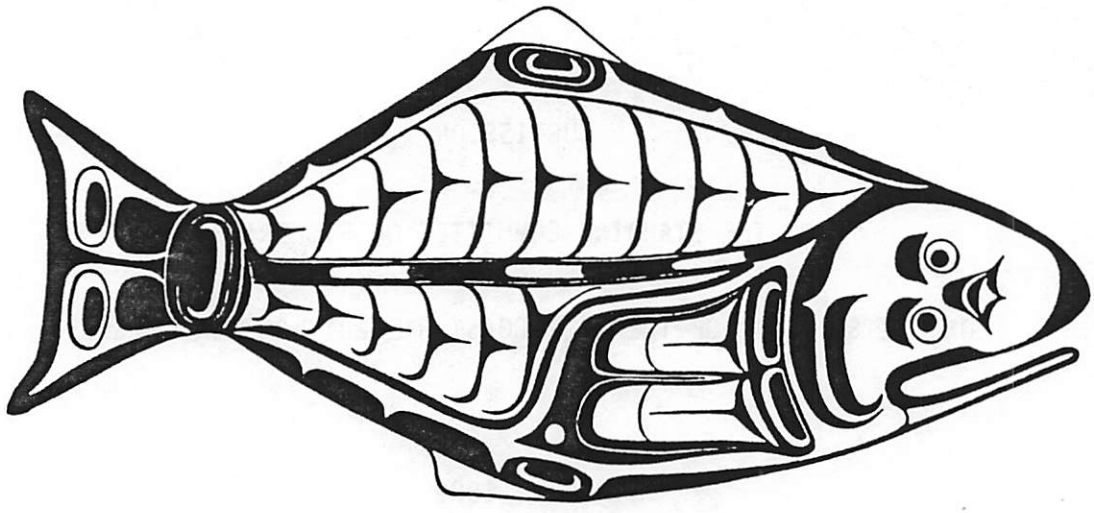
SUBMISSION

TO THE STANDING COMMITTEE OF FISHERIES

ON THE SURVIVAL OF THE WEST COAST HALIBUT LONGLINE FISHERY

APRIL, 1989

PRESENTED BY: Fishing Vessel Owners' Association of B.C.
United Fishermen and Allied Workers' Union
Pacific Trollers' Association
Prince Rupert Fishermen's Cooperative Guild
Native Brotherhood of B.C.
Prince Rupert Vessel Owners' Association
Northern Trollers' Association



The halibut fishing industry is unanimous on one thing at least, namely, that with few exceptions Pacific halibut is a single, migratory stock which is spawned in specific spawning areas in B.C. and Alaska. From these grounds, at certain stages in the development of the species, halibut migrate south and east onto fishing grounds in Washington, British Columbia and Alaska where they become available for harvest in traditional longline fisheries.

Thus it is that Canadian and United States organizations with an interest in halibut, representing government, science, fish processors, vessel owners, crew members and shoreworkers, all agree there is merit to joint Canadian/United States management of the halibut fishery. A break anywhere in the migratory chain caused by overfishing, or fouling or other destruction of nursery or feeding grounds in Alaska or British Columbia, will damage the entire stock.

The International Pacific Halibut Commission (IPHC) is responsible for the scientific data gathering and the formulation of regulations designed to protect the stock and to guarantee an ongoing commercial/sports industry. This organization, mandated by international treaty since 1929, has been funded and staffed jointly by both the Canadian and United States governments. Support for the IPHC and protection of the halibut stocks by all industry groups have taken many forms over the very long history of commercial set-line fishing. Poundage quotas were enforced, length of open fishing periods became tightly controlled, taking of small halibut was prohibited, and certain sensitive (i.e. nursery) grounds were shut down to any and all types of fishing pressure.

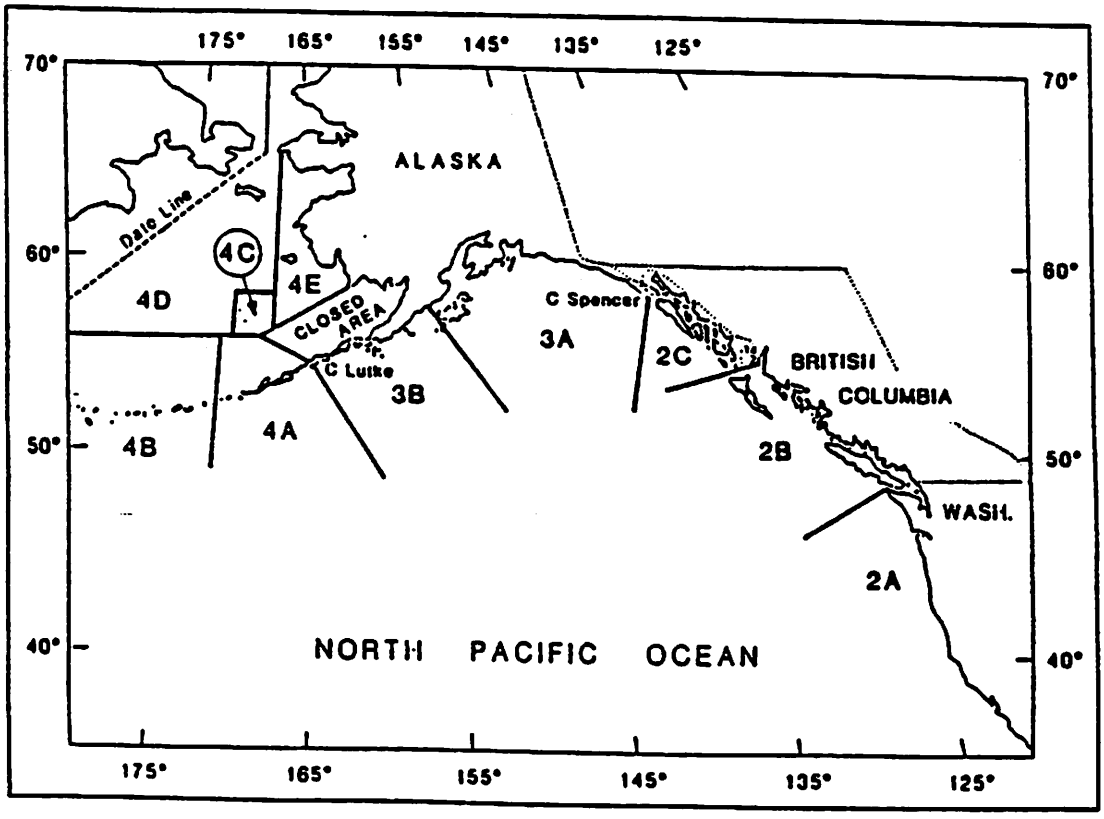
The most dramatic illustration of the importance we attached to our conservation efforts is the pressure which the U.S. and Canada jointly applied in the 1960's to force Japanese trawlers to stop dragging on more sensitive halibut habitat in the Bering Sea, long before the 200 mile limit became law in the late 1970's. Japanese heavy bottom draggers were tearing up important rearing grounds, which meant they not only slaughtered younger generations of halibut, which live to be 30 or 40 years old, but they also ruined feeding and spawning habitat for future generations. The Japanese had to be stopped to protect the species and they finally were!

