AGENDA C-3
JANUARY 1986

M E M O R A N D U M

TO: Council, AP and SSC Members

FROM: Jim H. Branson
Executive Director

DATE: January 8, 1986

SUBJECT: Crab/Halibut Interceptions in Bristol Bay Pot Sanctuary

ACTION REQUIRED

Review public comments and take final action on proposals to control interceptions.

BACKGROUND

At the December meeting the Council accepted for public review proposals addressing the bycatch of crab and halibut in the Eastern Bering Sea trawl fisheries. The proposals were mailed to those on the Council's general mailing list on December 13, 1985. The deadline for receipt of public comments was January 7, 1986.

The proposals and synopses of public comments are included as Attachment C-3(a). Full comments appear as Attachment C-3(b). Jerry Reeves and Joe Terry of the Northwest & Alaska Fisheries Center are expected to present a report to the Council in Sitka that relates to this matter.

In considering ways to address the bycatch problem, the Council is not limited to the specific proposals in Attachment C-3(a) but may consider others that may arise during its deliberations or during the public testimony period.

JAN86/AL

North Pacific Fishery Management Council

James O. Campbell, Chairman
Jim H. Branson, Executive Director

411 West 4th Avenue
Anchorage, Alaska 99510

Mailing Address: P.O. Box 103136
Anchorage, Alaska 99510

Telephone: (907) 274-4563
FTS 271-4064

December 13, 1985

TO PERSONS INTERESTED IN PROPOSALS ADDRESSING CRAB AND HALIBUT BYCATCH IN THE EASTERN BERING SEA TRAWL FISHERIES

Enclosed for your review and comment is a set of proposals offered by fishing groups and North Pacific Fishery Management Council members addressing the bycatch of crab and halibut in the Eastern Bering Sea trawl fisheries. Written comments on these proposals or alternative proposals should be received at the Council office before January 7, 1986. They should be addressed to:

Jim H. Branson, Executive Director
North Pacific Fishery Management Council
P.O. Box 103136
Anchorage, Alaska 99510

ATTN: Trawl Bycatch Comments

The proposals and the written comments will be considered by the Council at the January 13-17, 1986 Council meeting in Sitka where they are expected to adopt regulations to control the crab and halibut bycatch. Any proposal adopted by the Council in January will be forwarded to the Secretary of Commerce for implementation as an emergency regulation for the 1986 season.

THE PROPOSALS INCLUDED HEREIN ARE EXAMPLES OF THE TYPES OF MEASURES UNDER CONSIDERATION BY THE NORTH PACIFIC FISHERY MANAGEMENT COUNCIL. IN ADDRESSING THE BYCATCH ISSUE, THE COUNCIL WILL NOT BE LIMITED TO CONSIDERING ONLY THE PROPOSALS LISTED HERE, BUT MAY CONSIDER OTHERS DURING THE REVIEW AND COMMENT PERIOD OR DURING THE JANUARY COUNCIL MEETING.

Sincerely,

Jim H. Branson
Executive Director

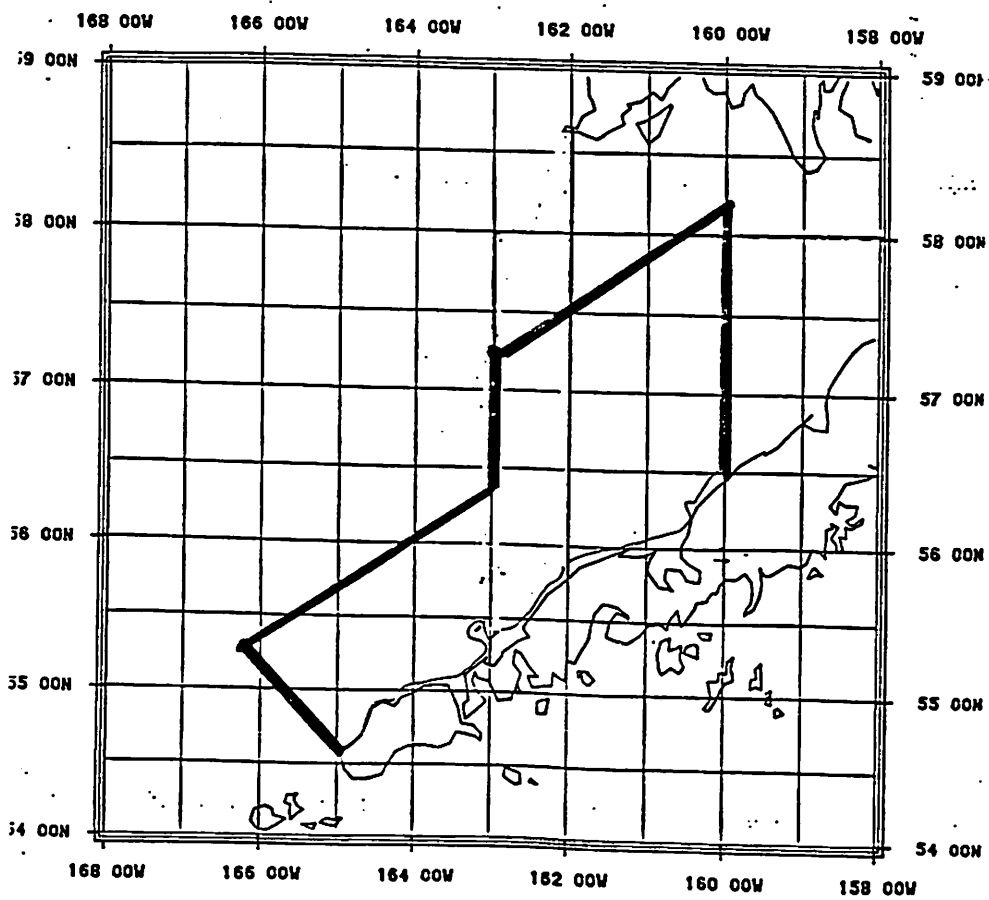
DEC85/BW

PROPOSALS FOR REDUCTION OF CRAB BYCATCH IN THE BRISTOL BAY POT SANCTUARY:

I. PROPOSAL SUBMITTED BY CRAB AND HALIBUT FISHERMEN

A. Submitted by Crab Fishermen Coalition

Restore and re-establish the jurisdiction of the pot sanctuary (see chart below) in the Eastern Bering Sea from Cape Saricheff east to Bristol Bay. It is requested that no trawling be permitted in this area by either foreign or domestic fishermen.



B. Submitted by Fishing Vessel Owners' Association

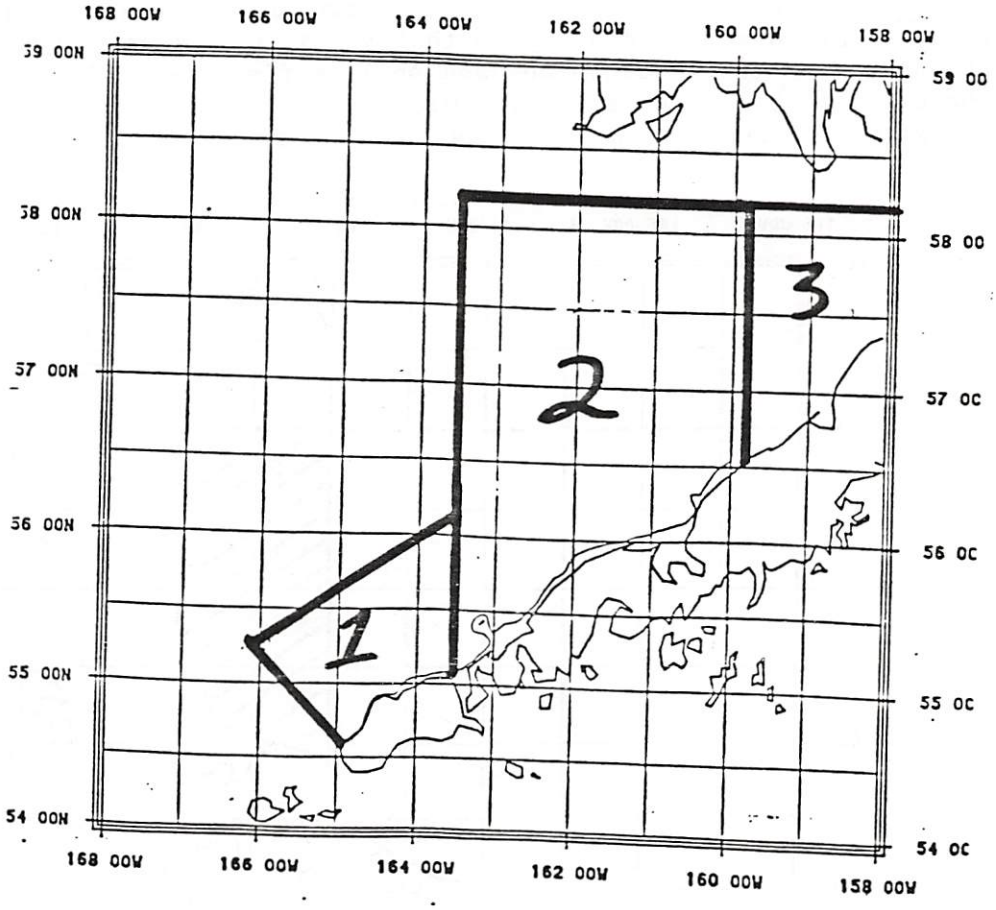
The FVOA proposes the following:

(a) In that area of the existing pot sanctuary extending from the westernmost point of the sanctuary to a line at 163'30" (Area 1), no flounder fishing would be permitted. Bottom trawl activities for cod and pollock, however, would be allowed to operate with a 25,000 halibut bycatch level.

(b) There would be no trawl activities in that area from 163'30" eastward to 159'45" with a northern boundary at 58'15" (Area 2) during 1986. ~~57~~ 160 58

(c) There would be a cap of 25,000 halibut for trawl activities in that area north of the Alaska Peninsula, south of 58'15" and eastward of 159'45" (Area 3).

Don C's motion to main Cons. motion



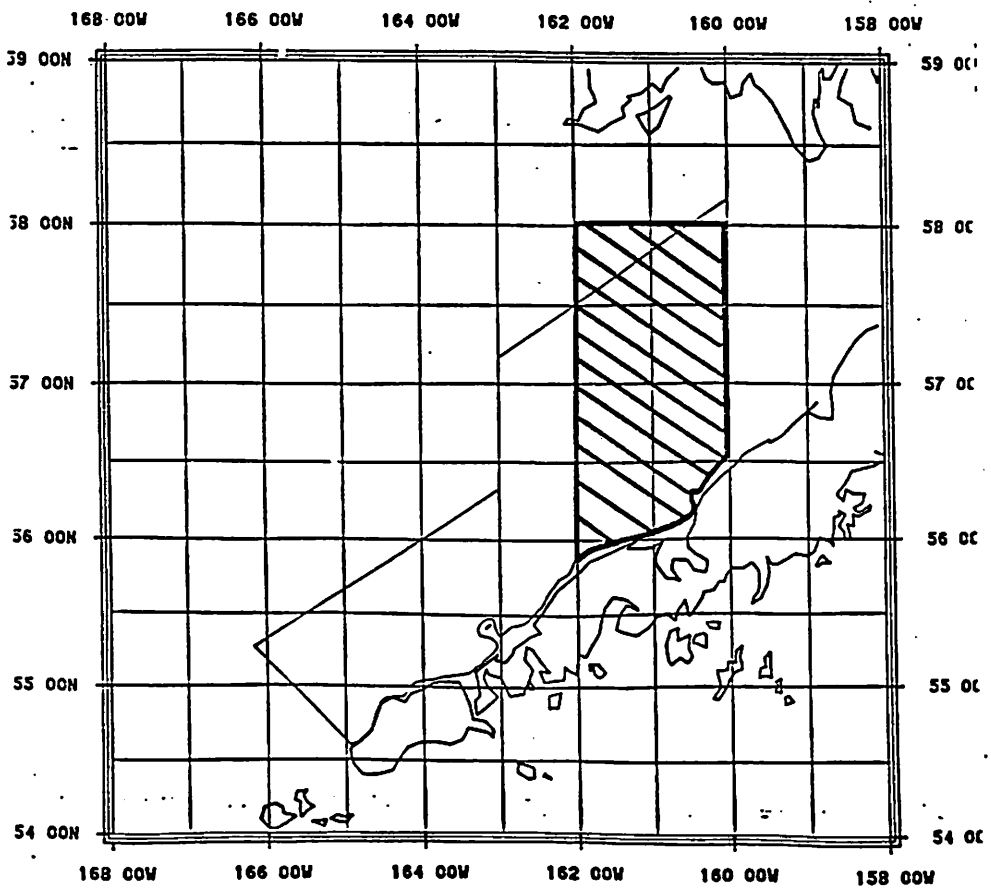
II. PROPOSALS SUBMITTED BY TRAWL GROUPS

NOTE: Industry groups have recently engaged in a series of negotiations to determine ways to reduce the crab and halibut bycatch in the Eastern Bering Sea trawl fisheries. The trawl participants in the negotiations wish to make it clear that their proposals listed immediately below are their current positions in those negotiations. Their statements address only their respective fisheries since they believe it is not proper for one trawl group to propose restrictions for other trawl fisheries. A comprehensive trawl proposal may eventually be offered combining the proposals from all trawl groups.

A. Submitted by the Alaska Factory Trawlers

Close the area south of 58°N between 160° and 162°W to on-bottom cod and pollock trawling. This closure would not apply to waters landward of the 25 fathom depth line and mid-water trawling.

Rationale: Each trawl fishery has its own unique circumstances, and any restrictive measure should apply to that specific fishery only. Our proposed solution applies to on-bottom cod and pollock fisheries only. Other measures may have to apply to the yellowfin sole fishery; however we are not presently in a position to suggest specific restrictions for that fishery.



B. Submitted by Joint Venture Flounder Trawlers

(1) King Crab

a. King crab bycatch areas divided into zones 1 and 2 as shown on the chart on the following page for the joint venture flounder trawl fishery. Joint venture bottom trawling for flounders will cease in Zones 1 and 2 if and when a cap of 155,000 king crab is taken.

b. Joint venture bottom trawling in Zone 1 for flounders will cease on June 1 whether or not the 155,000 crab cap has been taken.

c. Joint venture bottom trawling for flounder outside of Zones 1 and 2 will cease when a cap (in number of crab) of 2 crab per metric ton multiplied by the JVP allocation tonnage of yellowfin sole and other flounder caught outside of Zones 1 and 2.

(2) Tanner Crab

Joint venture bottom trawling for flounder will cease when a cap (in number of crab) of 4.4 crab multiplied by the JVP allocation tonnage for flounder and yellowfin sole is taken.

(3) Halibut

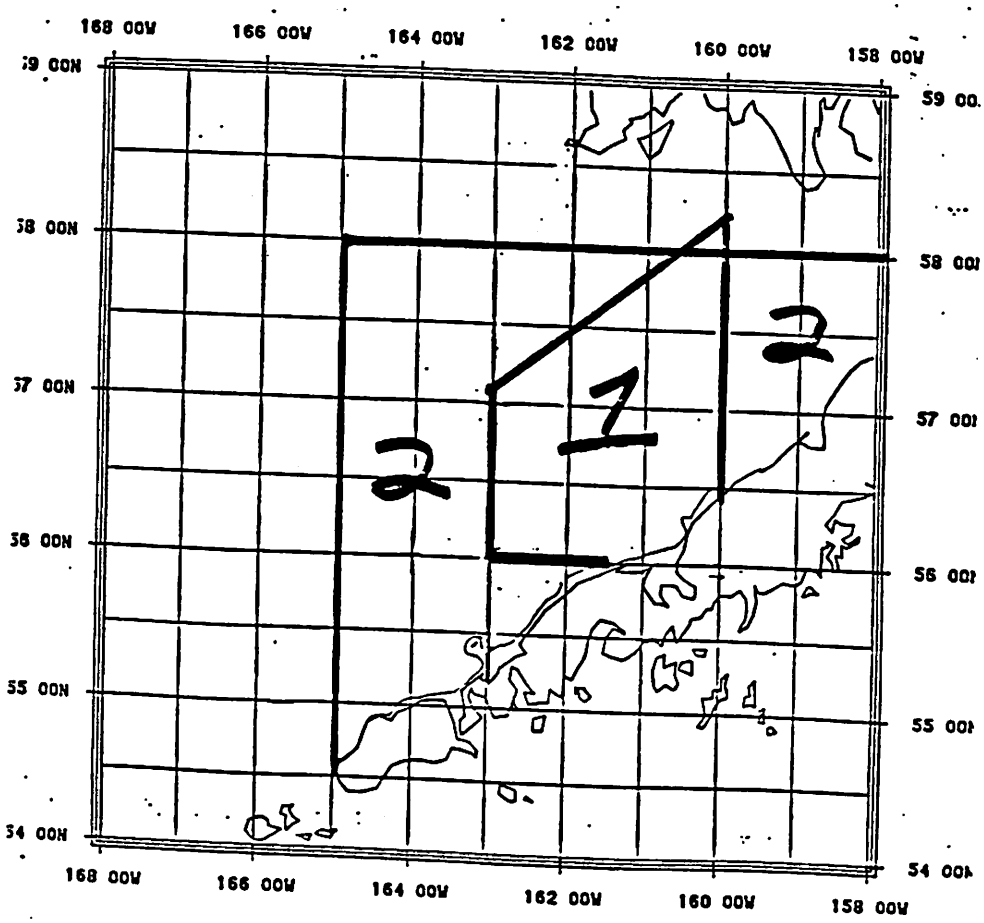
a. JV bottom trawling for flounders to cease in the pot sanctuary when a cap of 85,000 halibut are taken.

b. Outside the pot sanctuary JV bottom trawling for flounders shall cease when JV bottom trawling for flounders takes a cap (in weight) equal to 1% of the JVP tonnage for the flounder fishery.

(4) Distribution of Caps

All caps to be proportioned to individual JV operations on the basis of the percentage of the JVP tonnage of yellowfin sole and other flounder.

Rationale: To maintain the economic viability of our fishery, we need to fish in April and May. During that period the only commercially exploitable stocks of flounder are located in and adjacent to the Bristol Bay Pot Sanctuary. We can keep our bycatch of crab and halibut at very low levels by moving our operations to crab-free areas and refining gear to make it fish cleanly. The cap of 155,000 king crab, which actually comprises a removal of about 26,000 female crabs, guarantees that our operation will not have a significant biological impact on the king crab stocks.



The boundaries to the above zones are:

Zone 1: The eastern boundary follows the 160° east line from the Alaska Peninsula to 58°10' north latitude. The northern boundary extends southwest from 58°10' north latitude to the intersection of the 163° east line and 57°10' north latitude. The western boundary follows the 163° line south to 56° north latitude. The southern boundary is the 56° line from 163° longitude eastward to the Alaska Peninsula.

Zone 2: This zone extends seaward along the 165° east longitudinal line from the Alaska Peninsula to 58° north then eastward to the Alaska Peninsula.

C. Submitted by the Pollock Trawlers

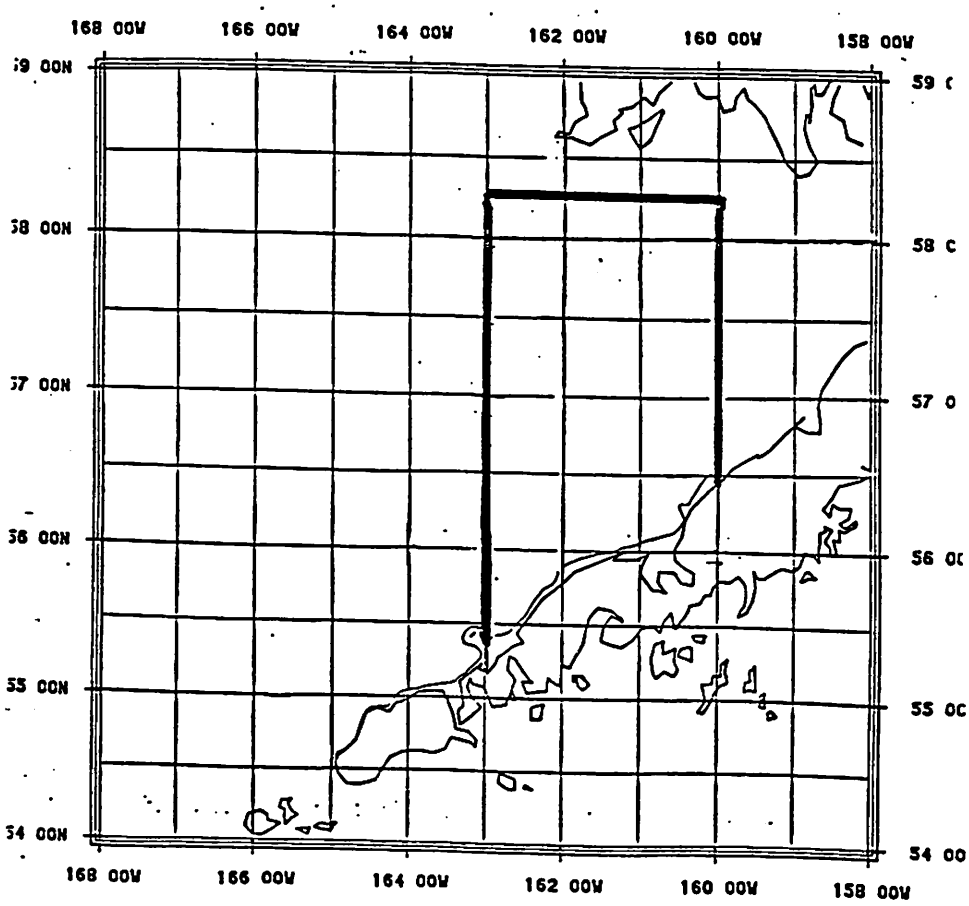
No time/area restrictions apply to pollock joint ventures until data indicate these fisheries impose harm on king crab stocks.

III. PROPOSALS SUBMITTED BY OTHER INDUSTRY PARTICIPANTS

A. Submitted by the North Pacific Fishing Vessels Owners Assn

A one-year moratorium (for 1986) on all trawling in the area south of 58°15' between 160° and 163° latitude.

Rationale: The moratorium is designed to protect the principle habitat of the female king crab stocks. It is NPFVOA's intention that this proposal may be amended as a result of the ongoing work of the industry incidental catch workgroup.

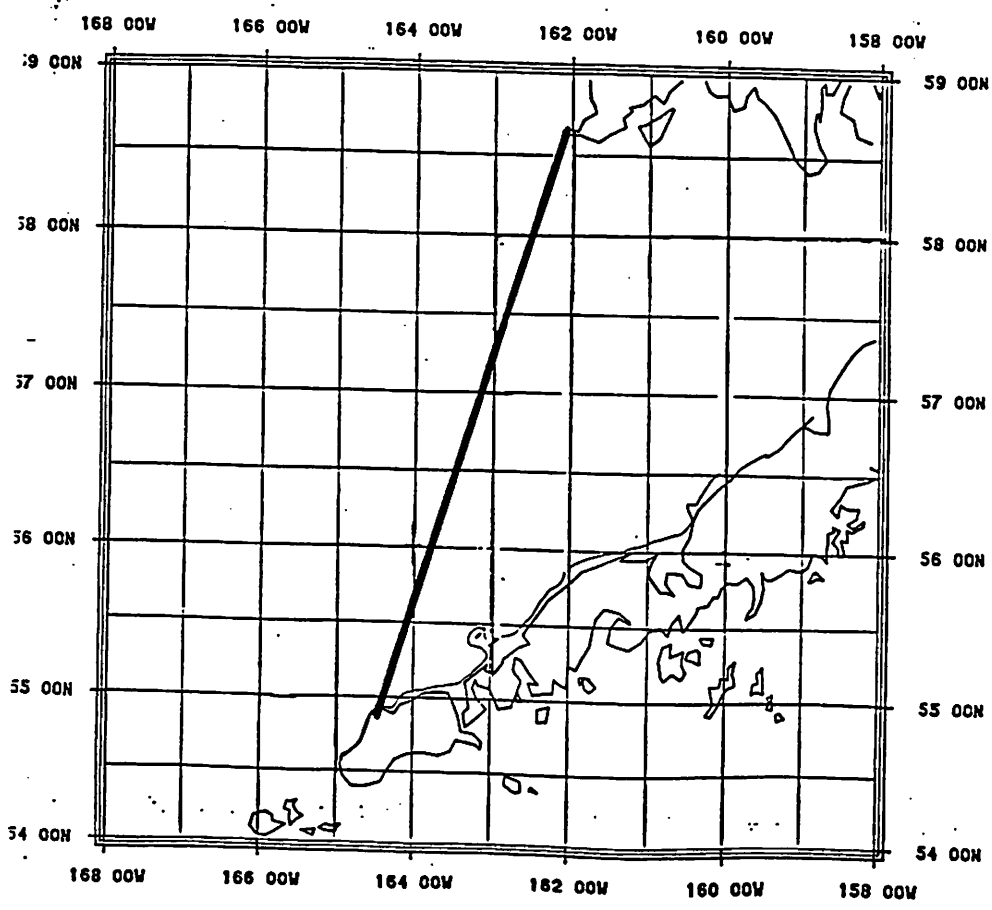


B. Submitted by Ocean Spray Fisheries

1. (a) The Council should delay action until NMFS conducts a crab survey in the pot sanctuary in February to double-check the results from the survey conducted in June; and,

(b) If the Council should deem that there is a significant biological problem with female red king crab in the existing pot conservation area and/or any other area as outlined by other closure proposals and closes the area to domestic fisherman, both pot and trawling, then the area east of a line from Cape Newenham to Cape Mordvinof (see chart below) be closed to all foreign trawling under an emergency order for one year and be reviewed after that one year is up.