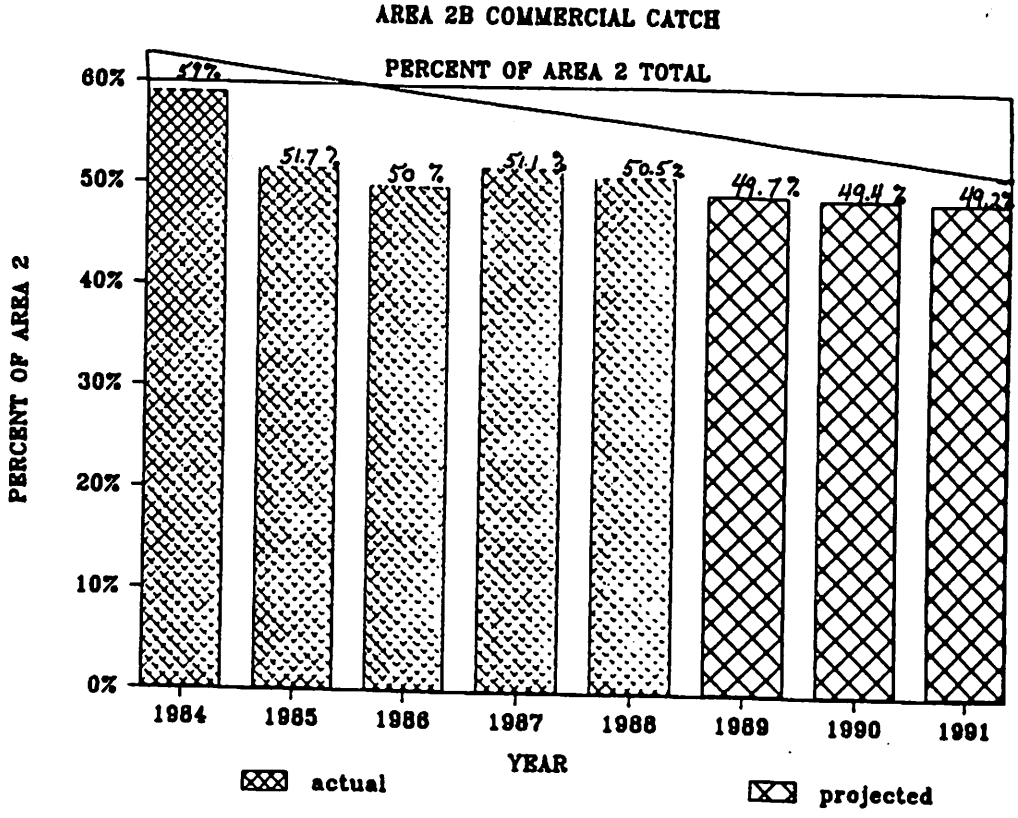
For 60 years Canadians and Americans cooperatively fished and helped manage halibut fisheries in the territories of both nations. Then, in 1980, something happened to change this. A treaty was signed by the U.S. and Canada which prohibited Canadians from harvesting halibut in U.S. waters and vice versa. The treaty also called for a division of catch based on the 60 years during which IPHC statistical records were available as a data base. In more northern areas

of Alaska, Canadians received no share. In Area 2, however, Canadians were to receive 60 percent of available quotas,

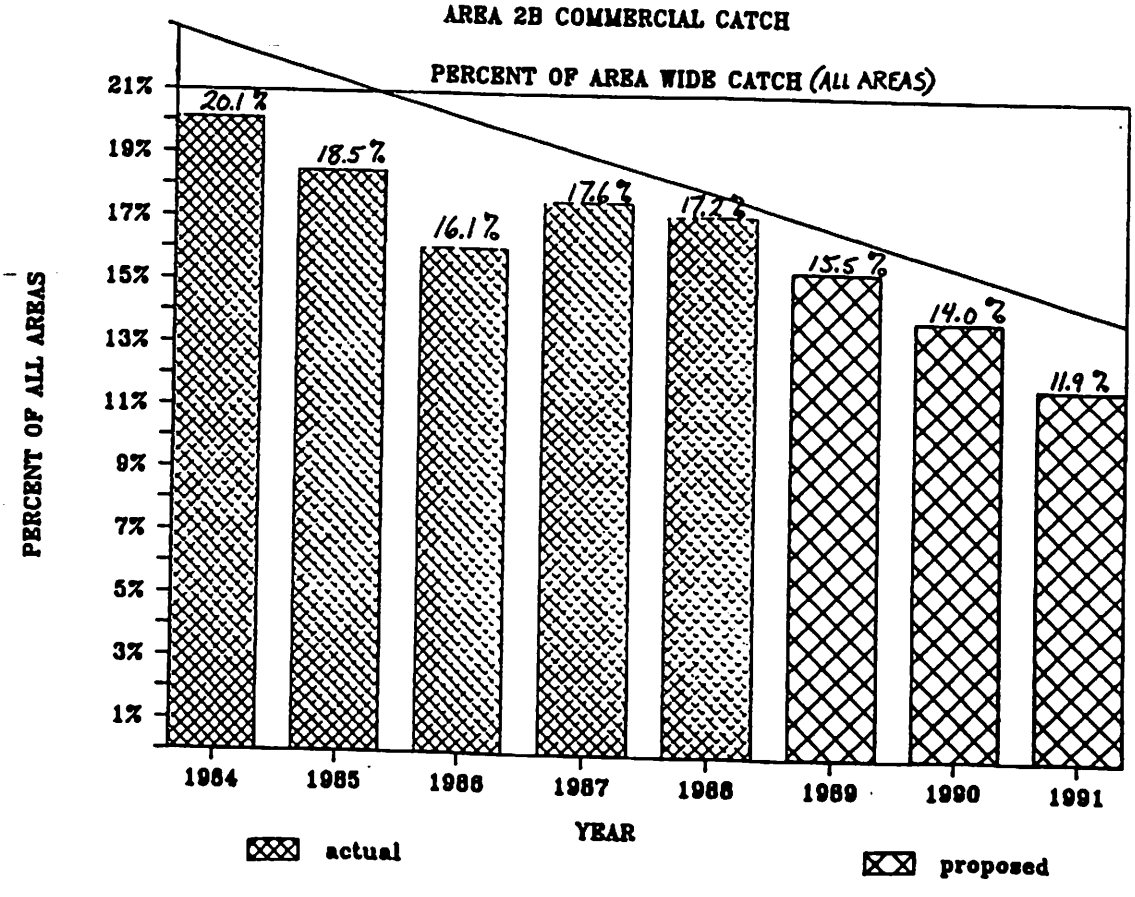
Area 2A - Washington State Area 2C - Southern Areas of Alaska	40 percent	Area 2
Area 2B - British Columbia	60 percent	

Regardless of what this treaty promised, however, Canadians were not to achieve the 60 percent share prescribed by the document. Graphs #1 and #2 clearly illustrate this point.




AREA 2B COMMERCIAL CATCH
PERCENT OF AREA 2 TOTAL
PERCENT OF AREA 2
60%
50%
40%
30%
20%
10%
0%
59%
51.7%
50 %
51.3%
50.5%
49.7%
49.4%
49.2%
1984
1985
1986
1987
1988
1989
1990
1991
YEAR
actual
projected

Graph 2


AREA 2B COMMERCIAL CATCH
PERCENT OF AREA WIDE CATCH (ALL AREAS)
PERCENT OF ALL AREAS
21%
19%
17%
15%
13%
11%
9%
7%
5%
3%
1%
20.1%
18.5%
16.1%
17.6%
17.2%
15.5%
14.0%
11.9%
1984
1985
1986
1987
1988
1989
1990
1991
YEAR
actual
proposed

Since 1984, when Alaska (Area 2C) showed higher than normal abundance, Canadian claims for 60 percent of total Area 2 quotas were denied on the basis that the volume of stock in Area 2C justified a larger share for Alaska (Area 2C) than prescribed by the treaty. The Americans and the IPHC conveniently ignored the fact that maximum fishing efforts in all Alaskan areas were choking off legitimate migration to British Columbia Area 2B.

This warp in halibut management was made worse at the 1989 IPHC Annual Meeting when the IPHC continued to deny Canadians 60 percent, despite the fact that halibut are no longer as abundant in Alaska (Area 2C). Why? Because now conservation efforts have to be shared by the fishery as a whole. Too much fish, too few fish....When do Canadians receive a proper share? When will Canada's government-appointed IPHC commissioners insist upon it?

Up to this point in the brief, all we intended to give was a scanty insight into the type of frustration Canadian fishermen have faced. However, everything discussed thus far is completely irrelevant unless we can ensure the survival of halibut stocks and, thus, the real reason that preparation and presentation of this brief is urgent; as is the need for emergency action by the Canadian government!

Since Canada signed the previously described 60/40 Agreement, the United States has unfairly moved the goal posts in such a manner as to endanger halibut as a species and as a viable commercial resource. The United States has allowed a huge new groundfish fishery to prey upon and/or damage halibut stocks completely separate and apart from any management regime controlled by the IPHC. Thus, there are now legitimate reasons to claim that integrated, joint Canadian/U.S. management of halibut stocks is somewhat an illusion and that, in

truth, the intent of our halibut agreement with the United States is being systematically violated. Furthermore, it appears to the overwhelming majority of industry advisors that the Canadian government is very reluctant to open its eyes to this sad reality.

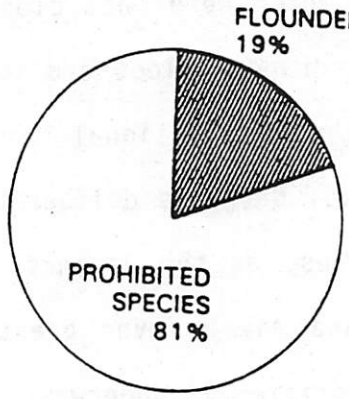
The nursery grounds, which were once closed to Japanese draggers, are now open to the U.S. domestic dragger fleet and the carnage is staggering. Recent reports from sources in the U.S. National Marine Fisheries Enforcement Branch indicate suspicion that U.S. draggers deliberately under-reported their regular catches and their by-catches, as the Japanese fleet did before them, and that the damage they have caused may be even greater than previously thought. An investigation by U.S. authorities is underway.

Let us not forget that this is the same U.S. fleet, operating under the same Alaskan fisheries management regime that permitted overfishing of king crab stocks to the point of near extinction during the 1970's and 1980's. As a result, many former Alaskan king crabbers were forced to convert to dragging and now operate as part of the U.S. dragger/trawl fleet that is currently causing damage to our halibut resource.

A further illustration of Alaskan fisheries management philosophy, when dealing with the American trawl/dragger fishing, is the fact that at the time this report was written trawling was proceeding on prime halibut rearing grounds in Zone 1, south of 50° and east of 165° W. If for no other reason, these areas should already have been legally closed due to the legal limit of 200,000 king crabs having long been surpassed.

ALASKA FISHERMAN'S JOURNAL
more than just the tip of the news . Vol. 12, No. 4 April 1989 $1.50

S.E. Alaska Trawl Fishery (1981-1988)



Pie chart above shows the targeted flounder were worth less than one-quarter the value of prohibited halibut and crab taken in the fishery.

IPHC scientists believe that 50 percent of the damage done to juvenile halibut stocks is being done right on sensitive nursery grounds and current U.S. ship construction will put an additional 62 new Alaskan factory trawler/dragger vessels on these grounds in 1989.

IPHC scientists also estimate that incidental or by-catches of halibut (mostly juveniles) by U.S. trawlers amounts to 17 million pounds; 7 million pounds more than the total legal Canadian quota in Area 2B. However, even these high statistics were challenged by fishermen at the 1989 Annual IPHC meeting as being much too low and scientists were compelled to admit the real numbers could in fact be much higher. In catches of this type, approximately only one in five incidentally-caught halibut survive, even when returned to the sea.

This bad situation is made even worse by reports from reliable company and other industry sources that indicate the existence of a large Japanese market for sub-legal sized halibut. Bob Alverson, U.S. government appointee to the North Pacific Fisheries Council, was recently astonished to find that before the legal halibut fishery even commences in May, the four million pound plus Japanese market for under 20 pound halibut has already been filled. This illegal trade has few sources of supply other than the U.S. domestic trawl fleet and few, if any, of such illegal by-catches are included in the IPHC reported by-catch statistics of 17 million pounds.

It is alarming to note that National Marine Fisheries Enforcement Branch representatives, present at the 1989 IPHC Annual Meeting, were unable to claim with certainty that the total of halibut by-catches by trawlers are limited to 25 million, 35 million or even 45 million pounds. Indeed, how can we know when the 1987 and 1988 U.S. observer program monitored less than three percent of Alaskan trawl fishing efforts?

It is notable that despite the industry's universal and continuing strong opposition to any type of landing tax, many Canadian fishermen's organizations view the situation with such alarm that they proposed a 1.5¢ per pound voluntary tax on halibut to help fund an observer program, provided U.S. draggers match any such funding.

It is our belief that current halibut management problems should be seen in two parts:

1. the need to guarantee Canada a fair economic return; and

2. an urgent need to step up conservation efforts to protect halibut from the U.S. trawl fleet.

In regard to the federal government's responsibilities in this matter, it was the opinion of most Canadian industry fishing and advisory organizations that a little less diplomacy and a little more backbone is in order.

The industry supports international management because halibut is a trans-boundary species. However, such support can only continue if the process leads to a fair play for Canada and also provided it remains relevant in terms of the IPHC's continued ability to manage and conserve halibut. What incentive is there for continued participation if Canadians don't receive a fair share, or if stocks are to be wiped out regardless of any sacrifices Canada might make? Why shouldn't we take what we can now if the stock is to be here today and gone tomorrow anyway?

Obviously such a position would signal a real defeat for conservation and our industry's prospects for survival. Nevertheless, it may soon be our only option if we don't move now to protect Canadian interests. One only needs to study the following graph to easily recognize that something is seriously wrong.

IPHC STAFF REGULATORY PROPOSALS, 1989

Millions of Pounds

Area	1988 Catch Limit	1989 Staff Recommendations	Projected Future Catch Limits 1990	1991
2A	0.75	0.65	0.6	0.5
2B	12.5	10.0	7.8	5.6
2C	11.5	9.5	7.4	5.3
3A	36.0	31.0	26.3	21.8
3B	8.0	8.5	8.9	9.2
4	5.4	5.0	4.8	4.6
TOTAL	74.15	64.65	55.8	47.0

* Includes recreational, Treaty Indian and other commercial fisheries.

There may be a unique opportunity that could allow Canada to make a difference if we act decisively. The North Pacific Fisheries Management Council met April 10-14 and will meet again June 19-23 for the purpose of establishing rules which will govern various Alaskan fisheries, including their domestic trawl/dragger fishery.

During the course of the June meetings, it will probably be possible to express a Canadian position and it is the intention of several Canadian industry representatives to attend. It is our firm opinion that strong Canadian government pressure on appropriate U.S. government authorities now could be especially effective in helping us and others in Alaska who will be fighting for regulations designed to protect halibut stocks.

Our best information indicates that a U.S. trawl lobby will spare no expense to block ANY conservation effort that threatens to interfere with ANY part of their fishery. The flip side of this coin is that Alaskan set-line fishermen, conservationists and sports fishing organizations also have a strong counter-lobby and these organizations have been asking Canadian organizations for whatever assistance we can lend. Canada has a vested interest in the outcome!

It would be understandable if Canadian commercial halibut fishermen were to become very jaded on the entire process, but we cannot afford to be. Therefore, we are linking up with fishing organizations in Canada and in the United States in an attempt to save our resource and our livelihoods. Following are some measures we recommend the Canadian government carefully consider.

Canada immediately act to ensure:

1. That the United States establish regulations prohibiting U.S. trawlers from dragging on more sensitive halibut nursery and rearing grounds.