(c) Domestic midwater trawling would be allowed to continue and not be burdened with any closures within the Newenham-Mordvinof line.



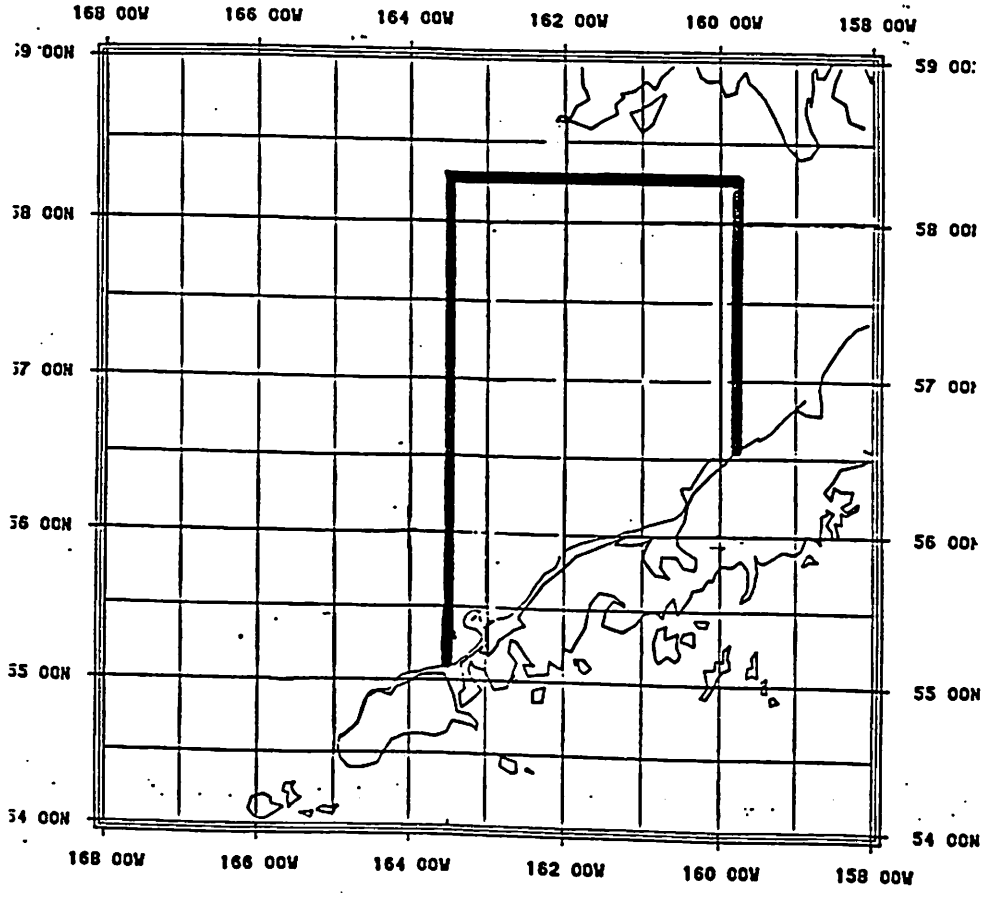
C. Submitted by United Fishermen's Marketing Association

In order of preference:

1. A total closure of pot sanctuary to on-bottom trawling.

2. A closure of the area bound by 163°30" to the West, 58°15"N and 159°45" to the East, (see chart below) to bottom trawling.

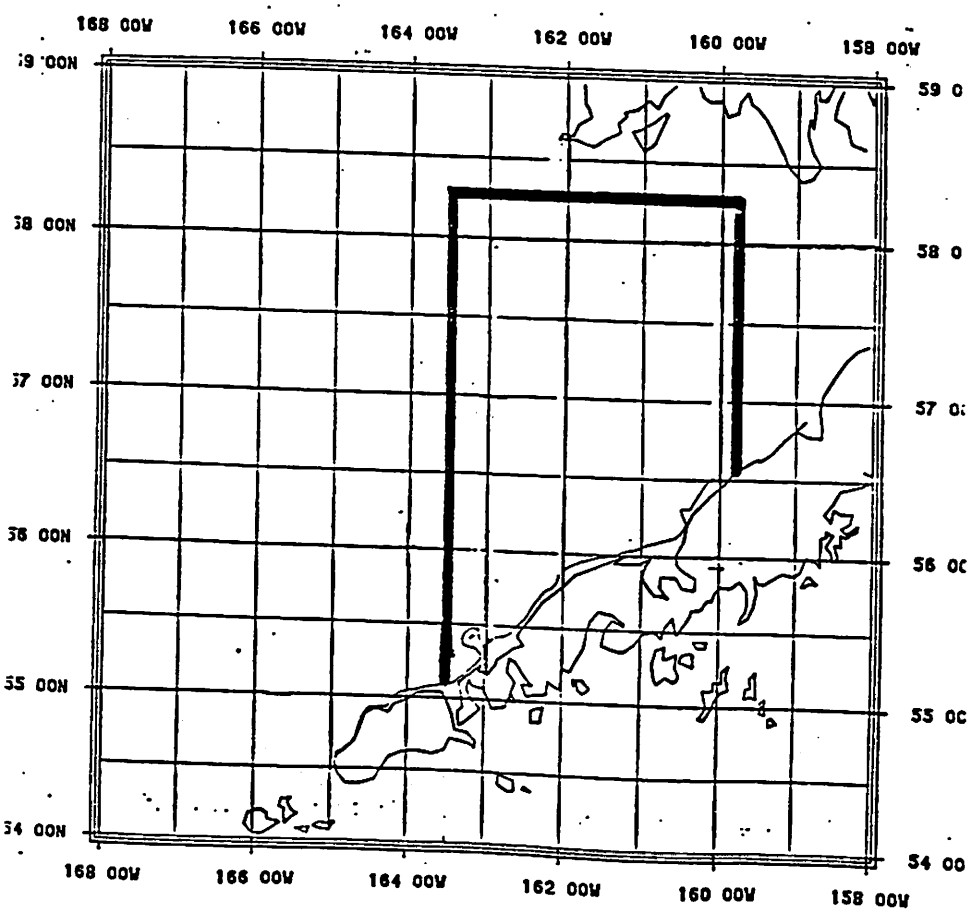
3. A five-month closure (April-August) of the pot sanctuary to bottom trawling.



IV. PROPOSALS SUBMITTED BY NORTH PACIFIC FISHERY MANAGEMENT COUNCIL MEMBERS

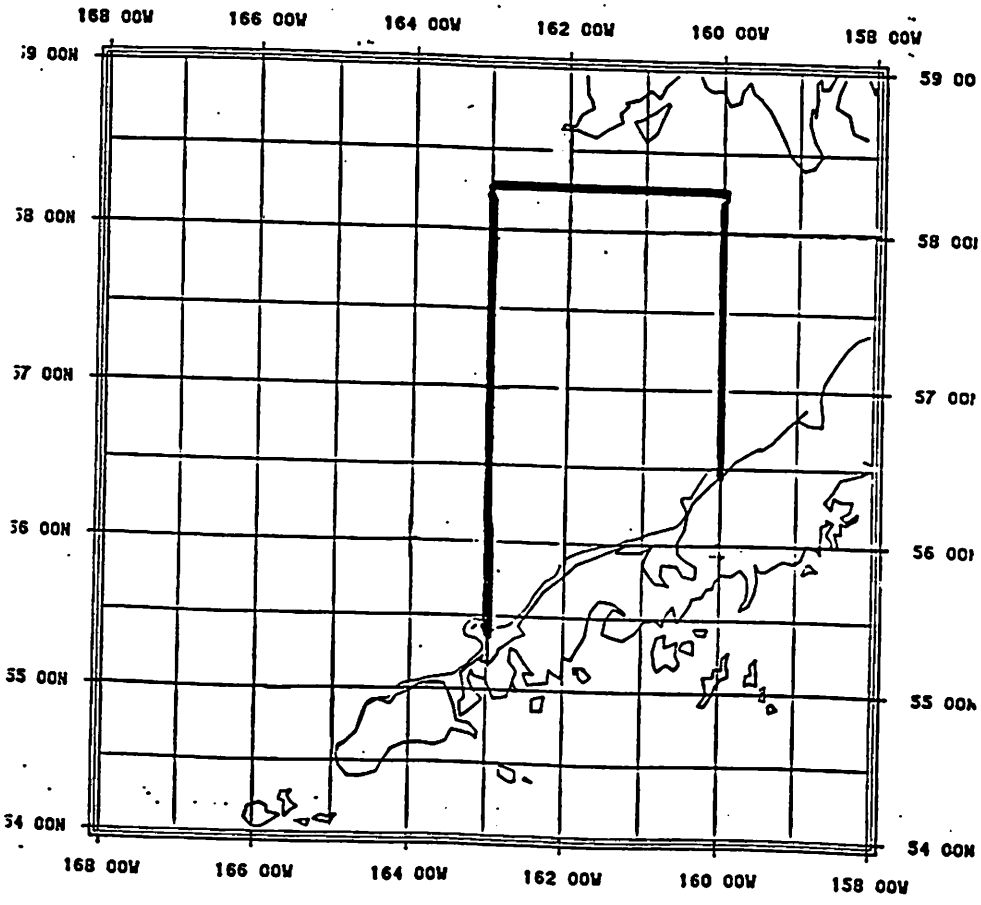
A.

A closure of the area 163°30" to 159°45" East latitude North to 58°15" would apply to all trawling. A yet to be determined cap on the number of halibut and crab taken as bycatch outside of that area would be placed on all trawling.



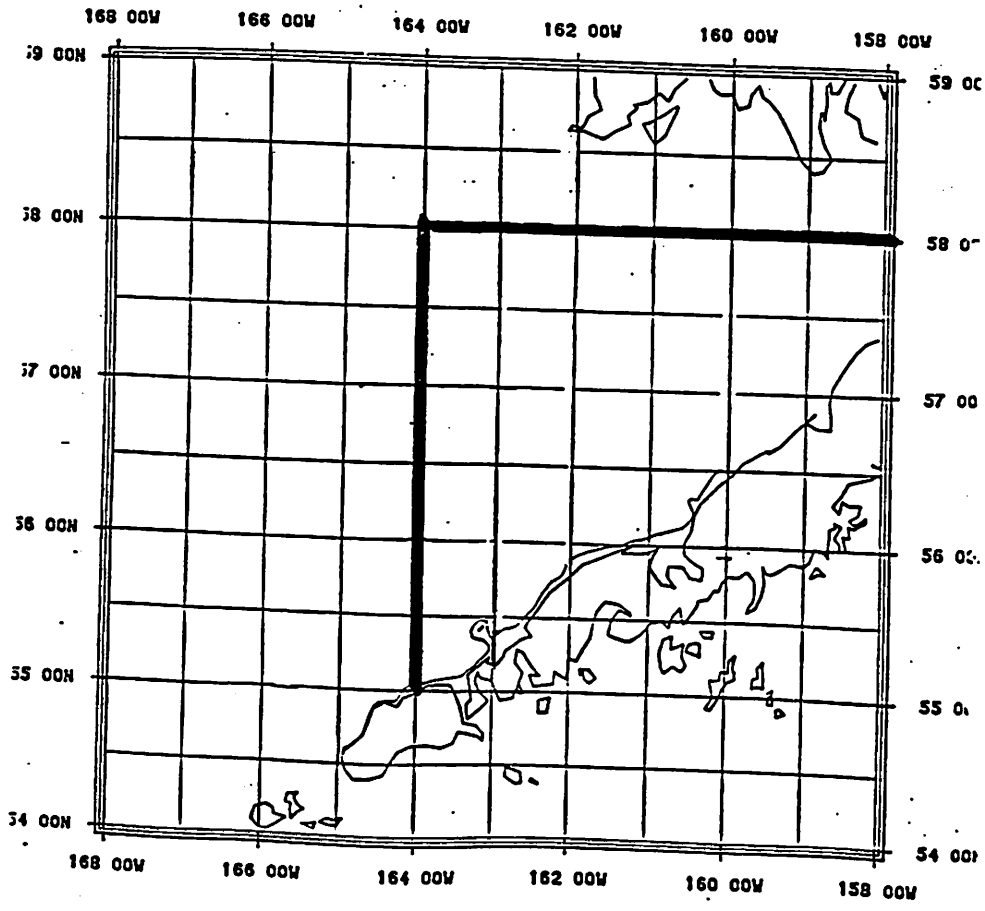
B.

The area south of 58°15" between 160° and 163° latitude (see chart below) would be closed to all fishing for one year.



C.

A total closure to all crab and trawl fishing in the area bounded by 164° longitude, 58° latitude and the Alaska Peninsula.



SYNOPSES OF PUBLIC COMMENTS

1. International Ocean Opportunities Unlimited, Inc.

   - The overall problem of bycatch should be equated with fully-utilized species and an integrated approach on an ecosystem basis is the only way to handle the bycatch problem in the long term.

   - The Council must apply workable king crab bycatch caps on an equitable basis for each trawl fishery based on the overall DAH for yellowfin sole and flatfish while taking into consideration TALFF and reserves.

   - Once the bycatch limit is reached, no further use of on-bottom gear should be allowed.

   - If an area closure is necessary, the area should be no larger than that area between 160° and 162°W. longitude with a northern boundary between 56° and 57°N. latitude.

   - The Tanner crab bycatch should be held at the 1985 levels.

2. Sitka Sound Seafoods Inc.

   - The Council should take immediate and conservative action on the trawl bycatch of crab and halibut in all areas.

3. C.L. Beahout

   - Listed three of the proposals in order of preference:

     - first choice, proposal I A
     - second choice, proposal IV A
     - third choice, proposal IV C

4. Midwater Trawlers Cooperative

   - Details the background of proposal II B.

   - Proposal II B will reduce bycatches as follows:

     403,000 less king crab
     67,700 less female king crab
     102,500 less halibut
     145,400 less Tanner crab

   - The data on crab resource distribution indicates the vast majority of red king crab females are to be found east of 163°W. longitude.

   - Closure of areas west of 163°W. longitude will result in a hardship to trawlers and will close grounds where few crab will be found.

- If major area closures to trawling in the Eastern Bering Sea on a year-round basis are implemented then a true crab sanctuary should be established wherein all fishing is prohibited year-round.

- A high bycatch of female and sublegal red king crab occurs in the red king crab commercial fishery.

- The Tanner crab fishery is an additional source of handling and sorting mortalities of red king crab.

5. Japan Fisheries Association

- Foreign fishermen are already prohibited from fishing in the pot sanctuary in the Winter Halibut Savings Area.

- The Council has already established a management system which controls the incidental catch of prohibited species in foreign trawl fisheries for the Bering Sea and Aleutian Islands area.

- No additional action is necessary to regulate the incidental catch of crab and halibut in the foreign trawl fishery.

- The Council is encouraged to develop a management system which will strike an equitable balance over the long term among the various domestic and joint venture user groups operating within the Bristol Bay Pot Sanctuary.

- Midwater trawling in the joint venture pollock fishery takes virtually no incidental catch of king crab and halibut.

- The U.S.-Japan joint venture trawl fishery for flounders has reduced incidental catches of king crab and halibut through gear modifications and other operational procedures.

6. North Pacific Fishing Vessel Owners Association

- The NPFVOA supports a one-year moratorium (for 1986) to all trawling in that part of the Eastern Bering Sea between 160° and 163°W. longitude and south of 58°15'N. latitude (proposal III A).

7. Walter C. Pasternak

- There should be no trawl fishing in that area from 163°30' eastward to 159°45' longitude with a northern boundary at 58°15' latitude during 1986 (proposal I B). In that area of the existing pot sanctuary extending from the westernmost point of the sanctuary to a line at 163°30' there should be a bycatch cap of 15,000-20,000 halibut instead of the 25,000 halibut as stated in proposal I B.

- All hard on-bottom trawling should be phased out of the halibut nursery grounds of the Bering Sea.

- Economic studies need to be done to determine the potential economic loss to historic fisheries caused by the bycatch of crab, halibut, salmon and blackcod.

- Observers should be placed on American factory trawlers.

8. James A. Lange

- Supports proposal I A.

- Place observers on all factory trawlers.

9. International Pacific Halibut Commission

- Three of the proposals offer some protection for juvenile halibut:

  - I A is probably superior in the short term without an observer program;

  - I B and IV A may provide better long-term protection, assuming an observer program is in place.

- The IPHC staff supports the concept of a bycatch limit for domestic trawling in the Bering Sea, but without an observer program such a limit is unenforceable.

10. Consolidated Trawler Response
From: Marine Resources Company, ProFish International, Westward Trawlers, Alaska Joint Venture Fisheries, Inc., Northern Deep Sea Fisheries, Inc., Factory Trawlers Association, and Midwater Trawlers Cooperative.

- Close for one year to all fishing the area between 160° and 162°W. longitude and south of 58°N. latitude to the 25-fathom line off the Alaska Peninsula (proposal II A).

- Support proposal II B.

International Ocean Opportunities Unlimited, Inc.
国际海洋无限机会公司
1216 Pine Street, Suite 306
Seattle, Washington 98101
Telex: 152856 SEA
Phone: (206) 622-5973

December 27, 1985

Jim H. Branson, Executive Director
North Pacific Fishery Management Council
P.O. Box 103136
Anchorage, Alaska 99510

Dear Mr. Branson; re: Trawl Bycatch Comments

International Ocean Opportunities supports a sound management system for the allocation of fish resources, based on the best available scientific evidence which takes an ecosystem approach to allocation of fish resources.

At the December meeting of the council legitimate evidence was presented by Gary Westman which supports the theory that a bottom trawl fishery may actually benefit the crab stocks of the Eastern Bering Sea. This evidence came late in the evening and was, unfortunately, taken lightly by council members and others. This testimony and other predator/prey data indicated by harvest patterns since the late sixties tell us one thing: we can not say for certain that there is a causative relationship between trawling in the E. Bering Sea and the demise of crab resources. Therefore, a conservative approach to the bycatch control question is the only one that makes sense.

The decline in king crab resources must be addressed, without unduly injuring rightful interests of other domestic fishermen in the area. The answer is not arbitrarily closing off half of the E. Bering Sea to some or all trawl groups.

The number of king crab which may safely be removed in all fisheries without further injury to stocks has been determined by NMFS. It is necessary to apply workable caps on an equitable basis to each trawl fishery, based on the overall DAH for yellowfin sole and flatfish, taking reserves and TALFF into consideration.

It is not fair to discriminate among DAH users within this gear group. Each domestic (JV and DAP) operation's bycatch limit will be set based on realistic tonnages. Once the bycatch is exceeded no further on-bottom gear will be allowed. Operations which do not receive a bycatch limit should not be allowed to use trawls other than midwater.

If it is deemed necessary, an area closure no larger than the square between 160 degrees W. Long. and 162 degrees W. Long., and 56 degrees N. Lat. and 57 degrees N. Lat. should protect these known nurseries for halibut and king crab, during times of high concentration. Tanner crab bycatch should be held to target levels of 1985.

We support Mick Steven's testimony which advocates that the overall problem of bycatch should be equated with fully utilized species, and that an integrated approach on an ecosystem basis is the only way to handle the problem in the long term. Thank you for the opportunity to testify.

Sincerely yours;

Lois J. DuPey

LD:cj

Sitka Sound Seafoods Inc.
329-333 Katlian Street
Sitka, Alaska 99835
P.O. 830 Sitka, Alaska 99835

Phone: 907-747-6662

SITKA SOUND SEAFOOD

January 2, 1986

Mr. Jim H. Branson
Executive Director
NPFMC
P.O. Box 103136
Anchorage, Alaska 99510

Dear Mr. Branson:

As a company that deals directly with literally hundreds of small and large hook-and-line fishermen involved in the tradition harvest of halibut and salmon, we feel an over-riding concern for the practices, and effects of the developing trawl fisheries. What is going on in the Eastern Bering Sea with regard to incidental catch by the trawlers of halibut and crab as well as in other areas is something the Council should take immediate and conservative action on. To error on the conservative side when one is dealing with a nursery grounds for at least two extremely valuable resources would seem to be prudent.

Americanization at any price is not in the best interests of all Americans.

Sincerely yours,

Harold Thompson
General Manager

3.

North Pacific Fishery Management Council

James O. Campbell, Chairman
Jim H. Branson, Executive Director

411 West 4th Avenue
Anchorage, Alaska 99510

Mailing Address: P.O. Box 103136
Anchorage, Alaska 99510

Telephone: (907) 274-4563
FTS 271-4064

December 13, 1985

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Jim H. Branson, Executive Director
North Pacific Fishery Management Council
P.O. Box 103136
Anchorage, Alaska 99510

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Sincerely,

Jim H. Branson
Executive Director

C.L. Beahout
P.O. Box 10-971
anch, AK 99511

Comment: Harsh methods have to be used now if the King Crab fishery is to recover in the near future. Many thousand of discarded or lost Crab pots are still catching this is all the Crab by catch the fishery needs. this is the endangered fishery

DEC85/BW

① Choice

PROPOSALS FOR REDUCTION OF CRAB BYCATCH IN THE BRISTOL BAY POT SANCTUARY:

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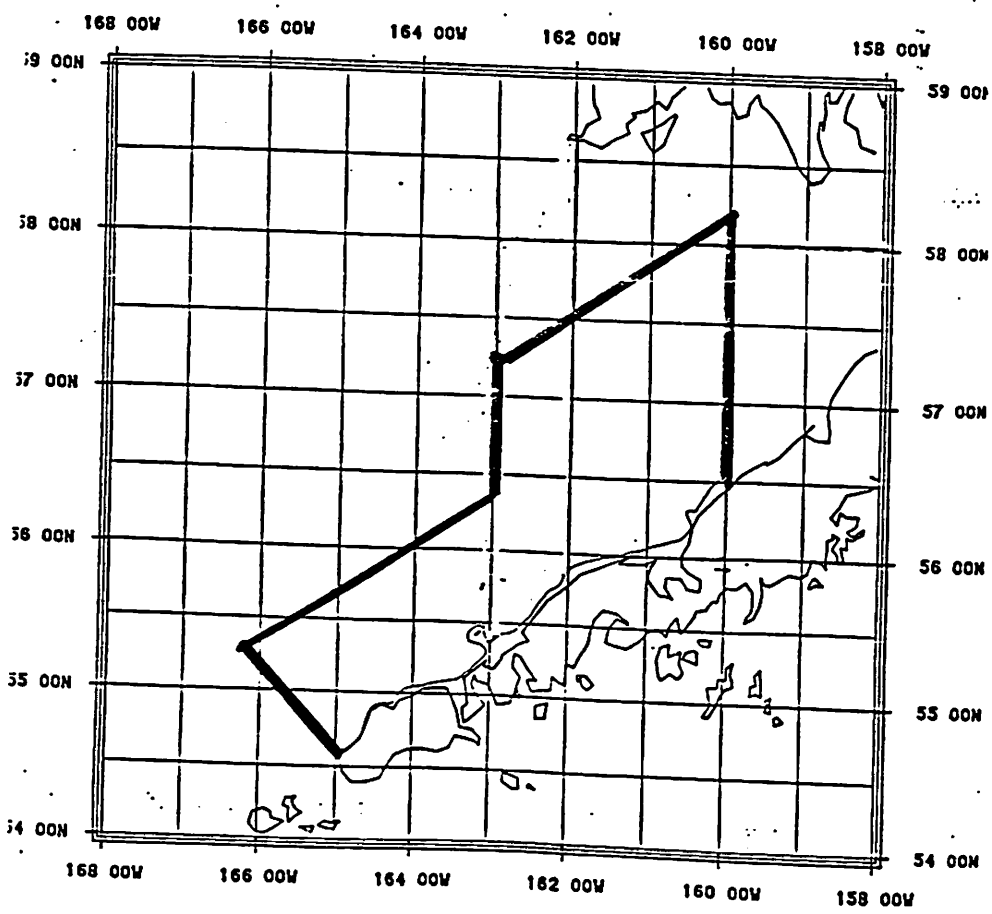

(2) Choice

IV. PROPOSALS SUBMITTED BY NORTH PACIFIC FISHERY MANAGEMENT COUNCIL MEMBERS

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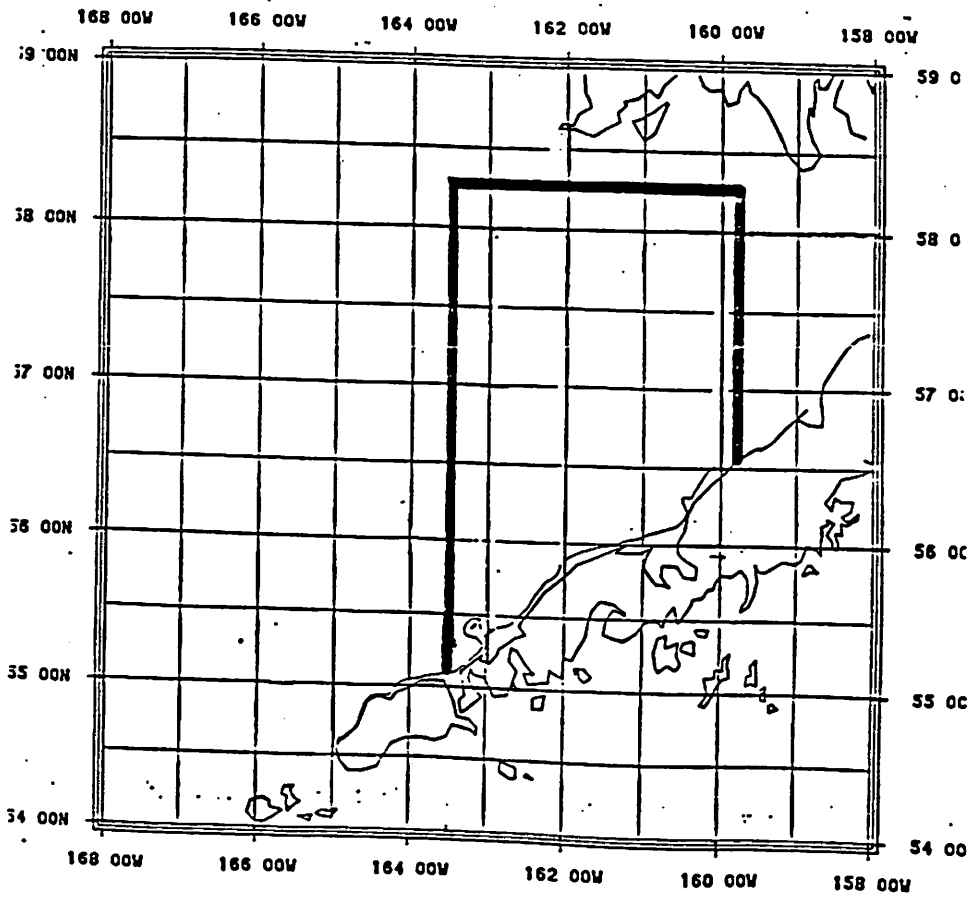

(3) Choice

C.