2. That the Canadian government give all possible aid to appropriate private or government groups, from Canada or the U.S., who are attempting to dramatically lower halibut by-catch limits in the Bering Sea downward from the current 5,300 ton limit.

3. That American authorities establish a 100 percent funded observer program to strictly regulate the U.S. domestic trawl fleet. Nothing less will be sufficient!

4. That a public investigation into the illegal supply of halibut to Japanese and/or other markets take place and that corrective measures be taken immediately.

5. That the United States compensate Canadian industry for any loss occurring as a result of illegal or negligent activity uncovered by such an investigation.

6. That the U.S. government move to establish penalties harsh enough to deter law breakers and bring them quickly to justice.

7. That there is adherence to the Canada/U.S. Halibut Agreement calling for a 60 percent share of Area 2 quotas for Canada.

/pf
oteu-15

STEVE COWPER
GOVERNOR

STATE OF ALASKA
OFFICE OF THE GOVERNOR
JUNEAU

June 21, 1989

Mr. John G. Peterson
Chairman
North Pacific Fishery
Management Council
P.O. Box 103136
Anchorage, AK 99510

Dear John,

My congratulations to the North Pacific Council for passing Amendment 12a to the Bering Sea/Aleutian Islands Groundfish FMP, setting limits on the allowable bycatch of crab and halibut in trawl fisheries. I realize that this was a contentious and controversial issue for the Council, but I believe it was necessary to protect the biological and economic health of Bering Sea fisheries. I hope that the amendment obtains its deserved approval by the Department of Commerce.

I am writing today, however, to encourage the Council to take action on three additional, and possibly difficult, issues: domestic observer coverage, a ban on roe-stripping, and shoreside processor preference. The Magnuson Act is designed to promote the development of socially and economically equitable fisheries, and the Council is the forum to assure that appropriate actions are taken. Unfortunately, inaction by the Council can defeat the purposes of the Act as assuredly as can poorly crafted regulations. In order to tailor the intent of the Magnuson Act, which was passed some 13 years ago, to current concerns, I believe that some regulatory changes are needed.

As all Council members are aware, fisheries cannot be properly managed without a substantial data gathering and analysis program. This requirement is so obvious that I won't belabor the point, but I recommend that the Council not become so concerned about the logistics of an acceptable observer program that it delays a decision any longer. Whether or not "100 percent coverage" means every haul-back of gear or only full coverage of those vessels capable of carrying an additional person, such details are insignificant compared to the need to implement as complete

an observer program as possible. And, the issue of funding should not impede your adoption of domestic coverage. If reasonable efforts to secure federal funding for such a program are not successful, then the industry must bear the burden similar to any other cost of doing business.

The practice of roe-stripping, even under conditions of economic efficiency, constitutes a waste of social and economic consequence. As illustrated this spring in the Gulf of Alaska, the lack of a prohibition essentially promoted a reallocation of the pollock resource from onshore processors to the offshore factory/trawler fleet. More basically, the dumping of carcasses was a wanton waste of product that could otherwise have been utilized. Again, I encourage the Council not to let the details of what constitutes full utilization unduly delay action to assure that the most complete and equitable use of the resources entrusted to you is made.

Finally, I request that you give full consideration to the various proposals for shore-based processor preference. A large part of the fishing industry in Alaska relies upon shoreside processing, which subsequently supports the economy of a number of maritime communities. Although the Council must assume a broader perspective than the State of Alaska in allocation issues, the Council also shares a responsibility towards coastal communities and their economies. The substantial economic and social investments made in the shoreside industry are at risk if some controls are not placed on the rapidly overcapitalizing factory/ trawler fleet.

John, I appreciate the difficulty of addressing and deciding issues that so measurably affect people's livelihood, but I reiterate my concern that inaction on domestic observers, roe-stripping, and shoreside processor preference would even more drastically, and inequitably, affect the industry.

Good luck in your upcoming deliberations.

Sincerely,

Steve Cowper
Governor

ARNI THOMSON MAY 30 1989

STEVE COWPER
GOVERNOR

STATE OF ALASKA
OFFICE OF THE GOVERNOR
JUNEAU

May 25, 1989

JUN 1989 RECEIVED

Mr. Arni Thomson
Executive Director
Alaska Crab Coalition
Suite 6
3901 Leary Way (Bldg) NW
Seattle, WA 98107

Dear Mr. Thomson:

Thanks for your letter regarding cooperative Alaska Crab Coalition (ACC) and National Oceanic and Atmospheric Administration/Outer Continental Shelf Environmental Assessment Program (NOAA/OCSEAP) larval king crab and juvenile red king crab habitat studies in the North Aleutian Basin.

As you are aware, the State of Alaska strongly supports research which would fill critical data gaps on the importance of the North Aleutian Basin to red king crab populations in the eastern Bering Sea. We have not had an opportunity to review the plan to determine if it will fill the information needs identified in the State's Sale 92 litigation. We have asked for a copy of the study plan from Lyman Thorsteinson and have asked Dana Schmidt of the Kodiak Department of Fish and Game office, who is doing similar larval crab research in the Gulf of Alaska, to review the plan. If his review confirms the study plan that addresses critical study needs, it will receive our full support.

My staff checked on the status of the budget for the cooperative study. Mr. Thorsteinson reported that the project is fully funded and he is not aware of any problem at this time. We asked him to keep us informed of the funding status and to let us know if it changes.

Thanks again for bringing this to our attention, and for Alaska Crab Coalition participation in the cooperative studies.

Sincerely,

Steve Cowper
Governor

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration

NATIONAL OCEAN SERVICE
OFFICE OF OCEANOGRAPHY AND MARINE ASSESSMENT
OCEAN ASSESSMENTS DIVISION
ALASKA OFFICE
FEDERAL BUILDING, U.S. COURTHOUSE, RM. A13
222 W. 8TH AVENUE, #56
ANCHORAGE, ALASKA 99513-7543

N/OMA3x3: LT-7A-379

Mr. Arni Thomson
Executive Director
Alaska Crab Coalition
3901 Larry Way, NE
Suite #6
Seattle, Washington 98107

Dear Mr. Thomson:

The National Oceanic and Atmospheric Administration (NOAA), through the Outer Continental Shelf Environmental Assessment Program (OCSEAP), is currently in the process of initiating new research on red king crab in Bristol Bay, Alaska. As you are aware, OCSEAP has received a technical proposal from the University of Washington (UW) to conduct a reconnaissance survey of the Port Moller estuary and adjacent coastal waters this year. We are currently in the process of establishing a cooperative agreement for this study. Contractually, the Government requires a special review of all requests for cooperative agreements. In this case, a specially-appointed Department of Commerce committee is reviewing the UW proposal to ensure the public interests are being served. This review should be completed by July 1.

The Alaska Crab Coalition's (ACC) proposed contribution to the OCSEAP study is substantial and offers a great advantage to this year's research. For this reason, it may be instructive for you, and ACC board members, to know a little more about the NOAA OCSEAP program and of this program's research interests in king crab biology and ecology. In brief, the purpose of OCSEAP is to conduct environmental studies for the Alaskan Outer Continental Shelf (OCS) areas identified by the Department of Interior (DOI) for potential oil and gas development. Scientific data and information obtained through OCSEAP are used to predict environmental effects that may result from development activities. One focus of OCSEAP has been to evaluate the biological consequences of oil spills off Alaska, as well as their effects on fisheries. Other research objectives have concerned regional ecosystems and the identification of critical habitats.

A major issue surrounding planned OCS leasing in the North Aleutian Basin lease area in Bristol Bay has centered on the possible effects of industrial developments on the red king crab population. This lease area encompasses virtually the entire spawning range of the species and includes most, if

not all, of the rearing habitat for juvenile age groups in Bristol Bay. The main area of industrial interest in the lease area (as evidenced in Sale 92) is located in coastal waters north of the Port Moller estuary. This area coincides with a portion of Bristol Bay that is thought to be of prime nursery importance to juvenile crabs. It is not insignificant that the environmental impact statement for Sale #92 (prepared by the DOI) concluded that a large oil spill near Port Moller could have a major (population-level) impact on the red king crab resource. Habitat disturbances associated not only with the petroleum industry, but also with increased bottom trawling in this area, may also have an adverse effect on the population.