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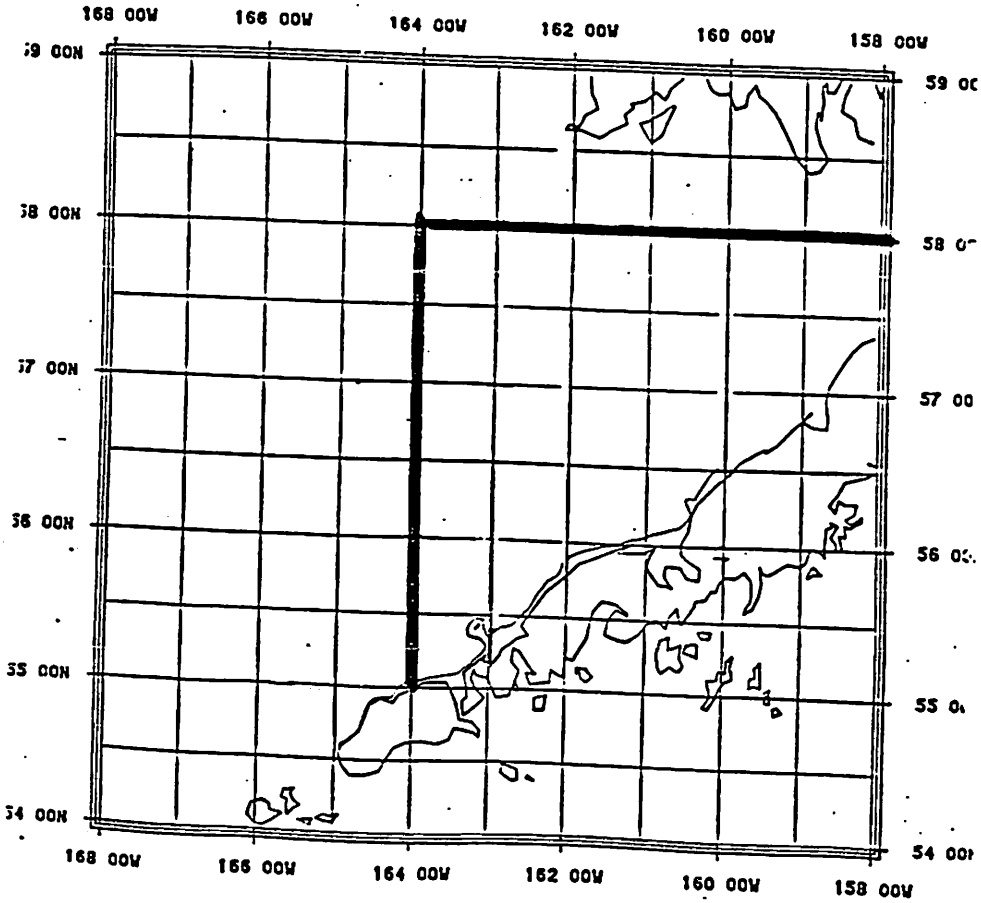


Midwater Trawlers Cooperative
3055 21st Avenue West Seattle, Washington 98199

December 19, 1985

Mr. Jim Campbell and
Mr. Jim Branson
North Pacific Fishery
Management Council
P. O. Box 3136DT
Anchorage, Alaska 99510

Dear Jim and Jim:

You might characterize this as a multi-purpose letter. First, our members wish to thank you and your Council for their perception and what we believe was good judgment in reviewing the sensitive Bering Sea king crab bycatch issue, sending the various proposals out for public review and deferring final decisions until January. Secondly, in preparation of the "Flounder Trawlers Proposal" our members put forth a solid, good faith effort using an extensive technical data base and we believe our proposal addresses the key concern--conservation of female red king crab. This proposal represents major compromise to our fisheries, yet we certainly recognize the severity of the problem.

As for the third item, we would like to respond to Jim Branson's letter of December 13, 1985 calling for public comment on the bycatch issue and the various proposals provided by industry groups and NPFMC members.

As regards our Flounder Trawlers Proposal, several Council members asked good questions which seemed oriented toward seeking comparative information as to how regulations proposed for 1986 would compare to the actual track record in 1985. In response, we have prepared the following points which we believe addresses these questions:

1. Within the pot sanctuary, the MRC fleet harvested about 87,000 mt of flounder, cod and pollock. This 87,000 mt comprised about 56 percent of MRC's 1985 joint venture fishery as their total harvest from inside and outside the pot santuary totaled about 154,000 mt.

2. In addition to the MRC catches noted above, several other JV operations targeted on yellowfin and other flounders. We estimate that other JV catches plus MRC catches would bring the total to 120,400 mt from inside the pot sanctuary. For all areas, the composite flounder fleets in 1985 harvested about 214,000 mt.

3. As for the respective bycatches, the MRC fleet accounted for about 403,000 king crab, 135,000 halibut and 165,100 Tanner crab as a result of operations within the pot sanctuary. We estimate all flounder JV's within the pot sanctuary had bycatches of 558,000 king crab, 157,500 halibut and 229,100 Tanners.

4. Our proposal request the pot santuary area be left open to bottom trawling for the months of April and May, then closed, or closed sooner if the ice edge permits fishing outside the pot santuary. Assuming two months fishing in this pot santuary area, we estimate a harvest by the flounder fleets of 62,000 mt would be achievable under proposed crab and halibut restrictive caps.

5. Inside pot santuary bycatches reported for 1985, projected for 1986 under our proposal, savings relative to 1985 and the cost relative to a pot santuary total closure are summarized below:

Total King Crab Bycatch		Savings Relative to 1985	Cost Relative to Closure
1985	1986		
558,000	155,000 cap	403,000-total king crab	- 155,000
Female King Crab Trawl Mortalities			
1985	1986		
93,740	26,040	67,704-female king crab	26,040
Halibut Bycatch			
1985	1986		
187,500	85,000 cap	102,500-halibut	85,000
Tanner Crab Bycatch			
1985	1986		
299,100	Unknown		
5.75/ton	4.4/ton	1.35/ton	4.4/ton
JV Catch Tonnage			
120,400 mt	62,000 mt		58,400 mt

While the details of these calculations and projections are fully explained in the full flounder proposal submitted to the NPFMC last week, we would like to summarize the likely impacts relative to 1985 from the above tabulations.

1. Drastically curtailed operations within the eastern pot santuary in 1986 as outlined in the Flounder Trawlers Proposal (limited to April and May at the extreme and 62,000 mt of catch), will result in sharply reduced bycatches:

403,000 less king crab
67,700 less female king crab
102,500 less halibut
145,400 less Tanner crab

2. The data on crab resource distributions suggests the vast majority of red king crab females reside east of 163°W.

3. Closure of areas west of 163° will result in a hardship to trawlers and close grounds where few crab reside.

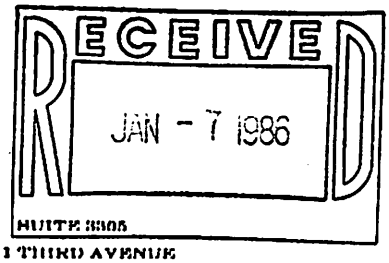
Finally, we are obviously aware that major area closures to trawling in the eastern Bering Sea are being contemplated on a year round basis. If the red king crab stocks are in such low levels of abundance to warrant these drastic actions, it is our belief that a true crab sanctuary be established wherein all fishing is prohibited year round. This area should be carefully chosen to provide maximum protection to female and juvenile crab but not arbitrarily close major areas to trawlers and pot fishermen. It is noteworthy that a high bycatch of female and sublegal red king crab occurs in the red king crab commercial fishery. NMFS scientists report one female and seven sublegals caught per legal male. Thus in each of the years 1984 and 1985, a catch of 800,000 legal males produced bycatches of 800,000 females and 5,600,000 sublegals. Additionally, we have no king crab bycatch data from the Tanner fishery but it obviously is a source of additional handling and sorting mortalities.

Thanks for your consideration.

Sincerely yours,

Barry Fisher
President

5.



JAY D. HASTINGS
ATTORNEY AT LAW

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1111 THIRD AVENUE
SEATTLE, WASHINGTON 98101

(206) 382-0702
TELEX: 32-8024
ANSBR FOSTER LAW SEA

January 7, 1986

Mr. Jim H. Branson
Executive Director
North Pacific Fishery Management Council
P.O. Box 103136
Anchorage, Alaska 99510

Re: Trawl Bycatch Comments

Dear Jim:

The Japanese trawlers would like to briefly comment upon incidental catch of red king crab and halibut in the eastern Bering Sea trawl fisheries. We want to emphasize that foreign fishermen are already prohibited from fishing in the pot sanctuary and the winter halibut savings area. These two areas have been closed to foreign fishing for a number of years.

Furthermore, the Council has already established a management system which controls the incidental catch of prohibited species in the foreign trawl fisheries for the Bering Sea and Aleutian Islands area. Amendment 3 to the FMP for the Bering Sea/Aleutian Islands groundfish fishery establishes annual prohibited species catch (PSC) limits for salmon, Pacific halibut, king crab, and Tanner crab which are prohibited species in the foreign groundfish fisheries. This Amendment has been in effect since July of 1983.

PSC limits under Amendment 3 are calculated for each prohibited species based upon historical incidental catch rates. These rates have been reduced annually since 1982 under a rate reduction schedule. Each foreign nation receives a portion of the PSC limit based upon its current groundfish allocation. If a nation uses its portion of the PSC limit for either Pacific halibut, king crab, or Tanner crab, the entire management area will be closed to vessels of that nation for the remainder of the fishing year. The Regional Director has also been given broad management flexibility under the Amendment to review PSC limits on an annual basis and to regulate the fishery through field order authority to ensure maximum protection of the resources.

The management concept under Amendment 3 has worked very well to accomplish its objective. According to the foreign fishery observer program the incidental catch of red king crab is minimal in the foreign trawl fisheries and incidental catches of the other prohibited species are well within the PSC limits established by

the Regional Director. These low incidental catches in the Japanese trawl fisheries can be attributed to two major factors: gear modifications and the internal Japanese allocation system. Each vessel within the Japanese fleet receives an allocation for each prohibited species from the Japanese portion of the PSC limit. This allocation scheme forces each vessel to keep its incidental catch well within it's allocated portion in order to ensure a margin of safety for fishing operations.

For the foregoing reasons no further action is necessary to regulate the incidental catch of crab and halibut in the foreign trawl fishery. The management system and regulatory flexibility are already in place under Amendment 3 to attain the Council objectives. Japanese fishermen have been able to keep their incidental catches well within the PSC limits established and the incidental catch of red king crab has been minimal.

However, we would like to encourage the Council to develop a management system which will strike an equitable balance among the various domestic and joint venture user groups operating within the Bristol Bay pot sanctuary over the long term. In this regard we would ask the Council to recognize that mid-water trawling in joint venture pollock fisheries takes virtually no incidental catch of king crab and halibut having no adverse effect upon the conservation and management of those resources. Furthermore, we want to emphasize that utmost efforts have been made in the U.S./Japan joint venture flounder fisheries to reduce incidental catches of king crab and halibut through gear modifications and other operational procedures. These practices have been followed in the Japanese joint ventures to ensure that viable U.S. joint venture trawl fisheries for flounders may be developed in coexistence with other fully developed U.S. fisheries.

Thank you for the opportunity to comment upon this matter. I shall be attending the Council meeting in Sitka should you have any questions.

Sincerely,

Jay D. Hastings

Jay D. Hastings
on behalf of the
Japan Fisheries Association

January 7, 1986

ACTION	ROUTE TO	INITIAL
	Exec. Dir.	
	Deputy Dir.	
	Admin. Ch.	
	Exec. Sec.	
	Staff Asst. 1	
	Staff Asst. 2	
	Staff Asst. 3	
	Economist	
	Sec./Stkr.	
	Sec./Typist	

6.

North Pacific Fishing Vessel Owners Association Comments on Proposals Addressing Crab and Halibut Bycatch in the Eastern Bering Sea Trawl Fisheries.

The NPFVOA continues to support a one-year moratorium (for 1986) to all trawling in that part of the Eastern Bering Sea between 160° and 163°W. longitude and south of 58°15'N. latitude. This closure is designed to provide protection to female red king crabs, most of which were located within that area during 1984 and 1985. This closure would allow for some bottom trawling in the Eastern Bering Sea, and may not affect the midwater pollock trawl fisheries which historically have been prosecuted to the west of 163°W. longitude.

Before submitting these comments, the NPFVOA had intended to conduct an independent review of analyses by the NWAFC staff regarding economic impacts of alternative proposals to protect crabs, and the biological basis for the declaration that no further female red king crabs should be subject to fishing mortality. As of this date, January 7, 1986, those analyses are not available for public review.

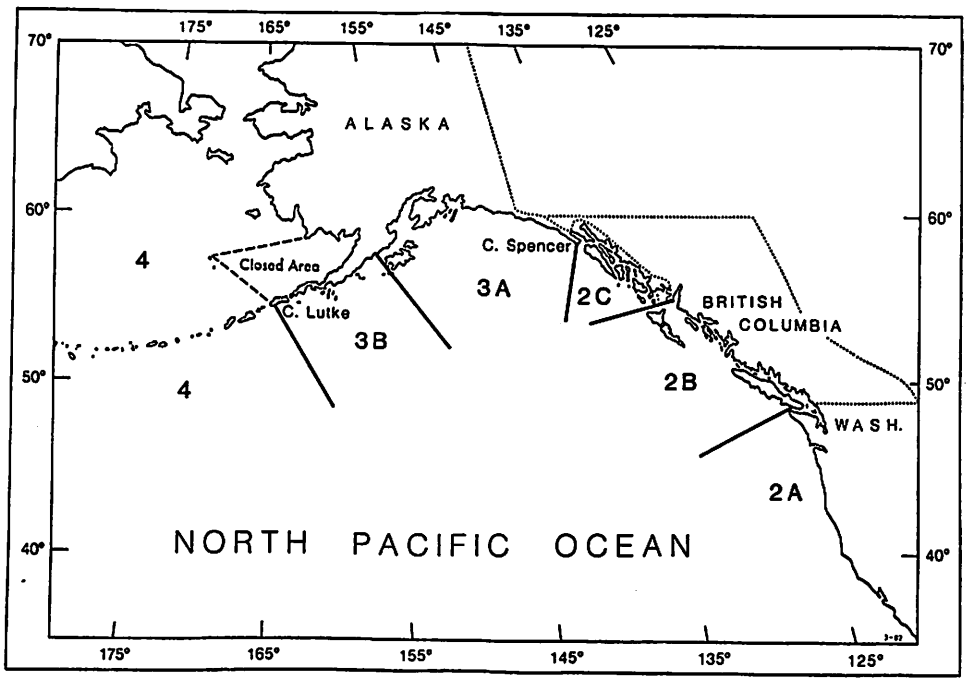
DEC85/CY

Dear Mr Branson, Jan 1 1986

I'm very glad to see the NPFMC take a concerned look at the by catch in the Bering Sea pot sanctuary and halibut nursery grounds.

I I support section "B" of the Fishing Vessel Owners proposal, on section "A" the cap of 25,000 halibut is too valuable of a resource to be destroyed ~~A~~ cap of ~~15~~ 15 to 20,000 is reasonable.

Below is a chart of the halibut nursery grounds that are enforced by the International Pacific Halibut Commission. This area is off limits to American longliners. All hard on bottom trawling needs to be phased out of this area of the Bering Sea.



II Economic studies need to be done to determine the potential economic loss to historic fisheries. Dollar value studies of trawl by catch of Crab, Halibut, Salmon and Blackcod need to be done post haste. If we wait 3 to 5 years a lot of valuable fish bycatch will be wasted.

III More observers must be placed on American factory trawlers. The same problem we had with the foreign fleets, before the FCMA was passed into law, could be going on.
Some arrangement of observer coverage needs to be worked out!!

IV It has been brought to my attention that there is a high possibility that flagrantly high catches of king salmon and halibut are occuring in the Gulf of Alaska.
I'm particularly asking for observer data on catches made by American trawlers that are delivering to the Alaska Enterprise in the Kodiak area.
I would greatly appreciate an up to date report on this issue at the up coming NPFMC meeting in Sitka.

Sincerely Yours, Walter C. Pasternack

8.

January 3, 1986

Jim H. Branson, Executive Director
North Pacific Fishery Management Council
P.O. Box 103136
Anchorage, Ak, 99510

Attn: Trawl Bycatch Comments

Dear Mr. Branson:

I have put a few thoughts together about the Eastern Bering Sea Trawl Bycatch problem. The bigest single thing that upsets me is that although this is a pot sanctuary and a halibut nursery and is closed to longline and crab fishing all the time you seem bent on destroying all the good the sanctuary has done. When you trawl for flounder and catch small halibut then filet them there's not much difference. It would seem to me that there would be no way to put a real cap on the bycatch no matter what the number.

Another thing is that we have no observers on ALL of the factory trawlers. There must be some way that we can get a better count on what is really being taken. After hearing horror stories about the bycatch of King Salmon, King Crab, Halibut and Black Cod, I think that we must put observers on all trawlers.

I believe that all American fishermen have a right to our resources but I cannot see any one group of fishermen being able to harvest anything they can catch at the expense of the resource and the local fishermen who have lived and been profiting from this sanctuary.

I have to support the proposal submitted by the crab and halibut fishermen. Thank you for your time.

Sincerely,

James A. Lange
P.O. Box 8085
Port Alexander, Ak. 99836

P.S. - Would you please put me on your mailing list. It is hard to find out what is happening in this neck of the woods. Thank you.

INTERNATIONAL PACIFIC HALIBUT COMMISSION

DIRECTOR
DONALD A. MC CAUGHRAN

P.O. BOX 95009
SEATTLE, WA. 98145-2009

TELEPHONE
(206) 634-1838

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

3 January 1986

Mr. Jim Branson
North Pacific Fishery Management Council
PO Box 103136
Anchorage, AK 99510

RE: Trawl By-catch Comments

Dear Jim:

The staff of the International Pacific Halibut Commission would like to comment on the series of proposals concerning the Bristol Bay Pot Sanctuary. The Commission regards the southeastern Bering Sea as one of the most important nursery areas for Pacific halibut on the coast and has closed the area to halibut longlining since 1967. Young halibut in this area make significant contributions to stocks in the Gulf of Alaska and further south, and the level of by-catch in the Pot Sanctuary area is of major concern to the Commission.

We have identified three proposals from the Council mailing thatoffer protection for halibut. The first, identified as No. I-A in the mailing, would re-establish the Pot Sanctuary and prohibit trawling by foreign,domestic, and joint-venture fishermen within the Sanctuary. Since juvenile halibut tend to concentrate along the north side of the Peninsula, this closed area would offer sufficient protection to much of the population.

The second proposal (No. I-B) involves a larger area, establishes by-catch limits in two of the three areas discussed, and prohibits flounder fishing in the area north of Unimak Island. This proposal appears to afford greater protection for halibut than No. I-A, assuming that an adequate observer program is in place to monitor the by-catch.

The third proposal (No. IV-A) closes a smaller portion of Bristol Bay to trawling and sets a limit on halibut by-catch taken on all trawl operations outside the area. The staff is concerned that large by-catches could occur west of the closed area, but supports the concept of a by-catch limit for domestic trawling in the Bering Sea as a whole.

A by-catch limit is a more direct management strategy and is consistent with foreign fishery regulations in the Bering Sea and domestic fishery regulations in the Gulf of Alaska. As you know, an observer program becomes a necessity in enforcing a by-catch limit, and the lack of a program for the domestic fishery is a serious shortcoming in the latter two proposals.

In summary, all of the three proposals mentioned above will provide some protection for juvenile halibut. No. I-A is probably superior in the short term without an observer program, whereas Nos.I-B and IV-A may provide better long term protection assuming a proper observer program is in place. We have no alternative to offer at this time and appreciate the opportunity to express our views.

Sincerely,

Stephen H Hoag

Stephen H. Hoag
Acting Director

SHH:cd

F/V Seaview Fisheries

ERNIE YECK
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LYLE YECK
HC 63 Box 117
Newport, Oregon 97365
(503) 265-5040

FRED YECK
P.O. Box 352
Newport, Oregon 97365
(503) 265-8888

January 8, 1986

Jim Branson
Director
North Pacific Fishery Management Council
411 West 4th Avenue
Anchorage, AK 99510

Re: Trawl Bycatch

Dear Mr. Branson:

Enclosed please find a copy of the united and consolidated proposal from the various segments of the Trawl Industry. The endorsers reflected on the proposal, as enclosed, are those which were present at the meeting when the negotiations for the enclosure took place.

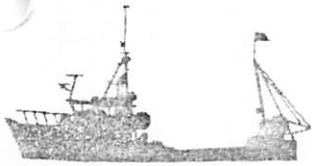
We expect that trawl endorsers will be substantially greater by the time we reach the Sitca Council Meeting.

Sincerely,

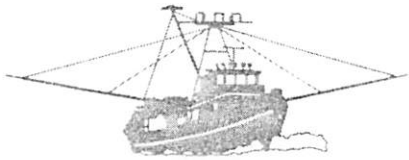
Fred A. Yeck

FAY:bjm
1-0886\SVF.L03
cc: Bert Larkins
MRC

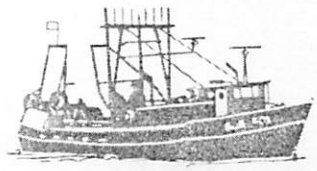
Associated Vessels



F/V RAVEN



F/V PACIFIC RAM



F/V BLUE FOX

CONSOLIDATED TRAWLER PROPOSAL
EASTERN BERING SEA BYCATCH REGULATIONS

The North Pacific Fishery Management Council directed "Industry" to meet and negotiate meaningfully to reach a negotiated solution for the regulation of Trawl Halibut and Crab bycatch in the Eastern Bering Sea; however, since the December Council Meeting, and as of January 8, 1986, that has unfortunately not occurred. As a result of concern within the Trawl Industry, representatives of the various segments of the Trawl Industry met in an attempt to negotiate and reach a unified and consolidated trawler proposal for regulation of bycatch limits in the Bering Sea.

While representatives of the Trawl Industry unanimously oppose creating artificial barriers and, in essence, fencing out various segments of the fishing industry from portions of the Bering Sea, the trawl industry, in the interest of further compromise, is prepared to present a uniform and consolidated proposal for a one year moratorium in what has been described as the most crab sensitive area of the Eastern Bering Sea. That moratorium would apply to all fishing within the described area.

Therefore, the following is submitted as a unified and consolidated proposal from the Trawl Industry for the regulation of bycatch limits and minimizing Halibut and Crab mortality in the Eastern Bering Sea:

1. Pollock Trawlers.

Close for one year the area enclosed by the following boundaries to ALL FISHING - East of 162° West to 160° West and South of 58° North shoreward to the 25 fathom line off the Alaska Peninsula.

2. Factory Trawlers.

Factory trawlers concur with the same defined closure as the Pollock Trawlers.

3. Flounder Trawlers.

(A) Flounder trawlers concur with the same proposed closure as the Pollock trawlers and Factory trawlers.

(B) In addition to the closed area, the Flounder trawlers would be subject to the regulations as submitted by the Joint Venture Flounder trawlers, and published by the North Pacific Fishery Management Council with its cover letter of December 13, 1985, as follows:

(1) King Crab

a. King Crab bycatch areas are to be divided into Zones 1 and 2, as shown on the chart on the following page, for the Joint Venture Flounder Trawl Fishery. Joint Venture bottom trawling for Flounder will cease in Zones 1 and 2, if and when a cap of 155,000 King Crab is taken (please note, no trawling will be permitted in that portion of Zones 1 and 2, subject to the closed area described above).

b. Joint Venture bottom trawling in Zone 1 for Flounder will cease on June 1, whether or not the 155,000 the crab cap has been taken. (Please note, again, no trawling will be permitted in that portion of Zone 1 at at any time in the closed area in 1986.)

c. Joint Venture bottom trawling for Flounder outside of Zone 1 and 2 will cease when a cap (in number of crab) of 2 crab per metric ton multiplied by the JVP allocation tonnage of ~~groundfish~~ flatfish (not inc. turbot) is caught outside of Zones 1 and 2.

(2) Tanner Crab

Joint Venture bottom trawling for Flounder will cease when a cap (in number of crab) of 4.4 crab multiplied by the JVP allocation tonnage for Flounder and Yellowfin Sole is taken.

(3) Halibut

a. JV bottom trawling for Flounder to cease in the pot sanctuary when a cap of 85,000 Halibut are taken.

b. Outside the pot sanctuary JV bottom trawling for Flounder shall cease when JV bottom trawling for Flounder takes a cap (in weight) equal to 1% of the JVP tonnage for the Flounder fishery.

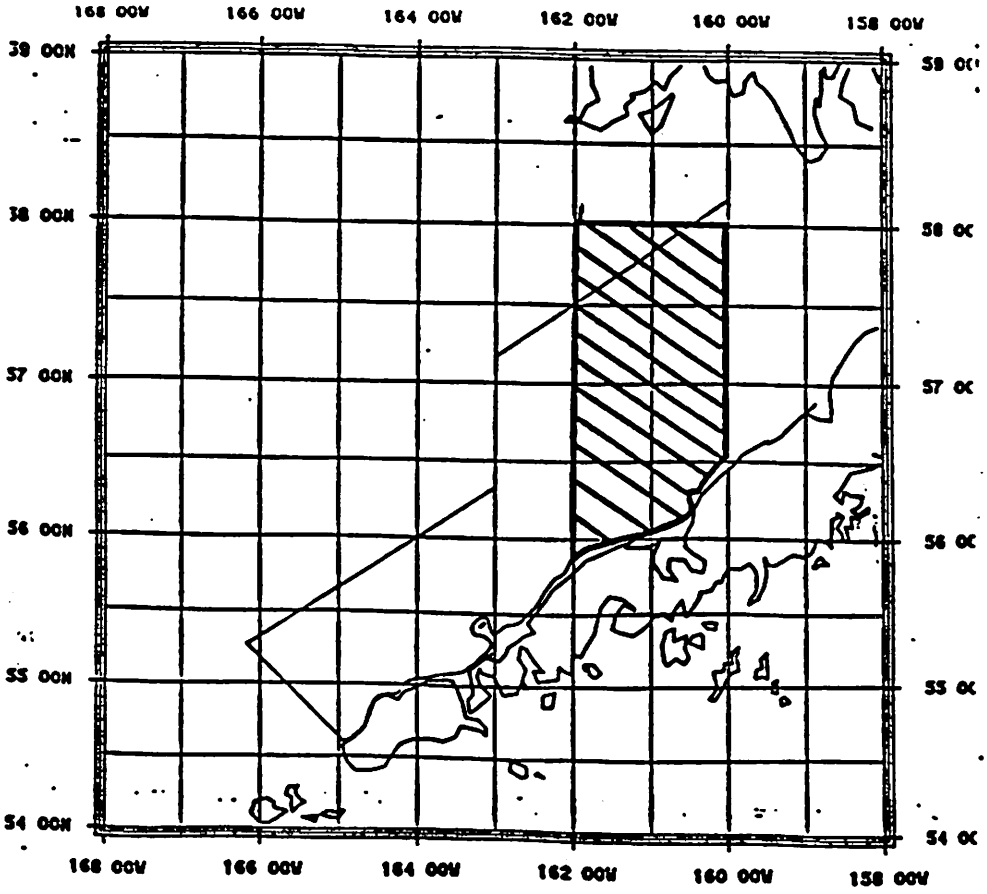
(4) Distribution of Caps

All caps to be proportioned to individual JV operations on the basis of the percentage of the JVP tonnage of Yellowfin Sole and other Flounder.

The area which is proposed for a total closure to all fishing is depicted in the attached exhibit.

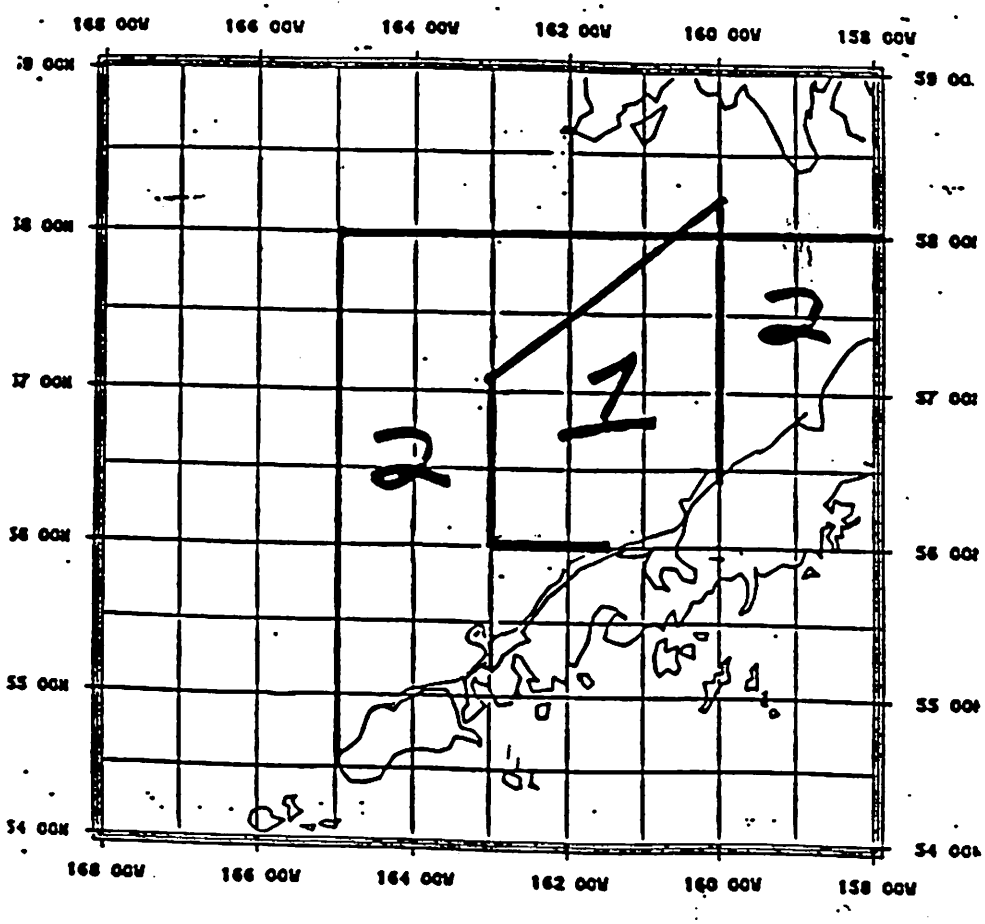
The foregoing consolidated and unified proposal has been endorsed by the following segments of the trawl industry:

Marine Resources Company
Profish International
Westward Trawlers
Alaska Joint Venture Fisheries, Inc.
Northern Deep Sea Fisheries, Inc.
Factory Trawlers Association
Midwater Trawlers Cooperative



DEC85/BW

AREA SUBJECT TO TOTAL CLOSURE



ZONES 1 & 2

FOR FURTHER REGULATION OF FLOUNDER TRAWLERS

RECEIVED
JAN 10 1986

ACTION	ROUTE TO	INITIAL
	Exec. Dir.	
	Deputy Dir.	
	Admin. Off.	
cc: JG RR	Secretary	Rle
	Staff Asst. 1	
	Staff Asst. 2	
	Staff Asst. 3	
	Economist	
COUNCIL	Sec./Bkkr.	
	Sec./Typist	

KODIAK LONGLINE ASSOCIATION
BOX 3406
KODIAK, AK 99615

NORTH PACIFIC FISHERIES MANAGEMENT COUNCIL
411 W. 4th AVENUE
ANCHORAGE, AK 99510

DEAR MR. CAMPBELL:

I REGRET THAT DAVE WOODRUFF AND I WON'T BE ABLE TO MAKE THE SITKA MEETING DUE TO THE SCHEDULING CONFLICT WITH THE TANNER CRAB SEASON. THIS IS MOST REGRETABLE AS THERE ARE SEVERAL ISSUES VITAL TO KODIAK AND PARTICULARLY THE CRAB INDUSTRY. I HOPE THE COUNCIL NOTES WHAT THE A.P. VOTES WOULD HAVE BEEN IF WE COULD BE PRESENT.

THE KODIAK A.D.F & G. ADVISORY BOARD MET ON JAN. 3, 1986, AND VOTED WITH ONLY ONE NEGATIVE VOTE TO ENDORSE A BOTTOM-TRAWL CLOSURE IN VARIOUS AREAS AROUND KODIAK. CRITICAL AREAS FOR MOLTING KING CRAB ARE CHIRIKOF, THE "TOWERS" SOUTH OF SITKINAK AND TUGIDIK IS., ALITAK FLATS AND ALITAK BAY, THE HORSES HEAD, EAST OF THE GEESE IS., THE SOUTH SITKALIDAK AND BARNABAS AREAS, MARMOT FLATS, CHINIAK BAY AND MARMOT BAY, KUPREANOF STR., VIEKODA, UGANIK, UYAK AND PERENOSA BAYS. NOT ONLY ARE KING CRAB IN TOUGH SHAPE AND NEEDING PROTECTION BUT ALSO TANNER CRAB ARE SHOWING A SERIOUS DECLINE, PARTICULARLY ON KODIAK'S WEST SIDE. OBSERVER DATA FROM DOMESTIC TRAWLERS TARGETING ON FLATFISH COD AND POLLOCK IN DECEMBER, SHOW ATROCIOUS BY-CATCHES OF TANNER CRAB AND HALIBUT. OUR ECONOMY CANNOT AFFORD UNRESTRICTED REMOVALS OF THIS MAGNITUDE. A ROE-FLATFISH J-V FISHERY OPERATING IN THE BAYS WOULD BE EVEN WORSE. IN 1985 TANNER CRAB WAS WORTH 18 MILLION DOLLARS, EXVESSEL IN THE KODIAK AREA, HALIBUT WAS PROBABLY ABOUT 15 MILLION, DUNGENESS CRAB WAS OVER 5 MILLION, AND THE LAST KING CRAB SEASON WE HAD WAS WORTH 32 MILLION, EXVESSEL; IN CONSTRAST, DOMESTIC TRAWL BOTTOMFISH LANDINGS IN THE CENTRAL GULF PRELIMINARY FIGURES IN 1985 WERE SLIGHTLY LESS THAN 1 MILLION DOLLARS INCLUDING BLACKCOD.

KING CRAB STOCKS ARE AT VERY LOW LEVELS ALL AROUND KODIAK. THE EAST SIDE AND UGANIK HAVE BARREN FEMALES. MARMOT BAY,

LATE COMMENT

KUPREANOF STR, VIEKODA AND UGANIK AND UYAK WERE MAJOR PRODUCTION AREAS A SHORT TIME AGO, BUT ARE AT EXTREMELY LOW LEVELS NOW. VERY SMALL REMOVALS OF KING CRAB FROM THESE AREAS COULD WIPE OUT THE STOCKS. SINCE THE CURRENTS ALL FLOW SOUTHWEST, IT COULD TAKE DECADES IF THESE STOCKS ARE LOST BEFORE THE MORE ABUNDENT STOCKS AT THE SOUTHEND COULD REPLENISH THE NORTH END STOCKS BECAUSE MIGRATION OF ADULTS AGAINST THE CURRENT WOULD BE THE ONLY WAY IT COULD OCCUR AS LARVAL DRIFT WOULD BE IN THE OPPOSITE DIRECTION.

FEDERAL MANAGEMENT IS GAINING A REPUTATION FOR POLITICAL FISHERIES MANAGEMENT WITH A POOR CONSERVATION RECORD. THERE IS A COMPELLING CONSERVATION CRISIS IN KING CRAB BOTH IN THE BERING SEA AND KODIAK. IF THE COUNCIL FAILS TO ACT ON THE KODIAK PROPOSAL WE WILL BE FORCED TO GO TO THE STATE BOARD OF FISH TO GAIN A TRAWL CLOSURE AT LEAST IN THE STATES JURISDICTION. THIS MAY BE MORE RESTRICTIVE THAN THE PRESENT ADVISORY BOARD PROPOSAL, BECAUSE WE WOULD HAVE TO COMPENSATE IN THE STATE WATERS FOR MAJOR KING CRAB AREAS THAT REACH OUT INTO FEDERAL WATERS. THIS COULD BE DONE BY INCREASING THE AREA INSHORE CLOSED TO BOTTOM TRAWLING, INCREASING THE TIME OF THE CLOSURE OR BOTH.

HISTORICALLY, THE BRISTOL BAY KING CRAB FISHERY HAS BEEN IMPORTANT TO KODIAK. PRODUCT IS LANDED IN KODIAK AND KODIAK VESSELS FISH THERE. IN 1984 APPROXIMATELY 4.3 MILLION DOLLARS OF BRISTOL BAY CRAB WAS LANDED. IN 1985 LANDINGS WERE APPROXIMATELY 1.6 MILLION DOLLARS. THE STOCKS ARE AT OBVIOUSLY VERY LOW LEVELS NOW.

THESE CRAB NEED PROTECTION IMMEDIATELY. I SUPPORT A CLOSURE TO BOTTOM TRAWLING IN THE AREA BOUNDED BY 58^{o}N-164^{o} E. N.M.F.S. JUST CLOSED THE BAIRDI TANNER CRAB FISHERY IN THIS AREA BASED ON THE CONDITION OF THE BAIRDI STOCKS. YOU NOW HAVE A DOUBLE CONSERVAION CRISIS. HOW BAD DO THINGS HAVE TO GET BEFORE SOMETHING IS DONE. FOREIGN FISHERY PERFORMANCE OUTSIDE THIS POT SANCTUARY SUGGESTS THAT THERE IS NO REASON THAT THE J-V YELLOWFIN SOLE FISHERY COULD NOT BE SUCCESSFUL TO THE WEST OF THE POT SANCTUARY. AN M.R.C. PROPOSAL TO TAKE HALF OF THE YELLOWFIN SOLE INSIDE THE POT SANCTUARY IN APRIL AND MAY IS COMPLETELY UNACCEPTABLE. FISHERMEN I HAVE TALKED TO IN KODIAK WHO HAVE TRAVELED TO TOGIAK EVERY SPRING SINCE THE MID-SEVENTIES SAY THAT MAY 2 IS THE LATEST THE ICE HAS LASTED OFFSHORE IN THE BERING SEA. THE KING CRAB ARE MOLTING AND <u>VERY</u> SOFT AT THIS TIME. HOW MANY WOULD BE FORCED RIGHT THROUGH THE TRAWL MESH AND NOT COUNTED? HOW COULD YOU COUNT THE MANGLED REMAINS IN THE TRAWL? THIS IS THE TIME THAT MORTALITY WOULD BE THE HIGHEST FOR CRAB THAT WENT UNDER THE TRAWL AND WERE NOT CAUGHT.

KING CRAB AGGREGATE IN PILES WHILE MOLTING. THEY WOULD BE VERY HARD TO AVOID AT THIS TIME OF YEAR AS HAULS WOULD BE VERY CLEAN GENERALLY WITH SUDDEN VERY HIGH CATCHES. IT IS VERY HARD FOR ME TO DISCOUNT ALL THE REPORTS I HAVE HEARD, AND MY FATHER HAS HEARD OF, DUMPED TOWS CONTAINING THOUSANDS OF CRAB IN THIS FISHERY THAT OF COURSE ESCAPE COUNTING.

I HAVE ALSO HEARD A REPORT THAT THE 100% OBSERVER COVERAGE ON THE PROCESSORS IS NOT 100% HONEST. YOU MAY REMEMBER THE FEMALE OBSERVER WHO TESTIFIED BEFORE THE COUNCIL IN DECEMBER " ON HER OWN" WHO APPEARED TO HAVE AN ATTACHMENT TO ONE OF THE J.-V. PARTICIPANTS. OBVIOUSLY, ANYONE WORKING AS AN OBSERVER WOULD BE UNDER PRESSURE NOT TO REPORT THINGS THAT WOULD THREATEN THE VENTURE.

I WOULD QUESTION N.M.F.S.'S ABILITY TO CONTROL THE BY-CATCH IF PORTIONS OF THE AREA WERE OPEN UNDER A RATE CONCEPT. MANY VENTURES OPERATED ABOVE THE RATE LAST YEAR. TESTIMONY, BEFORE THE A.P. IN DECEMBER, OF VERY LOW BY-CATCH RATES AT THE END OF THE SEASON TURNED OUT TO BE FROM OUTSIDE THE POT SANCTUARY. THIS CAME OUT UNDER QUESTIONING.

TRAWLERS ARE TARGETING ON BLACKCOD AROUND KODIAK. THE DUSK, DOMINION, ROYAL BARON, TOPAZ AND NORTHERN CHALLENGER HAVE BEEN SEEN FISHING FOR BLACKCOD AND HAVE MADE LANDINGS IN KODIAK. THERE ARE UNDOUBTEDLY OTHERS I HAVEN'T HEARD OF YET. I BELIEVE THESE VESSELS THAT I KNOW ABOUT ARE ALL MEMBERS OF THE ALASKA DRAGGERS ASSOCIATION. ONE OF THE AREAS BEING WORKED BY THEM IS THE SOUTH END OF SHELIKOF STR. BETWEEN CAPE IKOLIK AND FOGGY CAPE. THE MAXIMUM DEPTH WOULD BE ABOUT 160-170 FATHOMS. CONCENTRATIONS OF HALIBUT CAN BE EXPECTED IN THIS AREA AT THIS TIME OF THE YEAR. A FRIEND OF MINE IN THE AREA TO RETRIEVE BROWN CRAB POTS HEARD OF ONE TOW OF "STEPPED ON" BLACKCOD (HALIBUT) OF 15,000 LBS. HE ALSO HEARD THAT BLACKCOD CATCHES WERE RUNNING 700 LBS. TO 4,000 LBS PER TOW AND AVERAGE WEIGHT OF 3.4 LBS.

THE ORIGINAL INTENT OF THE TRAWL BLACKCOD ALLOCATION WAS TO PROVIDE ENOUGH BLACKCOD FOR TRAWL BY-CATCH. THERE IS NO OBSERVER DATA ON THIS FISHERY. IT SHOULD BE CLOSED UNTILIL N.M.F.S. IS PREPARED TO MANAGE IT PROPERLY. BOB MC VEY'S SUGGESTION IN DECEMBER TO ALLOW THE FISHERY TO RUN TO 15% AND THEN CLOSE IT AND PRETEND THAT THE REMAINING TRAWL BY-CATCHES WILL COVER THE REST OF THE YEAR IS UNACCEPTABLE. WITH NO DAP OBSERVER PROGRAM AND

INCREASED EFFORT A SUBSTANTIAL UNCOUNTED BY-CATCH COULD OCCUR. MC VEY ASSERTED THAT N.M.F.S. COULDN'T MONITOR A 5% BY-CATCH ALLOWANCE. EVIDENTLY THEY ARE INCAPABLE OF MONITORING CATCHES. IF THIS IS SO THEY COULD NOT ASSURE US THAT THE TRAWLERS WOULD BE SHUT OFF AT ANY PERCENTAGE. IF THEY ARE NOT PREPARED TO MANAGE THE BOTTOMFISH FISHERY, THEY SHOULD TURN JURISDICTION OVER TO THE STATE OF ALASKA.

I REGRET NOT BEING ABLE TO VISIT SITKA AND ATTEND THE MEETING BUT I CANNOT AFFORD TO RISK MISSING THE FIRST FEW DAYS OF THE TANNER CRAB SEASON THAT OPENS JAN. 15.

RESPECTFULLY,

Oliver N Holm

OLIVER N. HOLM, PRESIDENT
KODIAK LONGLINE ASSOCIATION

Capt. Douglas Barber
M/V Pavlof
6131 136th Ave N.E.
Kirkland, Wash. 98033

January 6, 1986

Jim H. Branson
North Pacific Fishery Management Council
P.O.Box 103136
Anchorage, Alaska 99510

Mr. Branson;

I am writing this letter in reference of the bycatch of crab and halibut in the Eastern Bering Sea trawl fisheries. I am very much in favor of the proposal submitted by the Crab Fishermen Coalition.

They suggest to restore and re-establish the jurisdiction of the pot sanctuary in the Eastern Bering Sea from Cape Saricheff east to Bristol Bay and that no trawling be permitted in this area by either domestic or foreign fishermen.

After reviewing all eleven proposals I believe the proposal submitted by the Crab Fishermens Coalition to be the most appropriate for the control of the crab and halibut bycatch. If the King Ctab stocks are ever to recover from their depressed state, then there must be an area for these crabs to breed and grow without disturbance from domestic and foreign trawlers. I do not believe the King Crab stocks can afford any bycatch rates, for these rates do not represent the actual extent of the damage done to the stocks by the nets and rolling gear dragged along the bottom of the ocean floor.

The King Crab are no longer threatened extinction from overfishing. They are now threatened extinction by trawlers who destroy the King Crabs breeding grounds and give the crabs no time to mature.

I have waited five years for the Eastern Bering Sea King Crab to once again become a fishable resource. I now imagine I will have to wait another five years for the King Crab to make a comeback due to the damage that has already been done to these crab stocks. Of course this will only happen if there is a sanctuary.

Your serious consideration to this matter would be greatly appreciated.

Sincerely,

Douglas Barber

Capt. Douglas Barber

LATE COMMENT

Petersburg Advisory Committee
Alaska Dept of Fish & Game
Petersburg, Alaska 99833
907 772 3622

January 4, 1986

Jim Branson, Executive Director
North Pacific Fishery Management Council
Anchorage, Alaska 99510

Dear Mr Branson, Attn: Trawl bycatch comments

The Petersburg Fish & Game Advisory committee is opposed to bottom trawling in the halibut nursery areas in the Bering Sea. This community depends heavily on the halibut resourse in southeastern Alaskan waters and the gulf of Alaska for its economy. We recognize the necessity of maintaining the Bering Sea nursery area to provide a healthy halibut resource is integral to shoreside Alaskan communities who depend on halibut fishing for a viable economy. Therefore we support actions that effectively reduce and control bycatch by the trawl fleets in the Bering Sea.

Our committee supports the Fishing Vessel Owners Assn proposal. It is the only one that fairly addresses our concerns.

Thanks for your consideration.

Kindest Regards,

LOREN CROXTON, Chairman

by Art Hammer,
Secretary.

A Biological and Economic Analysis of the Bycatch of Prohibited Species in the Bering Sea Area I Joint Venture Flounder Fishery

by

Jerry Reeves and Joe Terry

Northwest and Alaska Fisheries Center
National Marine Fisheries Service
7600 Sand Point Way N.E.
Seattle, Washington 98115
January 1986

Preface

The following material was prepared for the use of the North Pacific Council during their meeting in Sitka, January 13-17. The data base is complex, the analyses even moreso. Whatever could go wrong in the programming and implementation of the computer analyses (including a fire) did go wrong. While it is the objective of the Center to produce a finished document that has received peer review, achievement of this goal would have resulted in a delay so that the document would not be available on time for the Council meeting. We believe that the analyses are accurate and useful for consideration by the Council. Recognizing, however, that points of clarification and some uncertainties may exist, we ask the readers to note such points and bring them to our attention for inclusion in a subsequent draft.

The joint venture groundfish fisheries in the Bering Sea/Aleutian Islands region have developed rapidly. Annual catch increased from 32.7 metric tons (t) in 1980, the year these fisheries began, to approximately 633,000 t in 1985. One of the major objectives of the North Pacific Fishery Management Council (NPFMC) is to increase the domestic utilization of fishery resources off Alaska. Therefore, the NPFMC has encouraged the development of these fisheries and has permitted domestic trawlers to fish in areas that had been closed to foreign trawlers for many years. Although prohibited species are taken as bycatch in the joint venture fisheries for pollock, Pacific cod, Atka mackerel, and flounder, the annual rates of bycatch have been variable. Recently, the bycatch of crab and halibut in the joint venture flounder fishery became sufficiently high that the NPFMC established an industry working group to address the bycatch problem.