The cooperative agreement we are seeking plans for a three-year field study of the early life history of red king crabs in the Port Moller area. Our selection of study area reflects our perspective of the importance of this area to juvenile crabs and the population as a whole. This position is based on more than a decade's worth of OCSEAP research on various aspects of red king crab biology. We have also included Port Moller-Nelson Lagoon Complex in this study. The estuary has been identified as a potential site for a petroleum transfer facility to carry oil to the south side of the Alaska Peninsula and is thought to be of regional importance to the maintenance of certain commercial fin and shellfish stocks. Of particular interest, Herendeen Bay may contain an endemic population of blue king crabs. If so, this system will offer a unique "laboratory" in which to study the effects of environment on local recruitment processes and population size.

The ACC and OCSEAP share a common concern, and that is for the protection of habitat for juvenile crabs. It seems obvious that more precise information is needed regarding the location and relative importance of "refuge" habitats by fisheries managers. This summer's research will provide a "a first step" toward a detailed characterization of the Port Moller physical and biological environment. A more comprehensive research program is expected in the following two years. This summer, we will be conducting studies in both estuarine and coastal waters using logistics support supplied by the ACC and NOAA. We anticipate that at least five days of effort will be apportioned to the coastal research (generally, depths ranging from 15-50 m depths) utilizing ACC vessel support. Field work will involve side-scan sonar surveys and possibly underwater photography to document prospective benthic habitats. Additional objectives will include crab distributional studies utilizing shallow water trawling (NOAA vessel in Port Moller) and pot trapping (ACC) methodologies. For your information, we have already fielded two projects in the study area this year (oceanographic and larval studies).

I'm very aware of the ACC's need for additional

information from this office regarding planned field schedules, personnel, and equipment requirements associated with this year's effort. Presently, NOAA is planning on having scientists in the field on or around August 1. If available, we would be able to fully utilize the ACC-provided vessel (and crab pots) in the study area beginning on August 10. We are hoping for at least 10 days of field support from the ACC this year. We are aware that this schedule may be subject to change based on further discussion between the ACC, UW and NOAA. Two members (possibly three) of the UW research team will join the ACC crew on board the Lady Ann during the conduct of actual field work. Dr. Armstrong (of the UW) has advised me of his need for about 50 king crab pots. Of these, approximately 2/3 would be fished as is, and the remaining number would be equipped with small net-mesh liners in an attempt to retain pre-podding crabs. Finally, you have indicated that fuel acquisition may present a financial problem for the ACC. Perhaps we can help. Please keep me advised of this matter so that proper arrangements could be made.

The ultimate goal of any fishery oceanography program is to begin to understand how wild stocks fluctuate in response to naturally-occurring environmental conditions and events. While the proposed program is expected to provide OCSEAP with better information regarding crab/habitat relationships we believe necessary for OCS leasing decisions, the results obtained should be of interest to those involved in the management and commercial harvest of the species. The prospects of cooperative research involving the ACC, the UW, and possibly other groups, is exciting. Such efforts may provide the opportunity to advance our current forecasting techniques (if methods for monitoring trends in relative abundance of young crabs can be developed) with obvious benefits to management and industry alike. At the very least, we would hope that the research provides an additional means of monitoring the health of this population. A realistic expectation of the research should be the further identification of areas needing special protection if depleted stocks are to recover. If I can be of further information, please do not hesitate to give me a call.

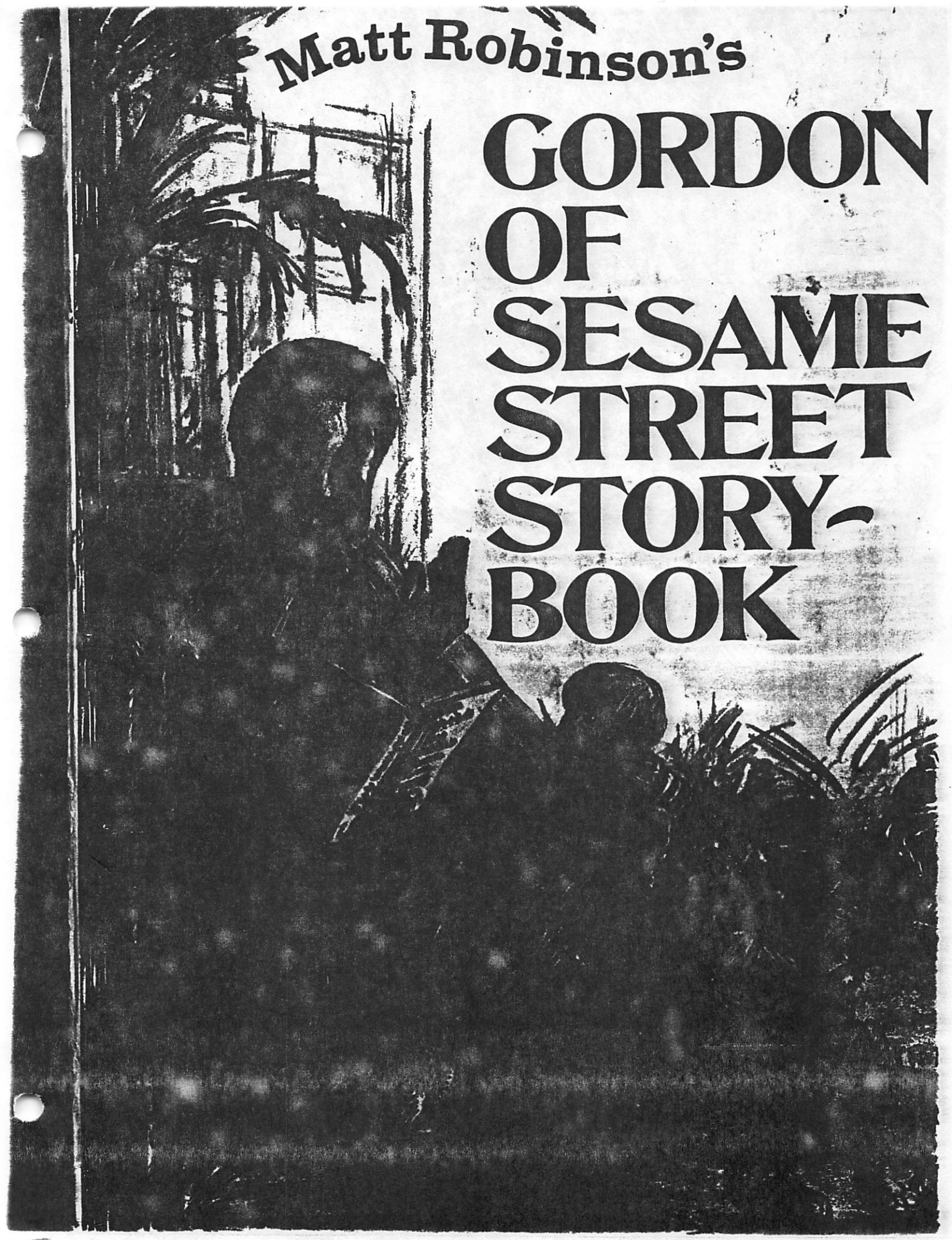
Sincerely,

Lyman Thorsteinson
Fishery Biologist

cc: D. Armstrong (UW)

Matt Robinson's

GORDON OF SESAME STREET STORY-BOOK



FISHER-MAN

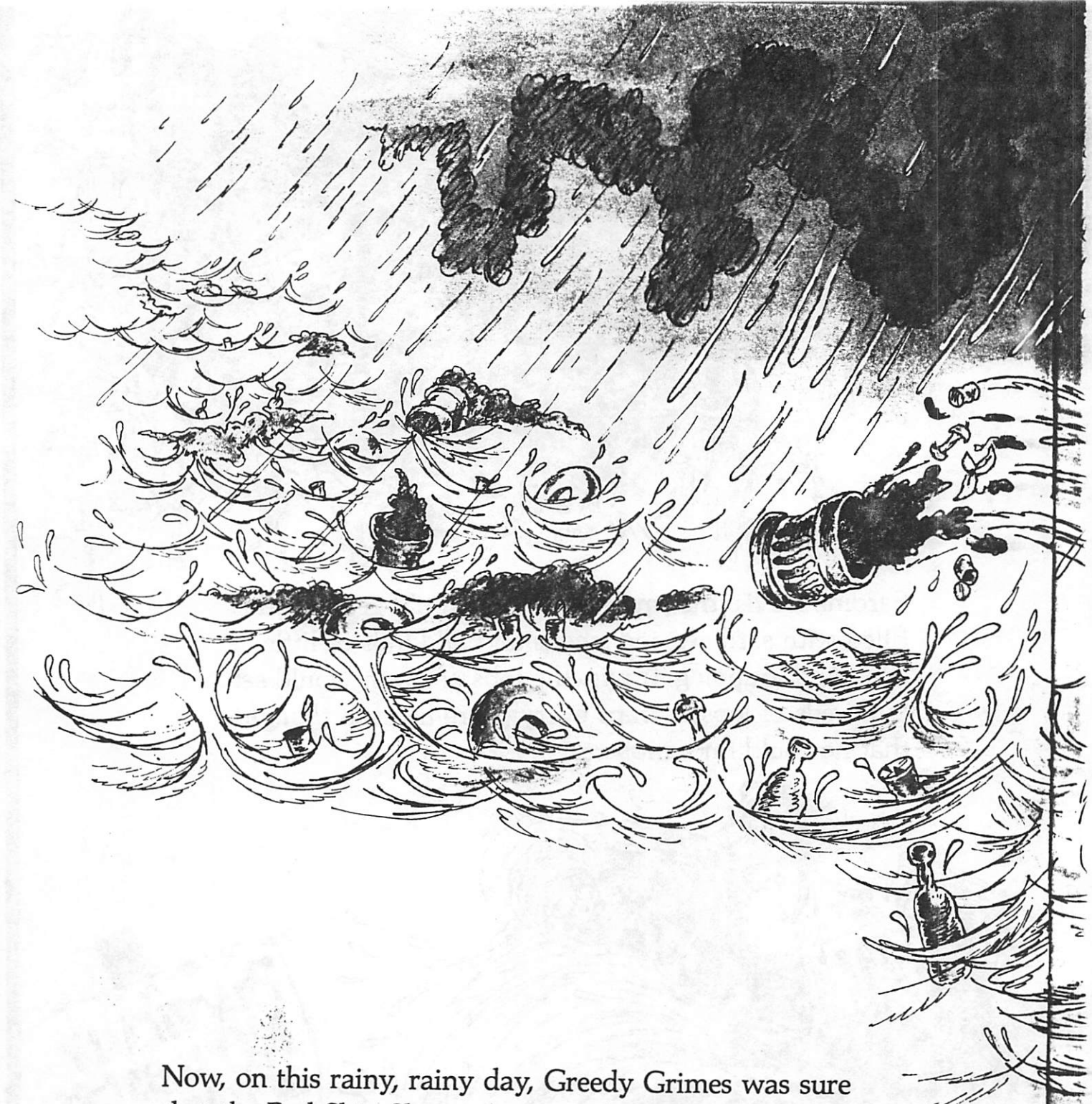
Way way out in the middle of the ocean, on a rainy, rainy day, there was a fishing boat. It was the only boat for miles around, and the name of this boat was the Bad Ship Sloppyslop. The Bad Ship Sloppyslop —the sloppiest, dirtiest, grimiest, filthiest boat on the seven seas.

Everywhere the Bad Ship Sloppyslop went—on the ocean, on the seas, on the rivers, on the lakes—the crew dumped garbage and trash overboard. They made the waters dirty for fish and dirty for people. The captain of this boat was Greedy Grimes.

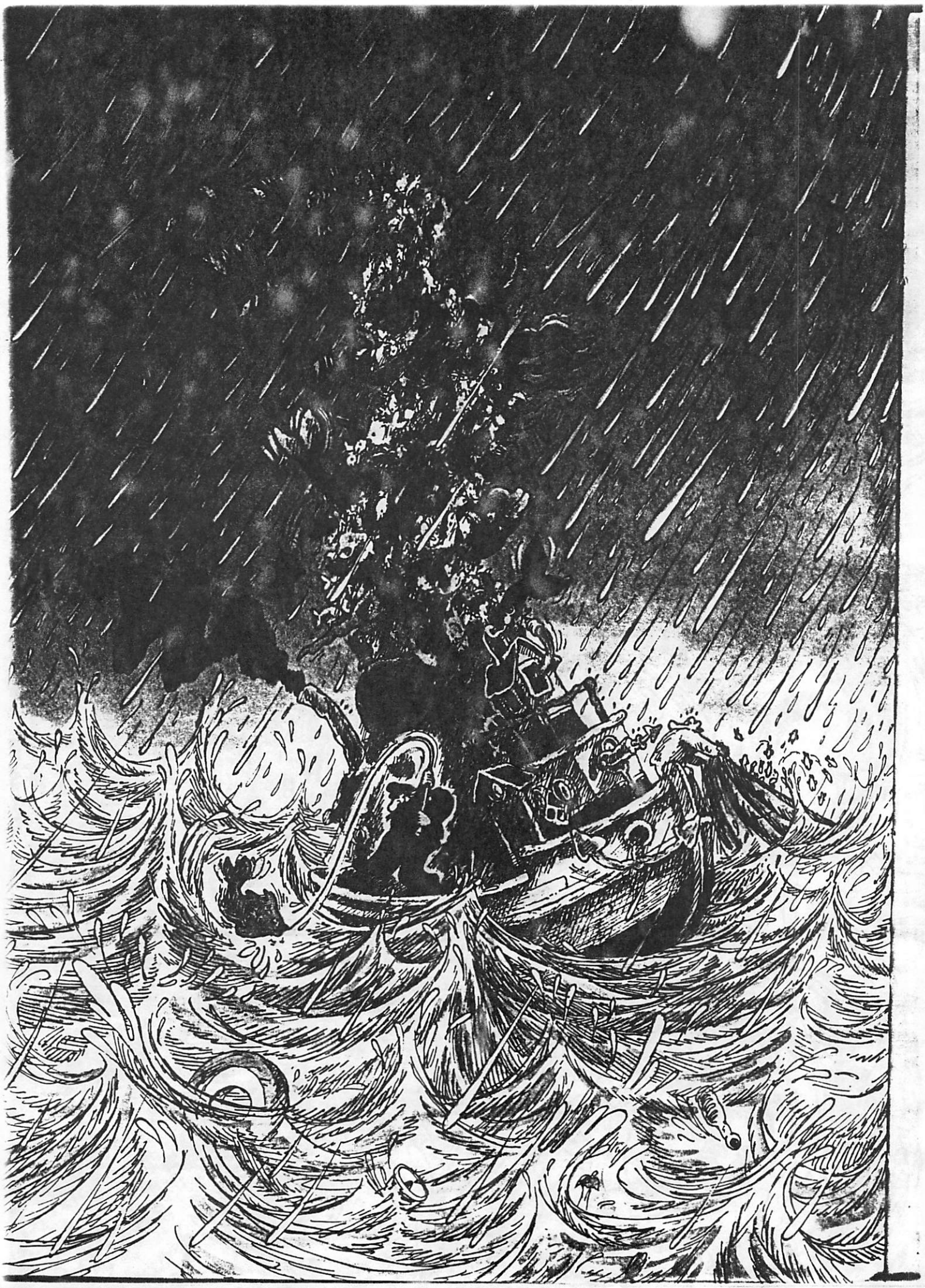
Now, if you think the Bad Ship Sloppyslop was bad, you should have seen Greedy Grimes. He was worse than the ship. And the worst thing about Greedy Grimes was the greedy way he fished. You see, Greedy Grimes and his two crew members, Trapping Travis, the lobster lover, and Sardine Davis, the small-fish man, lived on a little island called Dumb Dumb Island, just the three of them. But, when they went fishing, they caught hundreds and hundreds of fish, many many more than they needed.