The objective of this report is to provide biological and economic information that can be used in evaluating alternative management options for controlling the bycatch of prohibited species in the joint venture flounder fishery.

The biological analysis concentrates on red king crab because of the low stock levels associated with the species. An attempt is made to examine sources of incidental mortality imposed on red king crab. The relation of joint venture trawling to the recent decline of the red king crab stock also is discussed.

An economic analysis of the problem of bycatch allows us to address the problem as a whole instead of as separate problems for each bycatch species. This is particularly important because actions taken to reduce the bycatch of one species can increase the bycatch of other species. The economic section of this report defines the bycatch problem and outlines possible solutions given the information that is available. Estimates of both the costs imposed per unit of bycatch and the costs associated with actions to decrease bycatch are developed. The former estimates are used to compare bycatch imposed costs to the exvessel value of groundfish in the 1985 joint venture flounder fishery. And these estimates are also used together with monthly catch and bycatch data by half by one degree areas both to identify what would have been optimal time/area closures in each of several years and to provide other information that may assist in resolving the bycatch problem.

Red King Crab: Sources of Mortality and Status of Stock

In this section, an attempt is made to examine sources of mortality imposed on red king crab by trawling activities. Also, joint-venture trawl effort is evaluated with respect to the recent decline of the red king crab stock. Finally, the current reproductive status of the red king crab stock is discussed.

Trawl-Induced Mortality

Currently the only means available to monitor the incidental catch of king crab is through the National Marine Fisheries Service's Foreign Fisheries Observer program. Information collected by this program has been used to estimate the number of crabs caught incidentally by foreign and joint venture fisheries. Table 1, taken from Berger, et al (1984), shows annual estimates of king crab caught incidentally in these trawl fisheries for the 1977-85 period. Catches by foreign trawlers are composed predominately of species other than red king crab. Catches by joint venture fisheries, however, are made up almost entirely of red king crab. Prior to 1980 there was no joint venture effort. Since that time, estimated catches have ranged from .2 to 1.1 million red king crabs.

The possibility that trawling is causing mortality on red king crabs over and above that which is observed in catches has been the subject of controversy. Johnsen (1985) suggests that unobserved mortality may be substantial, while Loverich (1985) suggests that it is minimal. The actual unobserved mortality on red king crab due to trawling is unknown. In the absence of estimates of this unobserved mortality, an attempt is made here to determine its possible maximum value. This will provide an upper limit to a range of values for this parameter, so that it can be included in further analysis of management options.

The approach taken in this report to examine trawl-induced mortality is based on joint venture fishery and research survey information. The NMFS observer program provides data on trawling effort, size and sex composition of incidentally-caught red king crab, and some information from logbooks on the duration and speed of individual tows. This information is used to estimate the area swept by the joint venture trawl fisheries in a given season. The NMFS survey estimates of crab density, or number of crabs per unit area, are also available for each year for which information on the fisheries is available. Combining these sources of data along with assumptions regarding trawl gear mortality, provides an estimate of the possible number of red king crab encountered by trawl gear.

The number of tows in red king crab habitat was estimated for each joint venture by year for flounder, cod and mixed species target fisheries (Table 2), which are predominately on-bottom operations. This was done by multiplying vessel-days south of 58 degrees North and east of 165 degrees West by estimates of tows per day for each category. Total estimated tows for each year are shown in Table 3, along with estimates of average towing duration and speed. For the years where these data were not available, the average of the available data was used. Using a sweep width of 201 feet as indicated by Johnsen (1985), the average area swept per tow was calculated and then multiplied by total tows to estimate area swept by the fleet. This last step in the calculation assumes that no tows in the area overlap.

For each year of the fishery, crab density in the area of operation was estimated from survey data. These estimates were confined to those size

groups represented in the incidental catch (Table 4), but essentially include all sublegal males and all females available to the survey gear. An estimate of the maximum number of crabs encountered by the joint venture trawl gear was obtained by multiplying crab density by total area swept for each year. This calculation requires the assumption that crab densities estimated from surveys are characteristic during the trawling season in any given year. From Table 3, it is seen that these estimates range from 3.1 to 11.7 million red king crab and average 7.9 million. Using estimated incidental catches, an estimate of the ratio of crabs potentially encountered by trawl gear to crabs caught incidentally can be made. While this ratio varies considerably from year to year (3-56), the average value is approximately 16.

If all crabs estimated to be encountered by the trawl gear are killed, then the values of Table 2 represent trawl-induced mortality. However, it is not clear that this is the case and it is possible that different components of a typical trawl configuration may cause differential mortality of crabs. Johnsen (1985) indicates that the net component represents 19% of the total area swept, the mud gear represents 76%, and the doors represent 5%. Ascribing different rates of mortality on crabs to these components would result in an overall mortality of something less than 100%, with the rate ascribed to mud gear having a dominant effect, because it is such a large component of the gear sweep width.

A mortality of 70% is used for crabs caught in the net, based on crab viability data collected by the NMFS observer program (Table 5). This estimate comes from data collected from the latter part of the 1985 joint venture season, and results should be considered preliminary. The proportion of dead crabs and those in poor condition to the total crabs examined varies from 30% to 84% between cruises, but has an average value of 70%.

The mortality induced by the doors and mud gear is a major unknown. This has been pointed out by the conflicting opinions expressed by the trawl gear experts Johnsen and Loverich. In order to provide a range of possible values of overall trawl-induced mortality to crabs encountered by the gear, values ranging from 0 to 100% were assigned to these gear components. A weighted overall mortality was then calculated for each combination of gear component mortalities, using the proportion of total sweep width as weights. This range of overall mortality was applied to the estimate of crabs encountered in each year to provide a range of possible mortalities (Table 6). The unknown actual value within this range may be envisioned as the result of such factors as the actual area swept by the doors and mud gear and the crabs' ability to avoid them. On average it is seen that estimates of potential trawl-induced crab mortalities could range from 1.0 to 7.9 million crabs depending on the set of assumptions chosen. It should be noted that the value 1.0 million associated with the lowest mortality assumption is twice the average annual observed catch of red king crabs (Table 1). This suggests that the method used to estimate the numbers of crabs encountered has a tendency to overestimate, or that the observed catches are underestimated on average. It should be emphasized that the actual value for crab mortality due to joint venture trawling is unknown.

Relation of Joint Venture Trawling to Stock Decline

The decline of the Bristol Bay red king crab stock began sometime between the 1980 and 1981 NMFS surveys and from all indications can be ascribed to significant increases in mortalities of crabs, including females and sublegal males. Referring again to Table 3, estimates of crabs lost between annual surveys are given in the last column. These estimates pertain to crabs of sizes caught incidentally in the joint venture fisheries. Assuming 100% mortality of all crabs encountered by trawls, a maximum value of the proportion of these total losses caused by joint venture trawling can be calculated. These estimates range from 6% to 27% for the data in Table 2. On average, a "worst-case" estimate of 9% can be ascribed to trawling. The true value of this proportion depends heavily on the crab mortalities caused by the mud gear component of the trawl, as indicated by the data in Table 6.

Another approach that can be used to determining the relationship of crab mortalities to trawling is to compare trends in estimated mortality of crabs to trends in joint venture trawl effort. Crab mortality estimates have been calculated going back to 1969. Joint venture effort, as expressed by total tows, is available for the years 1980-84 (Table 3), and was insignificant or non existent prior to this period. Annual mortality estimates (instantaneous) for male and female red king crabs of sizes caught in the trawl fisheries are related to trawl effort in Figure 1. Correlation is poor for males and females, as indicated by R squared values of .36 for both. This and the previous analysis based on potential gear encounters indicate that factors other than or in addition to joint venture trawling are responsible for increased mortality and declining abundance.

Current Stock Condition

A spawner-recruit analysis has been developed for Bristol Bay red king crab based on survey abundance estimates. The optimal abundance of female spawners is estimated from a linearized fit of the Ricker model (R squared = 0.85). This relationship is shown in Figure 2. This analysis indicates that the optimum abundance of fertilized females is in the range of 24 to 44 million females, with a midpoint of 34 million crabs. The optimum abundance is considered to be the level of females that has the highest probability of strong future recruitment. As long as sex ratios are adequate, the abundance of females is used as an indicator of the stocks reproductive potential.

The abundance of fertilized females is at a historical low of 7 million, plus or minus 3 million crabs based on the 1985 survey. This is considerably below the estimated optimum level and is a point of concern. While we have had little success in predicting future abundance of females, indications from the 1985 survey are that we can expect little improvement in the stock, and it is possible that abundance will be lower in 1986.

Since the survey, about 200,000 females have been caught incidentally in the joint venture and foreign trawl fisheries. Another potential source of female mortality is the directed crab fisheries. Griffen et al. (1983) indicate that 1.1 female red king crab are caught for every legal male in the Bristol Bay red king crab pot fishery, and that .6 red king crab females is

caught for every legal C. bairdi Tanner crab. Using this information, it is estimated that during the 1985/86 fishing season about 900,000 females may have been caught incidentally in the red king crab fishery, which landed approximately 800,000 legal males.

The spawner-recruit analysis indicates that the lowest levels of spawners has produced the highest levels of recruits. However, environmental conditions at the beginning of the 1970's when strong year classes were produced may have been different than those currently prevailing. For example, cod are known to prey on king crab (June and Shimada,1985), and are currently higher in abundance on the king crab grounds than they were in the early 1970's (Bakkala,et al,1985). Further, it is only logical to assume that as the stock approaches zero, recruitment at some point will drop off, perhaps substantially. Also, the latest estimate of spawning stock is below the range of observations. Consequently, there is uncertainty regarding what level of recruitment will result from this lower abundance of spawners. It is not possible to say with certainty what level of female stock is critical to reproduction. While it should be realized that as the abundance of females trends lower the risk of recruitment failure increases, it seems unlikely that at this point in time permanent recruitment failure will ensue. A more likely course of events is that removal of a significant number of females may delay stock recovery.

The Economics of Bycatch

An economic analysis of the problem of bycatch allows us to address the problem as a whole instead of as separate problems for each bycatch species. This is particularly important because actions taken to reduce the bycatch of one species can increase the bycatch of other species. This section of the report defines the bycatch problem and outlines possible solutions given the information that is available. The optimal solution if there were perfect information is also discussed. Estimates of both the costs imposed per unit of bycatch and the costs associated with actions to decrease bycatch are developed. The former estimates are used to compare bycatch imposed costs to the exvessel value of groundfish in the 1985 joint venture flounder fishery. These estimates are also used together with monthly catch and bycatch data by half by one degree areas to identify what would have been optimal time/area closures in each of several years. The stability of these closures across years and their sensitivity to changes in the estimated costs per unit of bycatch are evaluated. The effects of these closures are estimated. Alternative methods of controlling bycatch that result in approximately the same levels of bycatch as the optimal closures are discussed. And both catch and revenue per unit effort data are compared for the joint venture and foreign fleets to provide information on the potential performance of the joint venture flounder fishery in areas traditionally fished by foreign fleets. Because 1985 bycatch data are not yet available by species and sex, the analysis of time/area data was done for 1982 through 1984.

The bycatch of crab and halibut in the joint venture flounder fisheries reduces the amount of these species available to the domestic target fisheries. This bycatch imposes costs (i.e., impact costs) on those who harvest, process, market, and consume crab and halibut. Efforts to decrease bycatch require changes in either fishing strategies or technologies. These modifications impose costs (i.e., control costs) on the joint venture flounder fleet. The optimal level of bycatch is the one that minimizes the sum of the impact and control costs.

The information required to calculate the optimal level of bycatch includes: 1) harvesting, processing, and marketing costs for crab and halibut; 2) the effect of bycatch on the target catch of crab and halibut; 3) the price responses to these changes in catch; 4) the costs of alternative methods the joint venture flounder fleet can use to reduce bycatch; and 5) the weights to apply in comparing costs imposed on different groups of individuals. Although, better information can be obtained at a cost, perfect information will never be available. Methods of analysis that can be used in the absence of such information are discussed in the remainder of this section. The results of the application of those methods are presented in later sections.

The estimates of impact costs presented in this report are in terms of the decreases in the exvessel and wholesale values that are expected to occur if bycatch does not affect crab and halibut prices. These estimates overstate the impact costs for two reasons. They tend to overstate the decrease in value that will result from bycatch losses because prices tend to increase as the result of decreased catch. They also ignore the reductions in total harvesting and processing costs that are associated with decreased catch. That is, these estimates tend to overstate the effect on value, and estimates in terms of the change in value overstate the effect on net value. It should be noted that, in the unlikely case that prices are very responsive to a decrease in catch, value will increase as a result of a decrease in catch.

At this time, the harvesting and processing cost information and the price response information required to eliminate these two upward biases are not available. However, these overestimates are offset, to some as yet undetermined degree, by ignoring impact costs beyond the harvesting or processing level. The net effect of these countervailing sources of bias is not known. Therefore, the usefulness of these preliminary estimates of impact costs will depend on how they are used in comparison with the control cost estimates discussed below.

Throughout this report, it is assumed that the retention of crab and halibut bycatch is prohibited. If retention were permitted, bycatch would still impose impact costs on crab and halibut fishermen, however, the costs imposed on society as a whole would tend to be less than the estimated impact costs because the groundfish fishermen would be able to sell at least part of the bycatch.

The choice between using either the estimated change in value at the exvessel level or the change at the wholesale level as an approximation of bycatch impact cost is not simple. If the problem of bycatch is considered to be one of a cost being imposed on crab and halibut fishermen by flounder fishermen, the problem could be eliminated by having the flounder fishermen bear this cost which is presumably not greater than the change in exvessel value of crab and halibut caused by the bycatch. Similarly, if markets are fairly competitive, we would expect, for example, the price that a halibut fisherman receives to reflect the value of halibut to society beyond the harvesting level. Certainly, if halibut were suddenly perceived to be a much more beneficial (i.e., valuable) product, we would expect its price to increase to reflect that increased value. These arguments suggest that the change in exvessel value is not a bad proxy for the bycatch impact cost if prices are not significantly affected by bycatch.

The arguments in favor of using the change in wholesale value as a proxy for the bycatch impact cost arise from market imperfections. These might include such things as buyers or sellers who, individually, have control over prices, or a workforce that is relatively immobile. At this time, it is difficult to determine which is the better proxy for impact costs.

The lack of information on techniques that can be used to control bycatch makes the estimation of bycatch control costs difficult. These techniques include changes in gear, season, area, depth, target species mix, effort, and target catch level. Only limited information concerning either the effectiveness or the cost of such techniques is available to fishery managers. In the absence of such information, the exvessel value foregone by reducing target catch to control bycatch can be used as an upper bound estimate of the control cost. It is an upper bound estimate (i.e., one would usually expect the actual value to be lower) for two reasons. First, there are probably less costly techniques available to the fleet than simply foregoing catch; and second, total harvesting costs will tend to be lower for the flounder fleet if it reduces its target catch. It should be noted that there are market-oriented solutions to the bycatch problem which do not require that fishery managers know anything about control costs.

The estimates of impact costs and control costs are used in the following ways to assist in the evaluation of management options to control bycatch. They are used to compare bycatch impact costs to the value of the groundfish catch in the 1985 joint venture flounder fishery. They are also used to estimate the bycatch rates at which impact costs equal the value of the groundfish catch. This is a point of indifference in an all or nothing situation. That is, if the choice is between a flounder fishery with that bycatch rate and no flounder fishery at all, society would be indifferent.

However, this point of indifference should not be considered optimal if the choice is between different levels of bycatch. The optimal level is that at which the sum of the bycatch impact and control costs is not affected by a small change in the level of bycatch. This occurs when the changes in bycatch impact cost and control cost associated with that small change in

bycatch are equal. When such changes are possible, the optimal level of bycatch will tend to be below that of a point of indifference in the all or nothing choice.

One way to demonstrate this is to think of the groundfish fishery as a large number of separate fisheries defined by small areas and time. For some of these time/areas, we would expect the bycatch to be high enough that the bycatch impact cost exceeds the value of the groundfish catch. If fishing in each time/area is independent of fishing in other time/areas and if the only way to reduce bycatch is to eliminate fishing in some time/areas, the sum of bycatch impact and control costs would be reduced if no fishing occurred in such time/areas. Therefore, the total bycatch that includes bycatch from such time/areas is above the optimal level.

Monthly data for one half by one degree areas are used to define time/areas for each of several years. The ratio of the value of bycatch to the value of groundfish is calculated for each time/area, and the time/areas are split into two groups. One group contains all the time/areas with a ratio less than or equal to one; the other group contains the time/areas with a ratio greater than one. The latter group defines what would have been an optimal time/area closure. The placement of time/areas into the two groups is compared across years to determine the stability of optimal closures. These data are also used to estimate the effects of alternative closures. A range is given for each such estimate. The end points of each range are the estimated effects with no redistribution of fishing effort into other time/areas and the estimated effects with complete redistribution of effort.

It should be noted that throughout this section of the report, estimates of total bycatch impact cost are based on the assumption that trawl-induced mortality equals observed bycatch. This is equivalent to assuming one of the following: (1) handling or discard mortality is 100 percent, and there is no other trawl-induced mortality and (2) discard mortality is less than 100 percent, but other trawl-induced mortality offsets that gain. With the latter and a discard mortality of 70 percent, the assumption would be that observed trawl-induced mortality is 30 percent of the observed bycatch. At this time, the information required to determine whether this assumption will result in an overestimate or an underestimate of trawl-induced costs is not available.

Estimated Bycatch Impact Costs Per Unit of Bycatch

The costs imposed per metric ton of bycatch are estimated for king crab, Tanner crab, and halibut. The estimates are in terms of the reductions in exvessel and wholesale value that are expected to result if the reduced directed catches of these species do not affect exvessel or wholesale prices.

The following example demonstrates one method used to estimate the cost (i.e., the reduced exvessel and wholesale value) per metric ton of bycatch for each prohibited species. If the average size of halibut taken as bycatch is 2.7 kg which is the weight of a 5 year old halibut and if halibut are typically taken in the halibut fishery at an age of 11 and at a weight of

21.7 kg, a bycatch of 1 t would take 370 halibut which would be reduced to 111 halibut with a total weight of 2.4 t after six years of natural mortality and growth. Therefore, 1 t of halibut bycatch with an average weight of 2.7 kg is expected to decrease the future directed halibut catch by 2.4 t; and if the round weight to dressed weight factor is 0.75 and if the 1985 exvessel and wholesale prices of $1.33 and $1.65 per pound dressed weight are used, the cost per metric ton of halibut bycatch is about $5,300 at the exvessel level and about $8,700 through the wholesale level. With a real discount rate of 5 percent, the discounted costs are $3,900 and $6,500. When this method was applied to Tanner crab, male and female crab were assumed to be of equal value; the value of male and female crab being based, respectively, on their direct value as catch and their indirect value as contributors to future catch. As noted below, a separate method is used for female red king crab.

The resulting estimates of the cost per metric ton of bycatch vary with the size or age of the bycatch species. Based on the average sizes in the 1984 joint venture fisheries, the estimated costs per metric ton of bycatch in terms of reduced exvessel and wholesale value, respectively, are as follows: 1) male king crab - $1,670 and $2,220; 2) bairdi Tanner crab - $1500 and $1,830; 3) opilio Tanner crab - $190 and $610, and 4) halibut - $3,900 and $6,500. The natural mortality rates, weight at age, and price assumptions used to generate these estimates are presented in the appendix. These are estimates of the cost per metric ton of bycatch if discard mortality is 100 percent. If the discard mortality is thought to be less than this, these cost estimates can be adjusted downward by multiplying these estimates by the lower mortality rate. For example, if the actual discard mortality is 70 percent, the adjusted cost estimates would be 70 percent of the initial estimates. Conversely, if the trawl-induced mortality is thought to be greater than the observed bycatch, the bycatch impact costs would be understated. Estimates of bycatch impact costs both for alternative differences between observed bycatch and trawl-induced mortality and for alternative average sizes are presented in Table 7.

A different method of cost estimation is used for female red king crab to account for their potentially high value in terms of the future productivity of the king crab stocks. This is thought to be particularly important at this time because the number of female crabs is at a very low level. The estimates are naturally dependent on the biological assumptions made. Two critical assumptions concern the contribution to future catch per mature female and the population of mature females during the next five years. The estimates of bycatch impact costs are quite sensitive to the assumptions that are used and it is very difficult to determine the validity of any such set of assumptions. Therefore, the estimates are subject to large errors. It is assumed that the population of mature female red king crab will remain at approximately the current level during the next five years, and two alternative assumptions are made concerning the future contribution to catch per mature female. If the former assumption is incorrect and this population increases to the optimal level within five or less years, the estimates will tend to overstate the actual bycatch impact cost per female. The two assumed levels of contributions are sufficiently different that the resulting estimates may bracket the actual bycatch impact cost per mature female red king crab.

This method of estimation is based on the additional assumption that the expected contributions to future catch per mature female in 1986 will begin in 1995 and decrease by 58 percent per year until it approaches zero in 1999. Reeves and Marasco (1980) use an annual mortality of 58 percent for mature female red king crab. The estimated bycatch impact cost per mature female is the discounted present value of this catch from 1995 through 1999. Due to uncertainty concerning the initial 1995 contribution per female, estimates are made for initial contributions of 2.7 and 8.2 pounds. The former is derived from a spawner-recruit relationship that has been used in managing the crab fishery; more specifically, it is the mean annual harvest for 1976 through 1980 (91.8 million lbs) divided by the optimal level of spawners (34.2 million mature female crab). The latter is the average annual catch for 1979 through 1981 (90.4 million lbs) divided by the average population of mature female red king crab for 1970 through 1972 (11 million crab). These are the years in which the population was at a relatively low level and yet produced large future catches. The current high levels of predators, including Pacific cod and flounders, compared to the levels of the early 1970s may prevent this large catch contribution per mature female being repeated.

Using 1985 exvessel and round weight equivalent wholesale prices of $3.00 and $4.00 per pound, respectively, and a real discount rate of 5 percent, the estimated bycatch impact costs per mature female red king crab are $8.70 at the exvessel level and $11.60 through the wholesale level, if the initial contribution per female is 2.7 pounds. If the initial contribution is 8.2 pounds, the corresponding estimates are $26.40 and $35.20. If the average weight per female red king crab in the 1984 Bering Sea/Aleutian Islands region joint venture fishery of 0.56 kg is used to convert the estimates of cost per female crab to estimates of cost per ton of bycatch, the first set of estimates are $15,500 and $20,700, respectively, at the exvessel and wholesale levels, and the second set of estimates are $47,100 and $62,900.

Using Estimated Bycatch Impact Costs to Evaluate the 1985 Joint Venture Flounder Fishery

The bycatch impact cost estimates developed in the previous section can be used together with catch and bycatch data for the 1985 joint venture flounder fishery to compare total bycatch impact costs to the value of groundfish for this fishery. Monthly data from the NMFS Observer Program were used to define the joint venture flounder fishery described in Table 8. The estimate of an average groundfish exvessel value of $133 per metric ton is based on price information provided by Marine Resources Company. The estimated bycatch values (i.e., impact costs) reported in Table 8 are based on the assumption that trawl-induced mortality equals observed bycatch. The estimated bycatch values range from $7.1 to $13.5 million at the exvessel level and from $10.4 to $19.0 through the wholesale level. This is less than the $28.9 estimated exvessel value of the groundfish catch.

Estimates of bycatch impact costs per metric ton of groundfish were used together with an estimate of the exvessel value of a metric ton of groundfish to determine the bycatch rates at which the bycatch impact cost per metric ton of groundfish equals the exvessel value of a metric ton of groundfish. Because the bycatch impact cost per metric ton of bycatch is thought to be much higher for female red king crab than for either male red king crab or other species, the impact cost per metric ton of groundfish was estimated for varying female king crab bycatch rates. The data in Table 9 indicate that, for female red king crab alone, the bycatch impact cost per metric ton of groundfish equals $133 for bycatch rates of 3.75 to 15.25 crab per metric ton of groundfish. If the cost of other bycatch is included, the female red king crab bycatch rates at which the impact cost per metric ton of groundfish equals $133 range from 3 to 13.25. As noted above, these bycatch rates are for the point of indifference in an all or nothing choice and as such they tend to exceed the optimal rates if the choice is from a range of bycatch levels.

Using Time/Area Data to Define and Evaluate Optimal Time/Area Closures

Monthly catch and bycatch data for half by one degree areas are used together with estimates of both bycatch impact costs and groundfish exvessel prices to identify what would have been optimal time/area closures in each of several years and to evaluate the stability of optimal closures across years. The optimal closure is defined as the collection of month by half by one degree time/areas for which the estimated bycatch impact cost exceeds the exvessel value of the groundfish catch. As noted above, such a closure is optimal (i.e., it results in the level of bycatch that minimizes the sum of bycatch impact and control costs) if bycatch can only be reduced by eliminating fishing in specific time/areas and if fishing in each time/area is independent of fishing in other time/areas.

Eight alternative optimal closures are defined for each year because bycatch impact cost estimates were made for both the exvessel and wholesale levels, because two alternative estimates of the value of female red king crab, and because the impact cost of each time/area is calculated for king crab alone and for all bycatch together. The data used to identify the closures were as follows. The estimates of impact cost per unit of bycatch by species and size developed above were used. Catch and bycatch data by year, month, nation, and half by one degree area were used first to select the subset of these data associated with the joint venture flounder fishery. That subset was defined as the data for the time/areas in which flounder accounted for more than 10 percent of the groundfish catch. This was done to eliminate the data by nation, year, month, and area that were associated with pollock or cod fisheries. The subset of data used included bycatch by weight and number, average size in kg, groundfish catch by major species group, and effort. Based on data provided by MRC, the following exvessel groundfish prices per metric ton were used: flounder $136, Pacific cod $220, pollock $42, and other groundfish $100. The low price for pollock reflects the fact that in the MRC flounder joint venture, most of the pollock catch is used for meal. The price of other groundfish was assumed to be $100; however, due to the small amounts of other groundfish taken in the flounder joint ventures,

this assumption has little effect on the estimated value of the total groundfish catch.

The stability of the optimal closures over time and their sensitivity to the bycatch impact cost estimates used can be determined with the data in Table 10. The data identify the time/areas that are in the closure for each year and for each set of bycatch impact cost estimates. The data in Table 10 indicate the following: 1) the areas within closure vary by year, that is these closures are not stable over time; 2) the optimal closures include areas both inside and outside the pot sanctuary; 3) there are some areas in the pot sanctuary that are not including any of the optimal closures; 4) the time/areas within the optimal closure are sensitive to the estimates of impact costs per unit of bycatch used; and 5) the optimal closures include time/areas that are often not contiguous in either time or space. The ratios of bycatch impact cost to groundfish exvessel value for each time/area are in Table 11.

The effects of the closures were estimated assuming no redistribution of effort to time/areas that are outside a closure and a complete redistribution. This should provide estimates of the effects of a closure that will tend to bracket what the actual effects would have been. The estimates of the effects with a redistribution of effort are based on the assumption that the catch and bycatch in the time areas outside the closure will increase proportionately with the increase in total groundfish catch that would be necessary for total catch to remain unaffected by the closure. For example, if in the absence of the closure 40 percent of the total groundfish catch was taken outside the closure, with the closure catch in the outside time/areas must increase by 150 percent to keep total groundfish catch at the same level. Therefore, in this example, it would be assumed that catch and bycatch in the outside areas would have all increased by 150 percent. It should be noted that when this method is used, the estimated effect of the closure is zero only for total catch.

The estimated effects of each of the eight closures are presented in Table 12. The estimates are in terms of the catch and bycatch in the outside time/areas as a percentage of catch and bycatch in all time/areas. For example, with closure 1, which is based on the exvessel bycatch impact costs of only king crab, it is estimated that the 1984 bycatch of female red king crab would have been 95.4 percent of the actual catch. Similarly, with closure 8, the most restricting case considered, the 1984 bycatch of female red king crab would have been 40.9 percent of the actual level without a redistribution of effort, or 66.1 percent with a redistribution of effort.

The data in Table 12 suggest the following: 1) with lower estimated impact costs per unit of bycatch, the optimal closure includes few time/areas and the effect of the closure is minimal; 2) as the estimates of cost per unit of bycatch increase, a larger proportion of fishing is effected; 3) the closures result in larger decreases in bycatch than in target catch; 4) with a redistribution of effort, significant decreases in bycatch occur without, by assumption, a change in total catch; and 5) with or without a redistribution of effort the ratios of bycatch impact

cost to groundfish exvessel value ranges from 0.2 to 0.74. These values are significantly below the ratio of 1 that occurs at the point of indifference in the all or nothing choice referred to above.

Alternatives to Time/Area Closures

The identification and analysis of optimal time/area closures in terms of combinations of monthly half by one degree time/areas was not intended to define feasible closures. It was intended to provide some insights into the merits of time/area closures relative to other management methods to control bycatch. As noted in that analysis, the optimal closure is not stable over time and it is probably not possible to define a large time/area closure of contiguous small time/areas that both includes all the small time/areas with high bycatch impact costs per metric ton of groundfish catch and excludes all small time/areas with low bycatch impact costs per ton of groundfish. This suggests that alternative methods should be explored.

One alternative is to control bycatch directly rather than indirectly by controlling time/areas that can be fished. The analysis indicates that the optimal bycatch (i.e., the bycatch levels that would occur with an optimal closure) is significantly greater than zero. For the eight closures considered, the optimal level of bycatch, measured in terms of total bycatch impact cost, ranged from 6.1 to 95.5 percent of the level that occurred without a closure and without a redistribution of effort. With a redistribution of effort it ranged from 13.5 to 96.0 percent (Table 12).

Whichever closure is chosen, it will result in some bycatch being taken, unless the closure is so large that it probably includes many small time/areas with very low ratios of bycatch impact costs to groundfish exvessel value. And in many cases the design of the closure is intended to reduce bycatch to a predetermined level. Therefore, an alternative to such a closure is a bycatch ceiling equal to that predetermined level. The advantage of this alternative is that it permits the groundfish fleet to control bycatch in the most cost effective manner. The disadvantage to the groundfish fleet is that once the ceiling is reached all fishing would cease. This alternative is viable only if there is adequate observer coverage.

An even more direct solution to the problem of bycatch addresses the source of the problem itself. The source of the problem is that flounder fishermen impose a cost on crab and halibut fishermen that the flounder fishermen do not bear. A direct solution to the problem is, therefore, to implement a market-oriented management measure that either eliminates the cost or has flounder fishermen bear it. The former is not physically possible without highly selective fishing gear and strategies. The latter may not be politically feasible given the reluctance of the industry and fishery managers to use market-oriented management measures. The greatest part of this reluctance may stem from a lack of experience with such measures.

Using Foreign Catch Per Unit of Effort Data to Identify Potential Alternative Fishing Areas for the Joint Venture Flounder Fishery

Monthly catch, bycatch, and effort data by half by one degree areas were to be used to estimate what the revenue per unit of effort (RPUE) of the joint venture flounder fishery would be in areas traditionally fished by foreign flounder fleets. However, there were not enough time/areas in which both the joint venture fishery and a foreign fishery occurred to accurately estimate the differences in RPUE among fleets. Therefore, it is not possible to estimate joint venture adjusted RPUEs from the foreign RPUE data. At this time, it is only possible to present estimates of the actual joint venture and foreign RPUEs. This is done in Table 13 for two foreign flounder fleets, the Japanese large trawler and flounder mothership fleets. The data are for time/areas in which flounder accounted for over 10 percent of a fleet's groundfish catch.

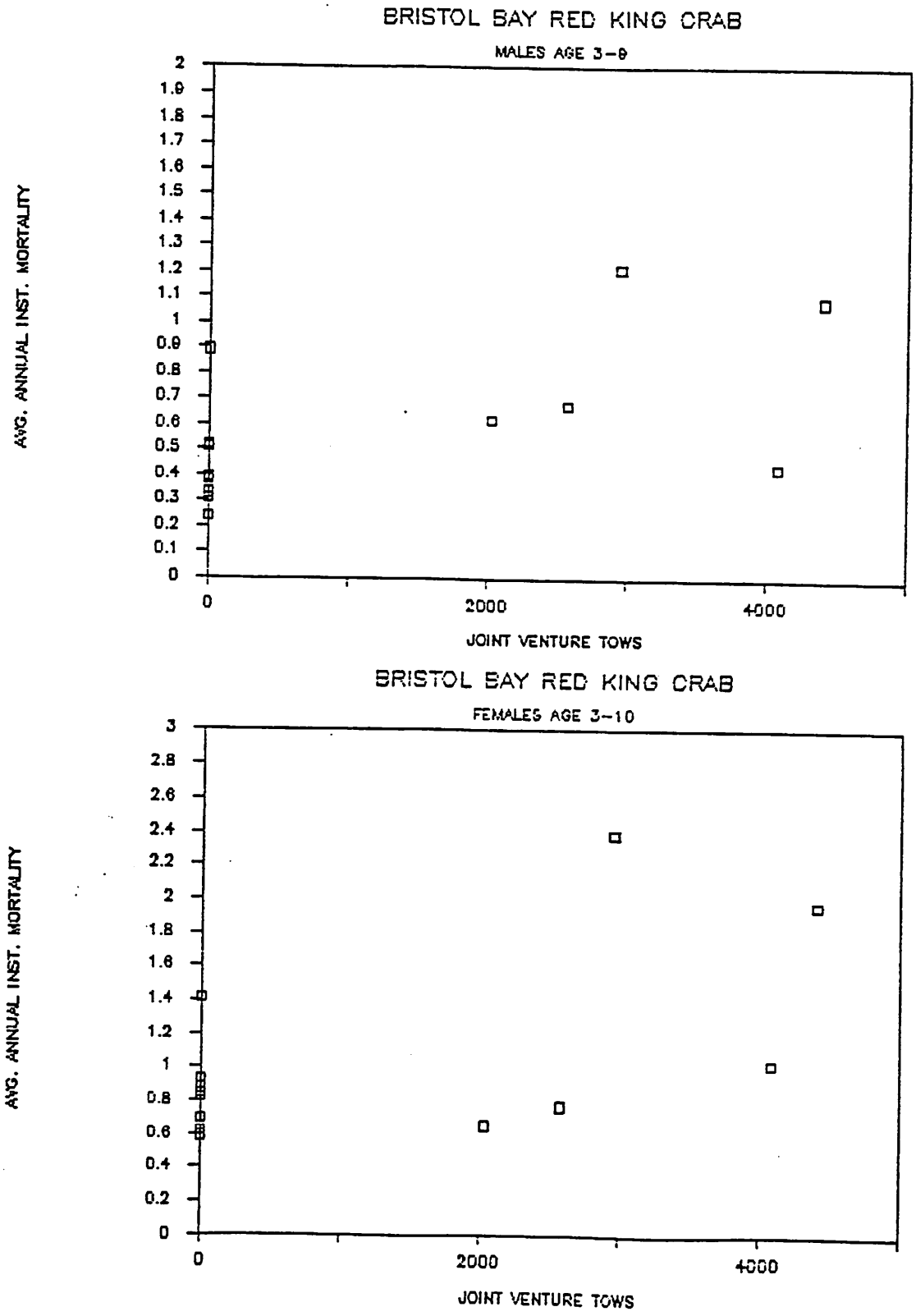


Figure 1. Red king crab mortality related to joint venture trawl effort for males (top) and females (bottom).

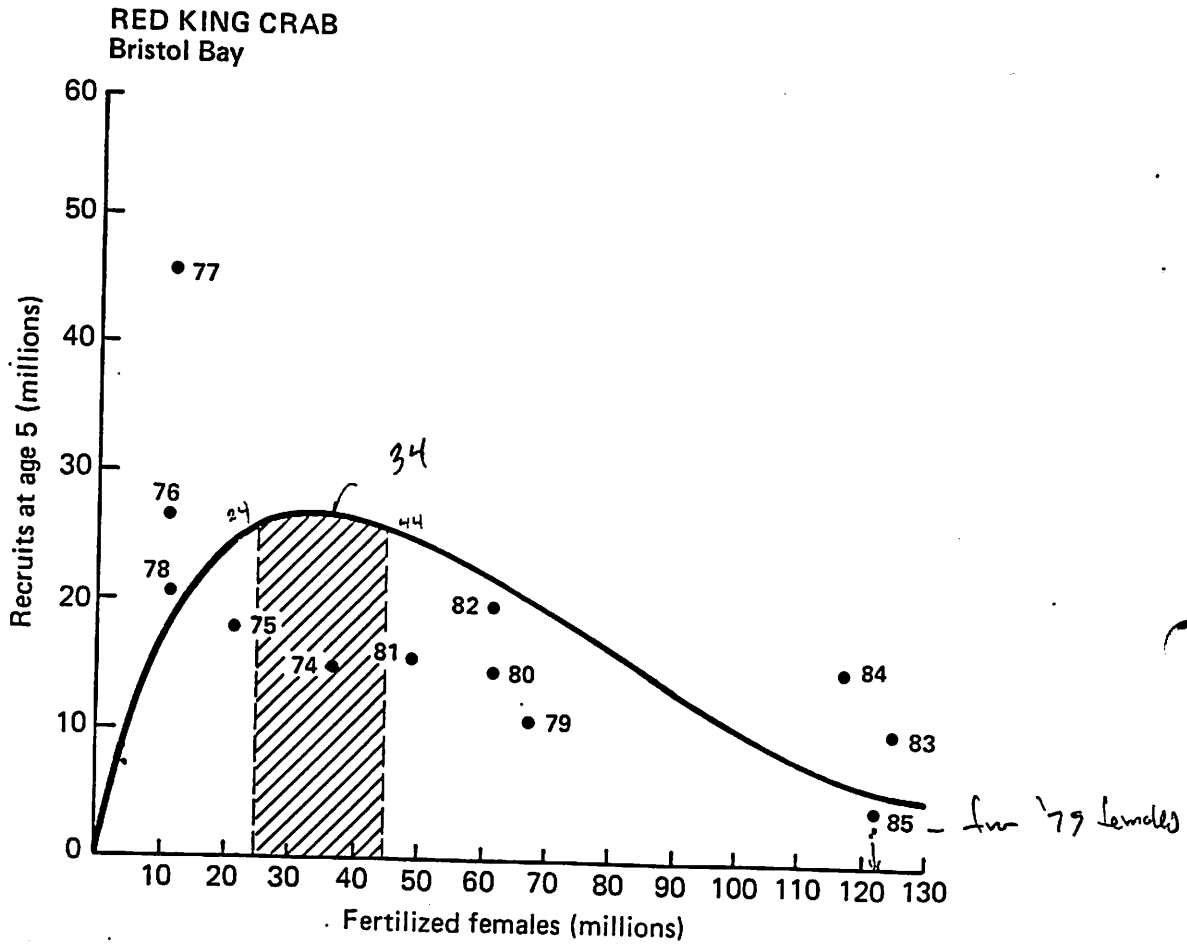


Figure 2. Spawner-recruit relationship for Bristol Bay red king crabs. Label for each observation is year of recruitment estimate.

Table 1.--Estimated incidental catches (numbers) of king crab (Lithodes and Paralithodes spp.) in the foreign and joint-venture groundfish fisheries in the Bering Sea/Aleutian Islands region, 1977-85.

Year	Foreign	Joint venture	Total
1977	599,623	NF	599,623
1978	1,277,931	NF	1,277,931
1979	1,007,796	NF	1,007,796
1980	858,129	289,542	1,147,671
1981	733,026	1,084,126	1,817,152
1982	380,004	193,915	573,919
1983	404,013	630,144	1,034,157
1984	292,223	398,865	691,088
1985[1/]	194,000	953,900	1,147,900

1/ 1985 preliminary data through October, from Russ Nelson, pers. comm.

Table 2.--Estimated number of tows in red king crab habitat for joint venture fisheries in Bristol Bay.

Year	Joint Venture	Yellowfin			Cod			Mixed			Total Tows
		Days	Tows/ day	Tows	Days	Tows/ day	Tows	Days	Tows/ day	Tows	
1980	US-USSR	291	3.6	1048				276	3.5	966	2014
	US-Korea							194	2.8	543*	543
	Total										2557
1981	US-USSR	407	4.3	1750							1750
	US-Korea							4	2.4	10	10
	US-FRG							70	3.9	273*	273
	Total										2033
1982	US-USSR	755	3.8	2869							2869
	US-Taiwan							17	4.8	82*	82
	Total										2951
1983	US-USSR	726	4.1	2977	24	3.4	82				3059
	US-Korea							177	5.8	1027	1027
	Total										4086
1984	US-USSR	637	3.6	2293	227	3.5	795				3088
	US-Korea							200	2.7	540	540
	US-Japan	70	2.5	175				85	3.8	323	498
	US-Spain							70	4	280	280
	Total										4406

* Probably overestimated.

Table 3.--Estimated numbers of Bristol Bay red king crab encountered by joint venture trawl gear, observed in trawl catchs and lost from the population between annual surveys.

Year	Crabs per sq. mi.	Joint venture tows	Tow duration (hours) 1/	Tow speed (knots) 1/	Area swept (sq.mi.) 2/	Millions of crabs: Encountered	Observed	Lost
1980	12883	2557	(2.75)	(3.05)	709.0	9.1	0.3	67.6
1981	5485	2033	(2.75)	3.06	565.6	3.1	1.1	51.3
1982	13922	2951	(2.75)	3.00	804.9	11.2	0.2	193.6
1983	3850	4086	2.91	(3.05)	1198.9	4.6	0.6	17.0
1984	10046	4406	2.59	3.10	1169.5	11.7	0.4	134.5
Average			2.75	3.05		7.9	0.5	92.8

1/ Numbers in parentheses are averages of available data.
2/ Based on Johnsen (1985), indicating a gear sweep width of 201 ft.

Table 4.--Estimates of sex ratio and average size for red king crab caught incidentally in joint venture trawl fisheries in Bristol Bay.

Year	Number measured	M:F	Sex	Average carapace length	2. SD
1981	5568	0.8	male	105	47-163
			female	98	58-138
1982	4920	0.2	male	56	0-127
			female	83	24-143
1983	6541	1.4	male	97	45-148
			female	85	48-123
1984	16217	1.4	male	104	53-154
			female	89	55-124
Average	8312	1.1	male	91	36-148
			female	89	46-132

Table 5.--Estimated mortality of red king crab caught incidentally in Bristol Bay joint venture fisheries in 1985.

Cruise	Condition			Percent Mortality 1/
	Excellent	Poor	Dead	
1	128	65	611	84
2	640	533	513	62
3	18	31	5	67
4	77	220	97	80
5	44	17	2	30
Total	907	866	1228	70

1/ Crabs in poor condition considered dead.

Table 6. Possible range of mortality of red king crab encountered by joint venture trawl gear in Bristol Bay.

Mortality by gear component		Weighted Average Mortality	Annual crab mortality (millions of crabs)					
Net (19%)	Doors & Mud gear (81%)		80	81	82	83	84	Average
100	100	100	9.1	3.1	11.2	4.6	11.7	7.9
70	100	94	8.6	2.9	10.5	4.3	11.0	7.4
70	90	86	7.8	2.7	9.6	4.0	10.1	6.8
70	80	78	7.1	2.4	8.7	3.6	9.1	6.2
70	70	70	6.4	2.2	7.8	3.2	8.2	5.6
70	60	62	5.6	1.9	6.9	2.9	7.3	4.9
70	50	54	4.9	1.7	6.0	2.5	6.3	4.3
70	40	46	4.2	1.4	5.2	2.1	5.4	3.7
70	30	38	3.5	1.2	4.3	1.7	4.4	3.0
70	20	30	2.7	0.9	3.4	1.4	3.5	2.4
70	10	21	1.9	0.7	2.4	1.0	2.5	1.7
70	0	13	1.2	0.4	1.5	0.6	1.5	1.0

Table 7.--Estimated bycatch impact costs per metric ton of bycatch for alternative average sizes and trawl-induced mortality rates, by species.

Impact costs at the exvessel level ($ per metric ton of bycatch)

Male king crab Age	Weight (kg)	Trawl-induced mortality as a % of observed bycatch 50	70	100	150	250	500
5	0.87	833	1166	1665	2498	4164	8327
6	1.25	1527	2138	3054	4581	7635	15270
7	1.65	2064	2889	4127	6191	10318	20636
8	2.05	3308	4631	6615	9923	16538	33075
9	2.44	3308	4631	6615	9923	16538	33075
10	2.81	3308	4631	6615	9923	16538	33075
11	3.16	3308	4631	6615	9923	16538	33075
12	3.47	3308	4631	6615	9923	16538	33075
13	3.76	3308	4631	6615	9923	16538	33075

Impact costs at the wholesale level ($ per metric ton of bycatch)

Male king crab Age	Weight (kg)	Trawl-induced mortality as a % of observed bycatch 50	70	100	150	250	500
5	0.87	1110	1554	2221	3331	5551	11103
6	1.25	2036	2850	4072	6108	10180	20360
7	1.65	2752	3852	5503	8255	13758	27515
8	2.05	4410	6174	8820	13230	22050	44100
9	2.44	4410	6174	8820	13230	22050	44100
10	2.81	4410	6174	8820	13230	22050	44100
11	3.16	4410	6174	8820	13230	22050	44100
12	3.47	4410	6174	8820	13230	22050	44100
13	3.76	4410	6174	8820	13230	22050	44100

Table 7.--Continued.

Impact costs at the exvessel level
($ per metric ton of bycatch)

Tanner crab, Bairdi Age	Weight (kg)	Trawl-induced mortality as a % of observed bycatch 50	70	100	150	250	500
2	0.01	1252	1752	2503	3755	6258	12517
3	0.06	622	870	1243	1865	3108	6216
4	0.15	565	790	1129	1694	2823	5646
5	0.28	629	881	1259	1888	3147	6294
6	0.44	751	1051	1501	2252	3753	7506
7	0.61	898	1257	1796	2694	4491	8981
8	0.79	1041	1458	2082	3124	5206	10412
9	0.97	1144	1601	2288	3432	5719	11439
10	1.14	1308	1832	2617	3925	6542	13084
11	1.31	1543	2161	3087	4631	7717	15435
12	1.46	1543	2161	3087	4631	7717	15435
13	1.60	1543	2161	3087	4631	7717	15435

Impact costs at the wholesale level
($ per metric ton of bycatch)

Tanner crab, Bairdi Age	Weight (kg)	Trawl-induced mortality as a % of observed bycatch 50	70	100	150	250	500
2	0.01	1529	2140	3058	4586	7644	15288
3	0.06	759	1063	1519	2278	3796	7593
4	0.15	690	965	1379	2069	3448	6896
5	0.28	769	1076	1538	2306	3844	7688
6	0.44	917	1283	1834	2750	4584	9168
7	0.61	1097	1536	2194	3291	5485	10970
8	0.79	1272	1780	2544	3815	6359	12718
9	0.97	1397	1956	2794	4191	6986	13972
10	1.14	1598	2237	3196	4794	7991	15981
11	1.31	1885	2639	3771	5656	9426	18853
12	1.46	1885	2639	3771	5656	9426	18853
13	1.60	1885	2639	3771	5656	9426	18853

Table 7.--Continued.

Impact costs at the exvessel level ($ per metric ton of bycatch)

Tanner crab, Opilio Age	Weight (kg)	Trawl-induced mortality as a % of observed bycatch 50	70	100	150	250	500
2	0.01	173	242	346	519	864	1728
3	0.04	78	110	157	235	392	783
4	0.09	70	98	140	210	351	702
5	0.17	79	110	158	236	394	788
6	0.26	95	134	191	286	477	954
7	0.36	116	163	232	349	581	1162
8	0.46	137	192	275	412	687	1374
9	0.55	154	215	308	461	769	1538
10	0.64	179	251	358	538	896	1792
11	0.72	215	301	430	646	1076	2152
12	0.79	264	370	529	793	1322	2644
13	0.85	331	463	662	992	1654	3308

Impact costs at the wholesale level ($ per metric ton of bycatch)

Tanner crab, Opilio Age	Weight (kg)	Trawl-induced mortality as a % of observed bycatch 50	70	100	150	250	500
2	0.01	553	774	1106	1659	2765	5531
3	0.04	251	351	501	752	1253	2506
4	0.09	224	314	449	673	1122	2245
5	0.17	252	353	504	756	1261	2521
6	0.26	305	427	610	916	1526	3052
7	0.36	372	521	744	1116	1860	3719
8	0.46	440	615	879	1319	2198	4396
9	0.55	492	689	985	1477	2461	4923
10	0.64	574	803	1147	1721	2868	5736
11	0.72	689	964	1377	2066	3443	6887
12	0.79	846	1185	1692	2538	4231	8461
13	0.85	1058	1482	2117	3175	5292	10584

Table 7.--Continued.

Impact costs at the exvessel level
($ per metric ton of bycatch)

Age	Halibut Weight (kg)	Trawl-induced mortality as a % of observed bycatch 50	70	100	150	250	500
4	1.38	3036	4250	6072	9108	15180	30361
5	2.73	1970	2757	3939	5909	9848	19696
6	4.69	1471	2059	2941	4412	7353	14705
7	7.25	1220	1708	2440	3659	6099	12198
8	10.35	1096	1535	2193	3289	5482	10963
9	13.87	1049	1468	2097	3146	5243	10486
10	17.71	1054	1475	2108	3162	5269	10539
11	21.71	1103	1544	2205	3308	5513	11025

Impact costs at the wholesale level
($ per metric ton of bycatch)

Age	Halibut Weight (kg)	Trawl-induced mortality as a % of observed bycatch 50	70	100	150	250	500
4	1.38	5009	7013	10019	15028	25047	50095
5	2.73	3250	4550	6500	9750	16250	32499
6	4.69	2426	3397	4853	7279	12132	24264
7	7.25	2013	2818	4025	6038	10063	20127
8	10.35	1809	2533	3618	5427	9045	18090
9	13.87	1730	2422	3461	5191	8651	17303
10	17.71	1739	2434	3478	5217	8695	17389
11	21.71	1819	2547	3638	5457	9096	18191

Table 8.--Catch and bycatch and a comparison of the estimated values of bycatch and groundfish catch in the 1985 Bering Sea Area I joint-venture flounder fishery[1/].