Why, Greedy Grimes would catch big fish like tuna and swordfish.

Sardine Davis, the small-fish man, would get his nets filled with sardines and smelts and all kinds of little fish. And Trapping Travis, the lobster lover, would set hundreds of lobster traps everywhere he even *thought* that he could find a lobster.



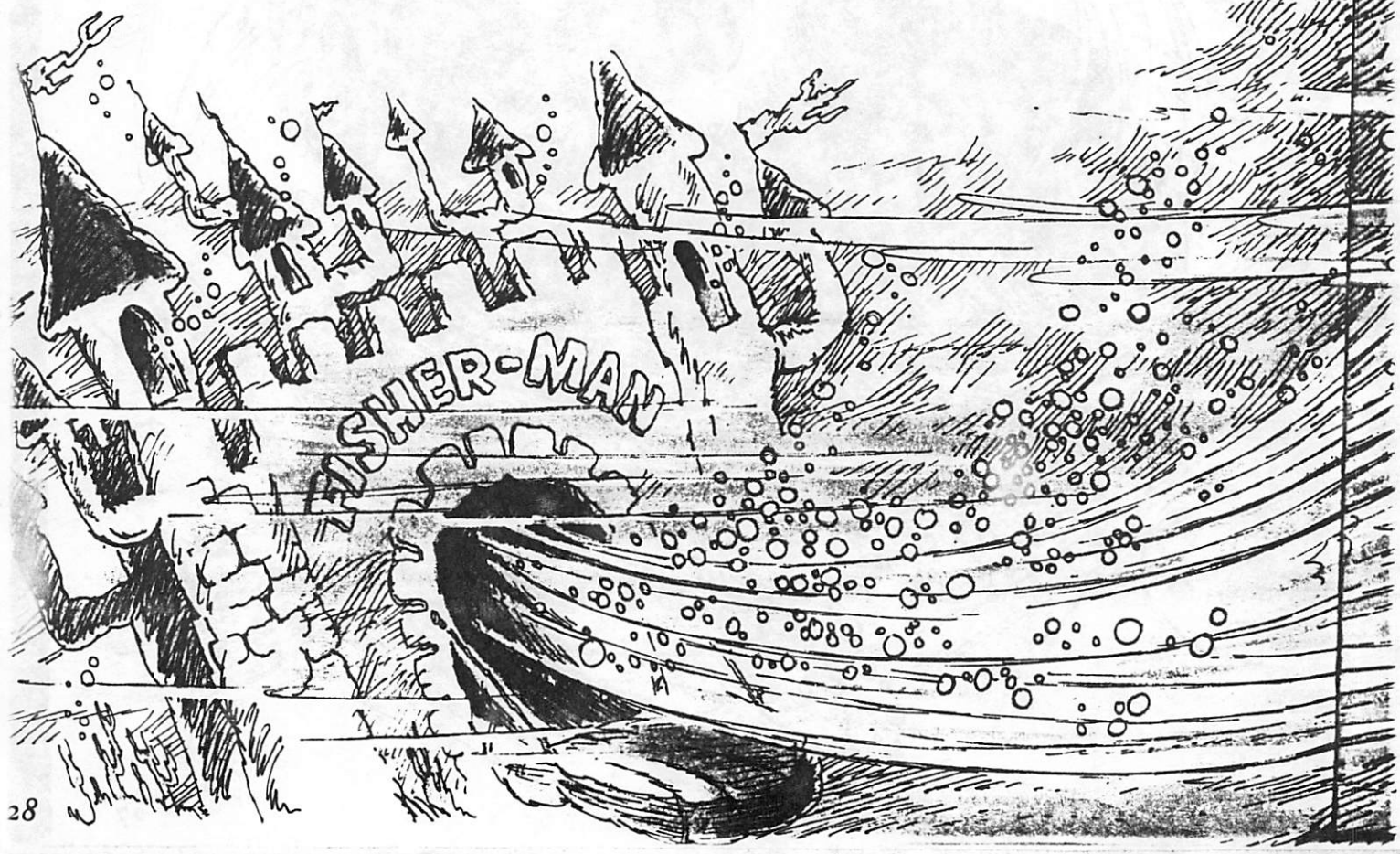
Now, on this rainy, rainy day, Greedy Grimes was sure that the Bad Ship Sloppyslop was the only boat on the ocean, so he tried to catch every fish swimming and crawling. He and his cruddy crew caught bass and flounder and crabs and mackerel and eels and everything they could reel in and pile on board. And to make room for more fish, they threw all kinds of junk in the water. They tossed in tin cans, old papers, orange peels, old rubber tires, just plain junk and garbage—anything to make room for more fish.