	Catch (t)	Catch as a (%) of groundfish catch
Groundfish		
pollock	41,409	19.1
Pacific cod	19,054	8.8
yellowfin sole	116,284	53.6
turbot	194	0.1
other flounder [2/]	40,052	18.5
other groundfish [2/]	22	0.0
Total	217,015	100.0
Bycatch		
king crab	768	0.354
Tanner crab	161	0.074
halibut	731	0.337
salmon	3	0.001

	Estimated value[3/] (millions of dollars)	
	Exvessel	Wholesale
groundfish	28.90	--
male king crab[4/]	0.86	1.15
Tanner crab	0.18	0.24
halibut	2.85	4.75
bycatch subtotal	$3.9	$6.1
female king crab (a)	3.17	4.22
female king crab (b)	9.01	12.81
bycatch total (a)	$ 7.1	$10.4
bycatch total (b)	$13.5	$19.0

(a) Based on values per crab of $8.70 and $11.60.
(b) Based on values per crab of $26.40 and $35.20.

1/ The catch and bycatch data are from the NMFS Observer Program. They are for the following Bering Sea Area I joint venture fisheries: 1) U.S.S.R. April-October; 2) Korea May-September; and 3) Japan, May, June and October. This catch accounted for the followong percentages of the total 1985 Area I joint venture catch: pollock 11.6%, Pacific cod 54.2%, flounder 91.3%, king crab 91.7%, Tanner crab 81.1%, halibut 69.9%, and salmon 11.5%.

2/ The category "other groundfish" contains Atka mackerel, all rockfish, and sablefish.

3/ These estimates are based on the assumption that trawl induced mortality equals observed bycatch.

4/ It is assumed that, in terms of numbers, 58.7 percent of the king crab were males. This is the 1984 percentage; the actual 1985 percentage is not yet available.

Table 9.--Estimated bycatch impact costs per metric ton of groundfish for different female king crab bycatch rates, for different estimates of the value per female king crab, and for the exvessel and wholesale levels, based on the 1985 joint venture flounder fishery in the Bering Sea, Area I.

Bycatch rate[1]	Estimated bycatch impact costs, exvessel level ($ per metric ton of groundfish)			
	Female king crab[2]		All bycatch[3]	
	a	b	a	b
3.00	26	79	44	97
3.25	28	86	46	104
3.50	30	92	48	110
3.75	33	99	51	117
4.00	35	106	53	124
4.25	37	112	55	130[4]
4.50	39	119	57	137
4.75	41	125	59	143
5.00	43	132[4]	61	150
5.25	46	139	64	157
5.50	48	145	66	163
5.75	50	152	68	170
6.00	52	158	70	176
7.00	61	185	79	203
8.00	70	211	88	229
9.00	78	238	96	256
10.00	87	264	105	282
11.00	96	290	114	308
12.00	104	317	122	335
13.00	113	343	131	361
13.25	115	350	133[4]	368
13.50	117	356	135	374
13.75	120	363	138	381
14.00	122	370	140	388
14.25	124	376	142	394
14.50	126	383	144	401
14.75	128	389	146	407
15.00	130	396	148	414
15.25	133[4]	403	151	421
15.50	135	409	153	427
15.75	137	416	155	434
16.00	139	422	157	440

Table 9.--Continued.

Bycatch rate [1]	Estimated bycatch impact costs, wholesale level ($ per metric ton of groundfish)			
	Female king crab [2]		All bycatch [3]	
	a	b	a	b
2.00	23	70	52	99
2.25	26	79	54	108
2.50	29	88	57	116
2.75	32	97	60	125
3.00	35	106	63	134 [4]
3.25	38	114	66	143
3.50	41	123	69	152
3.75	43	132 [4]	72	160
4.00	46	141	75	169
4.25	49	150	78	178
4.50	52	158	81	187
5.00	58	176	86	204
6.00	70	211	98	240
7.00	81	246	110	275
8.00	93	282	121	310
8.50	99	299	127	328
9.00	104	317	133 [4]	345
9.50	110	334	139	363
10.00	116	352	144	380
10.50	122	370	150	398
11.00	128	387	156	416
11.50	133 [4]	405	162	433
12.00	139	422	168	451

1/ Trawl induced mortality in number of female red king crab per metric ton of groundfish.

2/ Bycatch impact costs per female red king crab of $8.70 and $11.60 are used in case a; costs of $26.40 and $35.20 are used in case b.

3/ For other bycatch, the estimates of the bycatch impact costs per metric ton of groundfish are $18 and $28, respectively, at the exvessel and wholesale levels. These estimates are derived from data in Table 8.

4/ Bycatch impact cost per metric ton of groundfish approximately equal to the exvessel value of one metric ton of groundfish.

Table 10.--Months and areas fished and included in optimal closures for alternative estimates of impact costs per unit of bycatch, joint venture flounder fishery, Bering Sea/Aleutian Islands region, 1982-1984.

				Optimal Closures for Exvessel Level Impact Costs											
				Estimate A						Estimate B					
	Lati-tude	Longi-tude	Mo.	King crab only			All bycatch			King crab only			All bycatch		
				82	83	84	82	83	84	82	83	84	82	83	84
	5330	168	5	0	0	1	0	0	2	0	0	1	0	0	2
	5400	165	1	0	0	1	0	0	1	0	0	1	0	0	1
	5400	165	2	0	1	0	0	1	0	0	1	0	0	1	0
	5400	166	1	0	0	1	0	0	1	0	0	1	0	0	1
	5400	166	4	0	0	1	0	0	1	0	0	1	0	0	1
	5400	166	8	0	0	1	0	0	1	0	0	1	0	0	1
	5400	166	10	0	0	1	0	0	1	0	0	1	0	0	1
*	5430	164	4	0	0	1	0	0	1	0	0	1	0	0	1
	5430	165	3	0	1	0	0	1	0	0	1	0	0	1	0
	5430	165	4	0	0	1	0	0	1	0	0	1	0	0	1
*	5500	163	4	0	0	1	0	0	1	0	0	1	0	0	1
*	5500	163	6	0	1	0	0	1	0	0	1	0	0	1	0
*	5500	163	7	0	1	0	0	1	0	0	1	0	0	1	0
*	5500	164	2	0	0	1	0	0	1	0	0	1	0	0	1
*	5500	164	3	0	0	1	0	0	1	0	0	1	0	0	1
*	5500	164	4	0	0	1	0	0	1	0	0	1	0	0	1
*	5530	162	3	0	1	0	0	1	0	0	1	0	0	1	0
*	5530	162	4	0	1	1	0	1	1	0	2	1	0	2	2
*	5530	162	5	1	1	0	1	2	0	2	2	0	2	2	0
*	5530	162	6	0	1	1	0	1	1	0	1	1	0	1	1
*	5530	162	7	0	1	0	0	1	0	0	1	0	0	1	0
*	5530	162	8	0	1	0	0	1	0	0	1	0	0	1	0
*	5530	163	3	0	1	0	0	1	0	0	1	0	0	1	0
*	5530	163	4	0	0	1	0	0	1	0	0	1	0	0	1
	5530	165	3	0	0	1	0	0	1	0	0	1	0	0	1
	5530	169	8	0	0	1	0	0	1	0	0	1	0	0	1
*	5600	160	4	0	0	1	0	0	1	0	0	2	0	0	2
*	5600	160	5	1	0	1	1	0	1	2	0	1	2	0	1
*	5600	160	6	0	1	0	0	1	0	0	1	0	0	1	0
*	5600	160	7	1	1	0	1	1	0	1	1	0	1	1	0
*	5600	160	8	1	1	1	2	1	1	1	1	1	2	2	1
*	5600	160	9	0	0	1	0	0	1	0	0	1	0	0	1
*	5600	161	4	1	1	1	1	1	2	1	1	2	1	2	2
*	5600	161	5	1	1	0	1	1	0	2	1	0	2	1	0
*	5600	161	6	0	1	0	0	1	0	0	1	0	0	1	0
*	5600	161	7	1	1	0	1	2	0	1	1	0	1	2	0
*	5600	161	8	1	1	0	1	1	0	1	1	0	1	1	0
*	5600	161	9	1	0	0	1	0	0	2	0	0	2	0	0
*	5600	162	3	0	1	0	0	1	0	0	1	0	0	1	0
*	5600	162	4	0	1	1	0	1	1	0	2	2	0	2	2
*	5600	162	5	1	1	1	1	2	2	1	2	2	1	2	2
*	5600	162	8	0	1	0	0	1	0	0	1	0	0	1	0

Table 10.--Continued.

	Latitude	Longitude	Mo.	Optimal Closures for Exvessel Level Impact Costs: Estimate A: King crab only 82	83	84	Estimate A: All bycatch 82	83	84	Estimate B: King crab only 82	83	84	Estimate B: All bycatch 82	83	84
*	5600	162	9	1	0	0	1	0	0	1	0	0	2	0	0
	5600	163	4	0	1	0	0	1	0	0	2	0	0	2	0
	5630	158	6	1	0	0	1	0	0	1	0	0	1	0	0
	5630	159	5	1	0	1	1	0	1	1	0	1	1	0	1
	5630	159	6	1	0	0	1	0	0	1	0	0	1	0	0
	5630	159	7	1	1	0	1	2	0	1	1	0	1	2	0
*	5630	160	4	0	1	1	0	1	1	0	1	1	0	1	1
*	5630	160	5	1	1	0	1	1	0	1	2	0	1	2	0
*	5630	160	6	0	1	1	0	1	1	0	1	1	0	1	1
*	5630	160	7	1	1	0	1	1	0	1	1	0	1	1	0
*	5630	160	8	1	0	0	2	0	0	1	0	0	2	0	0
*	5630	160	9	0	0	1	0	0	1	0	0	1	0	0	1
*	5630	161	4	1	1	0	1	1	0	1	1	0	1	1	0
*	5630	161	5	1	0	1	1	0	1	1	0	1	1	0	1
*	5630	161	6	0	0	1	0	0	1	0	0	2	0	0	2
*	5630	161	7	0	1	0	0	1	0	0	1	0	0	1	0
*	5630	161	8	0	2	1	0	2	2	0	2	1	0	2	2
*	5630	162	6	1	0	1	1	0	1	1	0	1	1	0	1
*	5630	162	8	0	1	0	0	1	0	0	1	0	0	1	0
	5630	164	3	0	0	1	0	0	1	0	0	1	0	0	1
	5630	164	8	0	0	1	0	0	1	0	0	1	0	0	1
	5630	167	7	0	1	0	0	1	0	0	1	0	0	1	0
	5630	168	8	0	0	1	0	0	1	0	0	1	0	0	1
	5700	158	6	1	0	0	1	0	0	1	0	0	1	0	0
	5700	158	7	1	0	1	1	0	1	1	0	1	1	0	1
	5700	159	5	1	1	1	1	2	1	1	2	1	1	2	1
	5700	159	6	1	1	1	1	2	1	1	2	1	1	2	1
	5700	159	7	1	1	1	1	2	1	1	2	1	1	2	1
	5700	159	8	0	0	1	0	0	1	0	0	1	0	0	1
	5700	159	9	0	0	1	0	0	1	0	0	1	0	0	1
*	5700	160	4	0	0	1	0	0	1	0	0	1	0	0	2
*	5700	160	5	0	2	1	0	2	1	0	2	2	0	2	2
*	5700	160	6	1	2	1	1	2	1	1	2	1	1	2	1
*	5700	160	7	0	2	1	0	2	1	0	2	1	0	2	1
*	5700	160	8	0	0	1	0	0	1	0	0	1	0	0	1
*	5700	160	9	0	0	1	0	0	1	0	0	1	0	0	1
*	5700	160	10	0	0	1	0	0	1	0	0	1	0	0	1
*	5700	161	6	0	0	1	0	0	1	0	0	1	0	0	1
*	5700	162	3	0	1	0	0	1	0	0	1	0	0	1	0
*	5700	162	5	0	0	1	0	0	2	0	0	1	0	0	2
*	5700	162	8	0	0	1	0	0	1	0	0	2	0	0	2
*	5700	162	9	0	0	1	0	0	1	0	0	1	0	0	1
	5700	163	9	0	0	1	0	0	1	0	0	1	0	0	1
	5700	165	8	0	1	1	0	1	1	0	1	1	0	1	1
	5700	166	8	0	1	0	0	1	0	0	1	0	0	1	0

Table 10.--Continued.

	Lati-tude	Longi-tude	Mo.	Optimal Closures for Exvessel Level Impact Costs: Estimate A, King crab only 82	83	84	Estimate A, All bycatch 82	83	84	Estimate B, King crab only 82	83	84	Estimate B, All bycatch 82	83	84
	5700	167	8	0	1	0	0	1	0	0	1	0	0	1	0
	5700	169	7	0	1	0	0	1	0	0	1	0	0	1	0
	5700	169	8	0	1	0	0	1	0	0	2	0	0	2	0
	5730	158	5	0	1	1	0	1	1	0	1	1	0	1	1
	5730	158	6	1	0	1	1	0	1	1	0	1	1	0	1
	5730	158	7	1	0	1	1	0	1	1	0	1	1	0	1
	5730	159	5	1	1	1	1	1	1	1	2	1	1	2	1
	5730	159	6	1	1	2	1	1	2	1	1	2	1	2	2
	5730	159	7	1	1	0	1	1	0	2	2	0	2	2	0
	5730	159	8	0	0	1	0	0	1	0	0	1	0	0	1
	5730	159	9	0	0	1	0	0	1	0	0	1	0	0	1
*	5730	160	5	1	2	1	1	2	1	1	2	1	1	2	2
*	5730	160	6	0	1	1	0	1	1	0	2	1	0	2	1
*	5730	160	7	0	2	1	0	2	1	0	2	1	0	2	1
*	5730	160	8	0	0	1	0	0	1	0	0	1	0	0	1
*	5730	160	9	0	0	1	0	0	1	0	0	1	0	0	1
*	5730	161	6	1	0	1	1	0	1	1	0	1	1	0	1
	5730	162	7	1	0	0	1	0	0	1	0	0	1	0	0
	5730	162	8	0	0	1	0	0	1	0	0	1	0	0	1
	5730	163	6	0	0	1	0	0	1	0	0	1	0	0	1
	5730	163	8	0	1	1	0	1	1	0	1	2	0	1	2
	5730	163	9	0	0	1	0	0	1	0	0	1	0	0	1
	5730	164	7	0	1	0	0	1	0	0	1	0	0	1	0
	5730	165	7	1	0	0	1	0	0	1	0	0	1	0	0
	5730	166	6	0	0	1	0	0	1	0	0	1	0	0	1
	5730	166	7	1	1	0	1	1	0	1	1	0	1	1	0
	5730	166	8	0	1	0	0	1	0	0	1	0	0	1	0
	5730	167	6	0	0	1	0	0	1	0	0	1	0	0	1
	5730	167	7	1	1	0	1	1	0	1	1	0	1	1	0
	5730	167	8	0	1	1	0	1	1	0	1	1	0	1	1
	5730	168	6	1	0	0	1	0	0	1	0	0	1	0	0
	5730	168	8	0	1	0	0	1	0	0	1	0	0	1	0
	5800	159	5	0	2	0	0	2	0	0	2	0	0	2	0
	5800	159	6	1	0	0	1	0	0	1	0	0	1	0	0
	5800	159	7	1	0	0	1	0	0	2	0	0	2	0	0
	5800	159	9	0	0	1	0	0	1	0	0	1	0	0	1
	5800	162	6	1	0	0	1	0	0	1	0	0	1	0	0
	5800	162	7	1	0	0	1	0	0	1	0	0	1	0	0
	5800	166	6	0	0	1	0	0	1	0	0	1	0	0	1
	5800	166	7	0	1	0	0	1	0	0	1	0	0	1	0
	5800	166	8	0	1	1	0	1	1	0	1	1	0	1	1
	5800	167	8	0	1	0	0	1	0	0	1	0	0	1	0
	5830	163	7	0	1	0	0	1	0	0	1	0	0	1	0
	5830	167	8	0	0	1	0	0	1	0	0	1	0	0	1
	5830	169	8	0	0	1	0	0	1	0	0	1	0	0	1
	5900	168	8	0	0	1	0	0	1	0	0	1	0	0	1
	5900	169	8	0	0	1	0	0	1	0	0	1	0	0	1

Table 10.--Continued.

	Lati-tude	Longi-tude	Mo.	Optimal Closures for Wholesale Level Impact Costs: Estimate A, King crab only 82	83	84	Estimate A, All bycatch 82	83	84	Estimate B, King crab only 82	83	84	Estimate B, All bycatch 82	83	84
	5330	168	5	0	0	1	0	0	2	0	0	1	0	0	2
	5400	165	1	0	0	1	0	0	2	0	0	1	0	0	2
	5400	165	2	0	1	0	0	1	0	0	1	0	0	1	0
	5400	166	1	0	0	1	0	0	2	0	0	1	0	0	2
	5400	166	4	0	0	1	0	0	1	0	0	1	0	0	1
	5400	166	8	0	0	1	0	0	1	0	0	1	0	0	1
	5400	166	10	0	0	1	0	0	1	0	0	1	0	0	1
*	5430	164	4	0	0	1	0	0	1	0	0	1	0	0	1
	5430	165	3	0	1	0	0	1	0	0	1	0	0	1	0
	5430	165	4	0	0	1	0	0	1	0	0	1	0	0	1
*	5500	163	4	0	0	1	0	0	1	0	0	1	0	0	1
*	5500	163	6	0	1	0	0	1	0	0	1	0	0	1	0
*	5500	163	7	0	1	0	0	1	0	0	1	0	0	1	0
*	5500	164	2	0	0	1	0	0	1	0	0	1	0	0	1
*	5500	164	3	0	0	1	0	0	1	0	0	1	0	0	1
*	5500	164	4	0	0	1	0	0	1	0	0	1	0	0	1
*	5530	162	3	0	1	0	0	1	0	0	1	0	0	1	0
*	5530	162	4	0	1	1	0	2	2	0	2	1	0	2	2
*	5530	162	5	2	1	0	2	2	0	2	2	0	2	2	0
*	5530	162	6	0	1	1	0	1	2	0	1	1	0	1	2
*	5530	162	7	0	1	0	0	2	0	0	1	0	0	2	0
*	5530	162	8	0	1	0	0	1	0	0	1	0	0	1	0
*	5530	163	3	0	1	0	0	1	0	0	1	0	0	2	0
*	5530	163	4	0	0	1	0	0	1	0	0	1	0	0	1
	5530	165	3	0	0	1	0	0	1	0	0	1	0	0	1
	5530	169	8	0	0	1	0	0	1	0	0	1	0	0	1
*	5600	160	4	0	0	1	0	0	1	0	0	2	0	0	2
*	5600	160	5	2	0	1	2	0	1	2	0	1	2	0	1
*	5600	160	6	0	1	0	0	2	0	0	1	0	0	2	0
*	5600	160	7	1	1	0	2	2	0	1	1	0	2	2	0
*	5600	160	8	1	1	1	2	2	1	1	2	1	2	2	1
*	5600	160	9	0	0	1	0	0	1	0	0	1	0	0	1
*	5600	161	4	1	1	2	1	2	2	1	2	2	1	2	2
*	5600	161	5	1	1	0	1	1	0	2	2	0	2	2	0
*	5600	161	6	0	1	0	0	1	0	0	1	0	0	1	0
*	5600	161	7	1	1	0	1	2	0	1	1	0	1	2	0
*	5600	161	8	1	1	0	1	1	0	1	1	0	1	2	0
*	5600	161	9	1	0	0	2	0	0	2	0	0	2	0	0
*	5600	162	3	0	1	0	0	1	0	0	1	0	0	1	0
*	5600	162	4	0	1	1	0	2	2	0	2	2	0	2	2
*	5600	162	5	1	2	1	1	2	2	1	2	2	1	2	2
*	5600	162	8	0	1	0	0	1	0	0	1	0	0	2	0
*	5600	162	9	1	0	0	2	0	0	2	0	0	2	0	0
	5600	163	4	0	1	0	0	1	0	0	2	0	0	2	0

Table 10.--Continued.

	Latitude	Longitude	Mo.	Optimal Closures for Wholesale Level Impact Costs: Estimate A, King crab only 82	83	84	Estimate A, All bycatch 82	83	84	Estimate B, King crab only 82	83	84	Estimate B, All bycatch 82	83	84
	5630	158	6	1	0	0	1	0	0	1	0	0	1	0	0
	5630	159	5	1	0	1	1	0	1	1	0	1	1	0	1
	5630	159	6	1	0	0	1	0	0	2	0	0	2	0	0
	5630	159	7	1	1	0	1	2	0	1	1	0	1	2	0
*	5630	160	4	0	1	1	0	1	1	0	1	1	0	1	2
*	5630	160	5	1	1	0	1	1	0	2	2	0	2	2	0
*	5630	160	6	0	1	1	0	1	1	0	1	1	0	1	1
*	5630	160	7	1	1	0	2	2	0	1	1	0	2	2	0
*	5630	160	8	1	0	0	2	0	0	1	0	0	2	0	0
*	5630	160	9	0	0	1	0	0	1	0	0	1	0	0	1
*	5630	161	4	1	1	0	1	1	0	1	1	0	1	1	0
*	5630	161	5	1	0	1	1	0	1	2	0	1	2	0	1
*	5630	161	6	0	0	1	0	0	1	0	0	2	0	0	2
*	5630	161	7	0	1	0	0	1	0	0	1	0	0	1	0
*	5630	161	8	0	2	1	0	2	2	0	2	1	0	2	2
*	5630	162	6	1	0	1	1	0	1	1	0	1	1	0	1
*	5630	162	8	0	1	0	0	1	0	0	1	0	0	1	0
	5630	164	3	0	0	1	0	0	1	0	0	1	0	0	1
	5630	164	8	0	0	1	0	0	1	0	0	1	0	0	1
	5630	167	7	0	1	0	0	1	0	0	1	0	0	1	0
	5630	168	8	0	0	1	0	0	1	0	0	1	0	0	1
	5700	158	6	1	0	0	1	0	0	1	0	0	1	0	0
	5700	158	7	1	0	1	1	0	1	1	0	1	1	0	1
	5700	159	5	1	2	1	1	2	1	1	2	1	1	2	1
	5700	159	6	1	2	1	1	2	1	1	2	1	1	2	1
	5700	159	7	1	2	1	1	2	1	1	2	1	1	2	1
	5700	159	8	0	0	1	0	0	1	0	0	1	0	0	1
	5700	159	9	0	0	1	0	0	2	0	0	1	0	0	2
*	5700	160	4	0	0	1	0	0	1	0	0	2	0	0	2
*	5700	160	5	0	2	1	0	2	1	0	2	2	0	2	2
*	5700	160	6	1	2	1	1	2	1	1	2	1	1	2	1
*	5700	160	7	0	2	1	0	2	1	0	2	1	0	2	1
*	5700	160	8	0	0	1	0	0	1	0	0	1	0	0	1
*	5700	160	9	0	0	1	0	0	1	0	0	1	0	0	2
*	5700	160	10	0	0	1	0	0	1	0	0	1	0	0	2
*	5700	161	6	0	0	1	0	0	1	0	0	1	0	0	1
*	5700	162	3	0	1	0	0	1	0	0	1	0	0	1	0
*	5700	162	5	0	0	1	0	0	2	0	0	1	0	0	2
*	5700	162	8	0	0	1	0	0	1	0	0	2	0	0	2
*	5700	162	9	0	0	1	0	0	1	0	0	1	0	0	1
	5700	163	9	0	0	1	0	0	1	0	0	2	0	0	2
	5700	165	8	0	1	1	0	1	1	0	1	1	0	1	1
	5700	166	8	0	1	0	0	1	0	0	1	0	0	1	0
	5700	167	8	0	1	0	0	1	0	0	1	0	0	1	0
	5700	169	7	0	1	0	0	1	0	0	1	0	0	1	0

Table 10.--Continued.