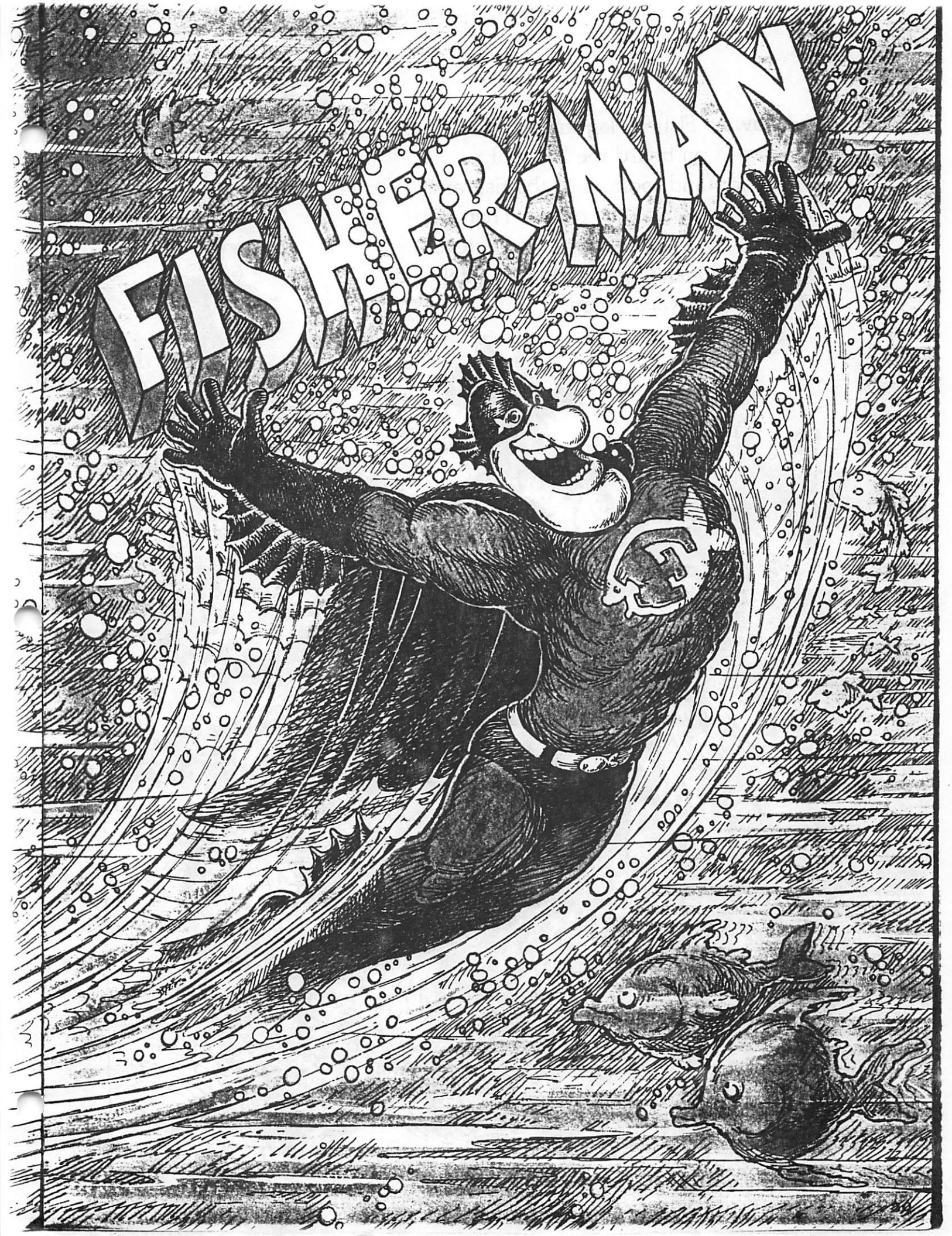


They piled so many fish on top of the boat that something began to happen. Something began to happen! The Bad Ship Sloppyslop began to sink. There they were in a sinking boat, way way out in the middle of the ocean, with the wind blowing, the rain pouring, and not another ship for miles around. When Greedy Grimes realized that his boat was sinking because the fish were too heavy, do you think he threw his fish overboard? Do you think so? No! He was too greedy! He just stood there and yelled and hollered, "Somebody, somewhere, save my boat and save the fish I caught!"

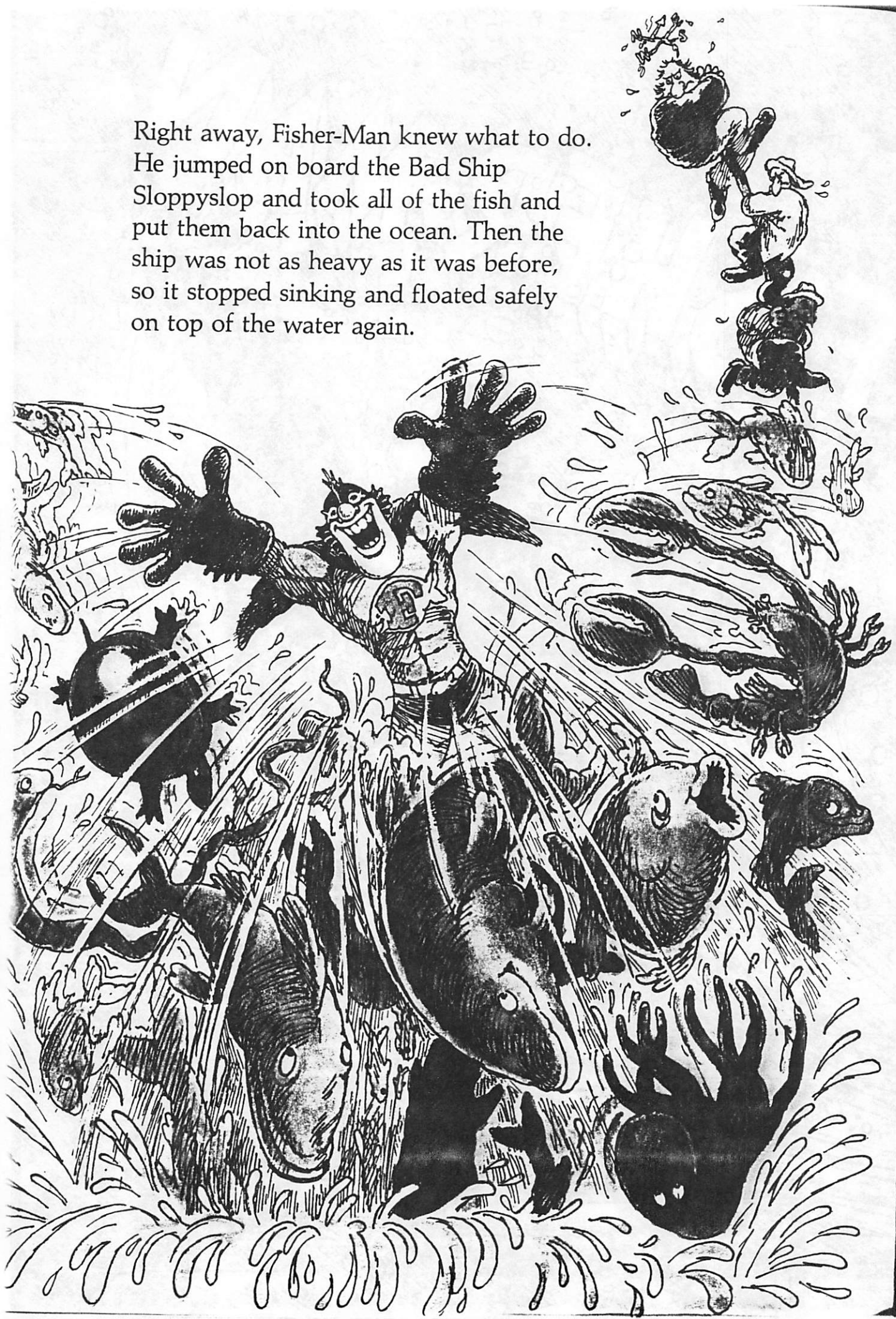
Of course, there was only one man in the world who could save him. Only one man. And that man wore a gray costume with a wide black cape, and a great pair of boots, and a black leather hat with a mask over his eyes, and they called that man Fisher-Man. Fisher-Man! Fisher-Man lived in the bottom of the ocean in a two-story watery castle, and he was there to make sure that no one made the water dirty and that no one took more fish than he needed.

Naturally, Fisher-Man had no use for Greedy Grimes and he wasn't too happy about the Bad Ship Sloppyslop or Trapping Travis or Sardine Davis. But, when a boat was in trouble, even if it was the Bad Ship Sloppyslop, it was Fisher-Man's duty to save the boat and everybody on board. So, when Fisher-Man heard Greedy Grimes yelling and hollering, he zoomed through the water until he came to the sinking ship.




FISHER-MAN

Right away, Fisher-Man knew what to do. He jumped on board the Bad Ship Sloppyslop and took all of the fish and put them back into the ocean. Then the ship was not as heavy as it was before, so it stopped sinking and floated safely on top of the water again.



But instead of being happy that they were safe, Greedy Grimes and his crew were angry because all of their fish were gone.

"Fisher-Man," said Greedy Grimes, "you had no right to throw all of our fish back into the ocean!"

"You're wrong, Greedy Grimes," said Fisher-Man. "Your boat was sinking because you had too many fish. Now! Not only won't you get your fish back, but I'm going to get all of the garbage and junk that you've ever thrown in the water and put it back on your boat."

Then the fantastic Fisher-Man scrounged up all of the junk in all of the water in the world and piled it all on top of the Bad Ship Sloppyslop. And in one great movement, he picked up the junky boat with one hand and swam back to Dumb Dumb Island. There he dumped the boat, the junk, Sardine Davis, Trapping Travis, and right on top of this huge pile, Captain Greedy Grimes himself.

And there they all are to this day, living in the Bad Ship Sloppyslop, up on top of all that garbage, and wishing they were someplace else.