				Optimal Closures for Wholesale Level Impact Costs											
				Estimate A						Estimate B					
	Lati- tude	Longi- tude	Mo.	King crab only 82	83	84	All bycatch 82	83	84	King crab only 82	83	84	All bycatch 82	83	84
	5700	169	8	0	2	0	0	2	0	0	2	0	0	2	0
	5730	158	5	0	1	1	0	1	1	0	1	1	0	1	1
	5730	158	6	1	0	1	1	0	1	1	0	1	1	0	1
	5730	158	7	1	0	1	1	0	1	1	0	1	1	0	1
	5730	159	5	1	1	1	1	2	1	1	2	1	1	2	1
	5730	159	6	1	1	2	1	1	2	1	2	2	1	2	2
	5730	159	7	1	1	0	1	2	0	2	2	0	2	2	0
	5730	159	8	0	0	1	0	0	1	0	0	1	0	0	1
	5730	159	9	0	0	1	0	0	1	0	0	1	0	0	1
*	5730	160	5	1	2	1	1	2	1	1	2	2	1	2	2
*	5730	160	6	0	1	1	0	1	1	0	2	1	0	2	1
*	5730	160	7	0	2	1	0	2	1	0	2	1	0	2	1
*	5730	160	8	0	0	1	0	0	1	0	0	1	0	0	1
*	5730	160	9	0	0	1	0	0	1	0	0	1	0	0	1
*	5730	161	6	1	0	1	1	0	1	1	0	2	1	0	2
	5730	162	7	1	0	0	1	0	0	1	0	0	1	0	0
	5730	162	8	0	0	1	0	0	1	0	0	2	0	0	2
	5730	163	6	0	0	1	0	0	1	0	0	1	0	0	1
	5730	163	8	0	1	1	0	1	1	0	1	2	0	1	2
	5730	163	9	0	0	1	0	0	1	0	0	1	0	0	1
	5730	164	7	0	1	0	0	1	0	0	1	0	0	1	0
	5730	165	7	1	0	0	1	0	0	1	0	0	1	0	0
	5730	166	6	0	0	1	0	0	1	0	0	1	0	0	1
	5730	166	7	1	1	0	1	1	0	1	1	0	1	1	0
	5730	166	8	0	1	0	0	1	0	0	1	0	0	1	0
	5730	167	6	0	0	1	0	0	1	0	0	1	0	0	1
	5730	167	7	1	1	0	1	1	0	1	1	0	1	1	0
	5730	167	8	0	1	1	0	1	1	0	1	1	0	1	1
	5730	168	6	1	0	0	1	0	0	1	0	0	1	0	0
	5730	168	8	0	1	0	0	1	0	0	1	0	0	1	0
	5800	159	5	0	2	0	0	2	0	0	2	0	0	2	0
	5800	159	6	1	0	0	1	0	0	1	0	0	1	0	0
	5800	159	7	1	0	0	1	0	0	2	0	0	2	0	0
	5800	159	9	0	0	1	0	0	2	0	0	1	0	0	2
	5800	162	6	1	0	0	1	0	0	1	0	0	1	0	0
	5800	162	7	1	0	0	1	0	0	1	0	0	1	0	0
	5800	166	6	0	0	1	0	0	2	0	0	1	0	0	2
	5800	166	7	0	1	0	0	1	0	0	1	0	0	1	0
	5800	166	8	0	1	1	0	1	1	0	1	1	0	1	1
	5800	167	8	0	1	0	0	1	0	0	1	0	0	1	0
	5830	163	7	0	1	0	0	1	0	0	1	0	0	1	0
	5830	167	8	0	0	1	0	0	1	0	0	1	0	0	1

Table 10.--Continued.

Latitude	Longitude	Mo.	Optimal Closures for Wholesale Level Impact Costs: Estimate A: King crab only 82	83	84	Estimate A: All bycatch 82	83	84	Estimate B: King crab only 82	83	84	Estimate B: All bycatch 82	83	84
5830	169	8	0	0	1	0	0	1	0	0	1	0	0	1
5900	168	8	0	0	1	0	0	1	0	0	1	0	0	1
5900	169	8	0	0	1	0	0	1	0	0	1	0	0	1

*Areas within the pot sanctuary.
A value of 0 indicates no fishing.
A value of 1 indicates fishing occurred, and the area is not within the optimal closure.
A value of 2 indicates an area within the optimal closure.
Estimates A and B are based on low and high estimates of the bycatch impact cost per female red king crab, respectively.

Table 11.--The ratios of the estimated bycatch impact costs to the exvessel value of groundfish in the joint venture flounder fishery by month and half by one degree area, Area I Bering Sea/Aleutian Islands region, 1982-1984.

				Ratios Using Bycatch Impact Costs at the Exvessel Level											
				Estimate A						Estimate B					
	Lati-	Longi-		King crab only			All bycatch			King crab only			All bycatch		
	tude	tude	Mo.	82	83	84	82	83	84	82	83	84	82	83	84
	5330	168	5	0.00	0.00	0.00	0.00	0.00	2.94	0.00	0.00	0.00	0.00	0.00	2.94
	5400	165	1	0.00	0.00	0.00	0.00	0.00	0.79	0.00	0.00	0.00	0.00	0.00	0.79
	5400	165	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5400	166	1	0.00	0.00	0.00	0.00	0.00	0.67	0.00	0.00	0.00	0.00	0.00	0.67
	5400	166	4	0.00	0.00	0.00	0.00	0.00	0.45	0.00	0.00	0.00	0.00	0.00	0.45
	5400	166	8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5400	166	10	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.25
*	5430	164	4	0.00	0.00	0.02	0.00	0.00	0.27	0.00	0.00	0.06	0.00	0.00	0.31
	5430	165	3	0.00	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.00	0.00	0.30	0.00
	5430	165	4	0.00	0.00	0.00	0.00	0.00	0.36	0.00	0.00	0.00	0.00	0.00	0.36
*	5500	163	4	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.13
*	5500	163	6	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.15	0.00
*	5500	163	7	0.00	0.00	0.00	0.00	0.41	0.00	0.00	0.00	0.00	0.00	0.41	0.00
*	5500	164	2	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.24
*	5500	164	3	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.04
*	5500	164	4	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.14
*	5530	162	3	0.00	0.06	0.00	0.00	0.09	0.00	0.00	0.14	0.00	0.00	0.17	0.00
*	5530	162	4	0.00	0.51	0.33	0.00	0.72	0.69	0.00	1.34	0.73	0.00	1.55	1.09
*	5530	162	5	0.83	0.62	0.00	0.99	1.16	0.00	2.22	1.66	0.00	2.38	2.20	0.00
*	5530	162	6	0.00	0.02	0.00	0.00	0.32	0.74	0.00	0.05	0.00	0.00	0.35	0.74
*	5530	162	7	0.00	0.01	0.00	0.00	0.79	0.00	0.00	0.03	0.00	0.00	0.81	0.00
*	5530	162	8	0.00	0.05	0.00	0.00	0.25	0.00	0.00	0.15	0.00	0.00	0.34	0.00
*	5530	163	3	0.00	0.16	0.00	0.00	0.52	0.00	0.00	0.33	0.00	0.00	0.68	0.00
*	5530	163	4	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.13
	5530	165	3	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.10
	5530	169	8	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.05
*	5600	160	4	0.00	0.00	0.44	0.00	0.00	0.47	0.00	0.00	1.21	0.00	0.00	1.23
*	5600	160	5	0.79	0.00	0.21	0.81	0.00	0.33	2.36	0.00	0.48	2.38	0.00	0.61

Table 11.--Continued.

				Ratios Using Bycatch Impact Costs at the Exvessel Level											
				Estimate A						Estimate B					
	Lati-	Longi-		King crab only			All bycatch			King crab only			All bycatch		
	tude	tude	Mo.	82	83	84	82	83	84	82	83	84	82	83	84
*	5600	160	6	0.00	0.01	0.00	0.00	0.65	0.00	0.00	0.03	0.00	0.00	0.66	0.00
*	5600	160	7	0.04	0.07	0.00	0.64	0.79	0.00	0.10	0.20	0.00	0.70	0.91	0.00
*	5600	160	8	0.15	0.32	0.00	1.22	0.96	0.00	0.44	0.90	0.00	1.50	1.53	0.00
*	5600	160	9	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.17
*	5600	161	4	0.23	0.30	0.95	0.23	0.81	1.05	0.67	0.86	2.26	0.67	1.38	2.36
*	5600	161	5	0.55	0.35	0.00	0.57	0.35	0.00	1.66	0.87	0.00	1.67	0.87	0.00
*	5600	161	6	0.00	0.03	0.00	0.00	0.33	0.00	0.00	0.09	0.00	0.00	0.39	0.00
*	5600	161	7	0.00	0.00	0.00	0.00	1.03	0.00	0.00	0.00	0.00	0.00	1.03	0.00
*	5600	161	8	0.15	0.24	0.00	0.36	0.52	0.00	0.43	0.68	0.00	0.64	0.97	0.00
*	5600	161	9	0.36	0.00	0.00	0.90	0.00	0.00	1.08	0.00	0.00	1.62	0.00	0.00
*	5600	162	3	0.00	0.08	0.00	0.00	0.09	0.00	0.00	0.20	0.00	0.00	0.21	0.00
*	5600	162	4	0.00	0.58	0.48	0.00	0.86	0.74	0.00	1.43	1.05	0.00	1.71	1.31
*	5600	162	5	0.13	0.82	0.64	0.13	1.20	1.94	0.36	2.21	1.36	0.36	2.59	2.65
*	5600	162	8	0.00	0.19	0.00	0.00	0.58	0.00	0.00	0.51	0.00	0.00	0.91	0.00
*	5600	162	9	0.30	0.00	0.00	0.98	0.00	0.00	0.90	0.00	0.00	1.57	0.00	0.00
	5600	163	4	0.00	0.62	0.00	0.00	0.70	0.00	0.00	1.67	0.00	0.00	1.75	0.00
	5630	158	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5630	159	5	0.04	0.00	0.04	0.04	0.00	0.05	0.11	0.00	0.11	0.11	0.00	0.11
	5630	159	6	0.25	0.00	0.00	0.25	0.00	0.00	0.75	0.00	0.00	0.75	0.00	0.00
	5630	159	7	0.15	0.03	0.00	0.15	1.03	0.00	0.42	0.04	0.00	0.42	1.04	0.00
*	5630	160	4	0.00	0.00	0.27	0.00	0.00	0.34	0.00	0.00	0.72	0.00	0.00	0.78
*	5630	160	5	0.29	0.68	0.00	0.30	0.70	0.00	0.86	2.00	0.00	0.86	2.02	0.00
*	5630	160	6	0.00	0.02	0.17	0.00	0.56	0.17	0.00	0.04	0.36	0.00	0.58	0.36
*	5630	160	7	0.05	0.08	0.00	0.85	0.80	0.00	0.14	0.20	0.00	0.94	0.92	0.00
*	5630	160	8	0.19	0.00	0.00	1.78	0.00	0.00	0.57	0.00	0.00	2.15	0.00	0.00
*	5630	160	9	0.00	0.00	0.10	0.00	0.00	0.29	0.00	0.00	0.31	0.00	0.00	0.49
*	5630	161	4	0.00	0.15	0.00	0.04	0.16	0.00	0.00	0.44	0.00	0.04	0.45	0.00
*	5630	161	5	0.30	0.00	0.40	0.30	0.00	0.40	0.90	0.00	0.40	0.90	0.00	0.40
*	5630	161	6	0.00	0.00	0.43	0.00	0.00	0.43	0.00	0.00	1.20	0.00	0.00	1.20
*	5630	161	7	0.00	0.12	0.00	0.00	0.29	0.00	0.00	0.18	0.00	0.00	0.34	0.00
*	5630	161	8	0.00	1.87	0.33	0.00	2.08	1.07	0.00	5.57	0.41	0.00	5.77	1.15

Table 11.--Continued.

	Lati-tude	Longi-tude	Mo.	Ratios Using Bycatch Impact Costs at the Exvessel Level: Estimate A: King crab only: 82	83	84	Estimate A: All bycatch: 82	83	84	Estimate B: King crab only: 82	83	84	Estimate B: All bycatch: 82	83	84
*	5630	162	6	0.00	0.00	0.28	0.00	0.00	0.28	0.00	0.00	0.53	0.00	0.00	0.53
*	5630	162	8	0.00	0.55	0.00	0.00	0.55	0.00	0.00	0.55	0.00	0.00	0.55	0.00
	5630	164	3	0.00	0.00	0.00	0.00	0.00	0.23	0.00	0.00	0.00	0.00	0.00	0.23
	5630	164	8	0.00	0.00	0.04	0.00	0.00	0.09	0.00	0.00	0.09	0.00	0.00	0.15
	5630	167	7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5630	168	8	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.02
	5700	158	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5700	158	7	0.00	0.00	0.08	0.07	0.00	0.28	0.00	0.00	0.21	0.07	0.00	0.41
	5700	159	5	0.06	0.96	0.16	0.06	1.24	0.18	0.18	2.79	0.42	0.18	3.06	0.44
	5700	159	6	0.00	0.94	0.09	0.00	1.07	0.15	0.00	2.66	0.22	0.00	2.79	0.27
	5700	159	7	0.10	0.97	0.12	0.19	1.09	0.12	0.27	2.55	0.27	0.36	2.67	0.27
	5700	159	8	0.00	0.00	0.14	0.00	0.00	0.33	0.00	0.00	0.35	0.00	0.00	0.54
	5700	159	9	0.00	0.00	0.08	0.00	0.00	0.77	0.00	0.00	0.24	0.00	0.00	0.93
*	5700	160	4	0.00	0.00	0.34	0.00	0.00	0.35	0.00	0.00	1.00	0.00	0.00	1.01
*	5700	160	5	0.00	2.85	0.45	0.00	3.20	0.51	0.00	8.25	1.26	0.00	8.61	1.31
*	5700	160	6	0.13	1.47	0.21	0.13	1.61	0.24	0.35	4.21	0.54	0.35	4.36	0.58
*	5700	160	7	0.00	1.44	0.12	0.00	1.53	0.16	0.00	3.90	0.26	0.00	3.99	0.30
*	5700	160	8	0.00	0.00	0.23	0.00	0.00	0.30	0.00	0.00	0.58	0.00	0.00	0.66
*	5700	160	9	0.00	0.00	0.13	0.00	0.00	0.49	0.00	0.00	0.37	0.00	0.00	0.73
*	5700	160	10	0.00	0.00	0.14	0.00	0.00	0.63	0.00	0.00	0.43	0.00	0.00	0.92
*	5700	161	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
*	5700	162	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
*	5700	162	5	0.00	0.00	0.46	0.00	0.00	1.90	0.00	0.00	0.52	0.00	0.00	1.97
*	5700	162	8	0.00	0.00	0.47	0.00	0.00	0.56	0.00	0.00	1.09	0.00	0.00	1.17
*	5700	162	9	0.00	0.00	0.17	0.00	0.00	0.18	0.00	0.00	0.51	0.00	0.00	0.52
	5700	163	9	0.00	0.00	0.25	0.00	0.00	0.25	0.00	0.00	0.75	0.00	0.00	0.75
	5700	165	8	0.00	0.00	0.00	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.02	0.01
	5700	166	8	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.03	0.00
	5700	167	8	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00
	5700	169	7	0.00	0.03	0.00	0.00	0.06	0.00	0.00	0.03	0.00	0.00	0.06	0.00
	5700	169	8	0.00	0.78	0.00	0.00	0.84	0.00	0.00	1.20	0.00	0.00	1.26	0.00

Table 11.--Continued.

				Ratios Using Bycatch Impact Costs at the Exvessel Level											
				Estimate A						Estimate B					
				King crab only			All bycatch			King crab only			All bycatch		
	Latitude	Longitude	Mo.	82	83	84	82	83	84	82	83	84	82	83	84
	5730	158	5	0.00	0.16	0.04	0.00	0.17	0.06	0.00	0.31	0.07	0.00	0.32	0.09
	5730	158	6	0.12	0.00	0.01	0.22	0.00	0.18	0.35	0.00	0.03	0.44	0.00	0.20
	5730	158	7	0.12	0.00	0.00	0.39	0.00	0.32	0.35	0.00	0.00	0.62	0.00	0.32
	5730	159	5	0.13	0.59	0.27	0.13	0.73	0.29	0.39	1.56	0.61	0.39	1.71	0.63
	5730	159	6	0.15	0.35	1.36	0.22	0.39	1.43	0.43	0.99	3.47	0.51	1.02	3.55
	5730	159	7	0.39	0.69	0.00	0.65	0.99	0.00	1.13	1.94	0.00	1.39	2.24	0.00
	5730	159	8	0.00	0.00	0.08	0.00	0.00	0.31	0.00	0.00	0.22	0.00	0.00	0.45
	5730	159	9	0.00	0.00	0.04	0.00	0.00	0.34	0.00	0.00	0.13	0.00	0.00	0.43
*	5730	160	5	0.12	1.19	0.37	0.12	1.33	0.41	0.37	3.28	1.00	0.37	3.42	1.04
*	5730	160	6	0.00	0.43	0.15	0.00	0.51	0.17	0.00	1.18	0.32	0.00	1.26	0.34
*	5730	160	7	0.00	1.54	0.09	0.00	1.65	0.13	0.00	4.45	0.20	0.00	4.56	0.24
*	5730	160	8	0.00	0.00	0.03	0.00	0.00	0.10	0.00	0.00	0.08	0.00	0.00	0.15
*	5730	160	9	0.00	0.00	0.08	0.00	0.00	0.32	0.00	0.00	0.25	0.00	0.00	0.48
*	5730	161	6	0.25	0.00	0.33	0.25	0.00	0.33	0.63	0.00	0.82	0.63	0.00	0.83
	5730	162	7	0.16	0.00	0.00	0.19	0.00	0.00	0.41	0.00	0.00	0.43	0.00	0.00
	5730	162	8	0.00	0.00	0.51	0.00	0.00	0.51	0.00	0.00	0.84	0.00	0.00	0.85
	5730	163	6	0.00	0.00	0.03	0.00	0.00	0.15	0.00	0.00	0.03	0.00	0.00	0.15
	5730	163	8	0.00	0.00	0.49	0.00	0.21	0.53	0.00	0.00	1.12	0.00	0.21	1.15
	5730	163	9	0.00	0.00	0.21	0.00	0.00	0.21	0.00	0.00	0.57	0.00	0.00	0.57
	5730	164	7	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.11	0.00
	5730	165	7	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00
	5730	166	6	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.07
	5730	166	7	0.00	0.00	0.00	0.06	0.03	0.00	0.00	0.00	0.00	0.06	0.03	0.00
	5730	166	8	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.06	0.00
	5730	167	6	0.00	0.00	0.11	0.00	0.00	0.23	0.00	0.00	0.11	0.00	0.00	0.23
	5730	167	7	0.00	0.00	0.00	0.10	0.03	0.00	0.00	0.00	0.00	0.10	0.03	0.00
	5730	167	8	0.00	0.00	0.00	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.02	0.01
	5730	168	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5730	168	8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5800	159	5	0.00	1.22	0.00	0.00	1.39	0.00	0.00	3.30	0.00	0.00	3.46	0.00
	5800	159	6	0.17	0.00	0.00	0.17	0.00	0.00	0.50	0.00	0.00	0.50	0.00	0.00

Table 11.--Continued.

Lati-tude	Longi-tude	Mo.	Ratios Using Bycatch Impact Costs at the Exvessel Level: Estimate A: King crab only: 82	83	84	Estimate A: All bycatch: 82	83	84	Estimate B: King crab only: 82	83	84	Estimate B: All bycatch: 82	83	84
5800	159	7	0.48	0.00	0.00	0.60	0.00	0.00	1.43	0.00	0.00	1.55	0.00	0.00
5800	159	9	0.00	0.00	0.13	0.00	0.00	0.69	0.00	0.00	0.39	0.00	0.00	0.95
5800	162	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5800	162	7	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00
5800	166	6	0.00	0.00	0.00	0.00	0.00	0.94	0.00	0.00	0.00	0.00	0.00	0.94
5800	166	7	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.02	0.00
5800	166	8	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.03	0.00
5800	167	8	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.02	0.00
5830	163	7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5830	167	8	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.00	0.00	0.00	0.21
5830	169	8	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.10
5900	168	8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5900	169	8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 11.--Continued.

	Latitude	Longitude	Mo.	Ratios Using Bycatch Impact Costs at the Wholesale Level: Estimate A: King crab only: 82	83	84	Estimate A: All bycatch: 82	83	84	Estimate B: King crab only: 82	83	84	Estimate B: All bycatch: 82	83	84
	5330	168	5	0.00	0.00	0.00	0.00	0.00	4.85	0.00	0.00	0.00	0.00	0.00	4.85
	5400	165	1	0.00	0.00	0.00	0.00	0.00	1.31	0.00	0.00	0.00	0.00	0.00	1.31
	5400	165	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5400	166	1	0.00	0.00	0.00	0.00	0.00	1.10	0.00	0.00	0.00	0.00	0.00	1.10
	5400	166	4	0.00	0.00	0.00	0.00	0.00	0.74	0.00	0.00	0.00	0.00	0.00	0.74
	5400	166	8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5400	166	10	0.00	0.00	0.00	0.00	0.00	0.42	0.00	0.00	0.00	0.00	0.00	0.42
*	5430	164	4	0.00	0.00	0.03	0.00	0.00	0.43	0.00	0.00	0.09	0.00	0.00	0.49
	5430	165	3	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.00
	5430	165	4	0.00	0.00	0.00	0.00	0.00	0.60	0.00	0.00	0.00	0.00	0.00	0.60
*	5500	163	4	0.00	0.00	0.00	0.00	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.22
*	5500	163	6	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.25	0.00
*	5500	163	7	0.00	0.00	0.00	0.00	0.67	0.00	0.00	0.00	0.00	0.00	0.67	0.00
*	5500	164	2	0.00	0.00	0.00	0.00	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.40
*	5500	164	3	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.06
*	5500	164	4	0.00	0.00	0.00	0.00	0.00	0.23	0.00	0.00	0.00	0.00	0.00	0.23
*	5530	162	3	0.00	0.08	0.00	0.00	0.12	0.00	0.00	0.19	0.00	0.00	0.23	0.00
*	5530	162	4	0.00	0.68	0.44	0.00	1.02	1.01	0.00	1.78	0.98	0.00	2.13	1.55
*	5530	162	5	1.10	0.82	0.00	1.37	1.70	0.00	2.96	2.21	0.00	3.23	3.09	0.00
*	5530	162	6	0.00	0.03	0.00	0.00	0.52	1.21	0.00	0.07	0.00	0.00	0.56	1.21
*	5530	162	7	0.00	0.01	0.00	0.00	1.30	0.00	0.00	0.04	0.00	0.00	1.33	0.00
*	5530	162	8	0.00	0.07	0.00	0.00	0.39	0.00	0.00	0.20	0.00	0.00	0.52	0.00
*	5530	163	3	0.00	0.22	0.00	0.00	0.78	0.00	0.00	0.44	0.00	0.00	1.00	0.00
*	5530	163	4	0.00	0.00	0.00	0.00	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.22
	5530	165	3	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.17
	5530	169	8	0.00	0.00	0.00	0.00	0.00	0.16	0.00	0.00	0.00	0.00	0.00	0.16
*	5600	160	4	0.00	0.00	0.59	0.00	0.00	0.62	0.00	0.00	1.61	0.00	0.00	1.64
*	5600	160	5	1.06	0.00	0.28	1.08	0.00	0.48	3.15	0.00	0.65	3.17	0.00	0.85
*	5600	160	6	0.00	0.02	0.00	0.00	1.07	0.00	0.00	0.03	0.00	0.00	1.09	0.00
*	5600	160	7	0.05	0.10	0.00	1.05	1.28	0.00	0.13	0.26	0.00	1.13	1.44	0.00
*	5600	160	8	0.20	0.43	0.00	1.95	1.48	0.00	0.58	1.19	0.00	2.34	2.25	0.00

Table 11.--Continued.

	Latitude	Longitude	Mo.	Ratios Using Bycatch Impact Costs at the Wholesale Level: Estimate A: King crab only: 82	83	84	Estimate A: All bycatch: 82	83	84	Estimate B: King crab only: 82	83	84	Estimate B: All bycatch: 82	83	84
*	5600	160	9	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.28
*	5600	161	4	0.31	0.40	1.26	0.31	1.24	1.41	0.89	1.15	3.01	0.89	1.99	3.16
*	5600	161	5	0.73	0.46	0.00	0.76	0.46	0.00	2.21	1.16	0.00	2.24	1.16	0.00
*	5600	161	6	0.00	0.04	0.00	0.00	0.54	0.00	0.00	0.12	0.00	0.00	0.62	0.00
*	5600	161	7	0.00	0.00	0.00	0.00	1.70	0.00	0.00	0.00	0.00	0.00	1.70	0.00
*	5600	161	8	0.20	0.32	0.00	0.54	0.79	0.00	0.58	0.91	0.00	0.92	1.38	0.00
*	5600	161	9	0.49	0.00	0.00	1.37	0.00	0.00	1.44	0.00	0.00	2.32	0.00	0.00
*	5600	162	3	0.00	0.11	0.00	0.00	0.12	0.00	0.00	0.27	0.00	0.00	0.29	0.00
*	5600	162	4	0.00	0.78	0.63	0.00	1.24	1.05	0.00	1.91	1.40	0.00	2.37	1.82
*	5600	162	5	0.17	1.09	0.86	0.17	1.71	2.97	0.48	2.95	1.81	0.48	3.57	3.93
*	5600	162	8	0.00	0.25	0.00	0.00	0.90	0.00	0.00	0.68	0.00	0.00	1.34	0.00
*	5600	162	9	0.40	0.00	0.00	1.40	0.00	0.00	1.19	0.00	0.00	2.19	0.00	0.00
	5600	163	4	0.00	0.83	0.00	0.00	0.96	0.00	0.00	2.23	0.00	0.00	2.36	0.00
	5630	158	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5630	159	5	0.05	0.00	0.06	0.05	0.00	0.07	0.14	0.00	0.14	0.14	0.00	0.15
	5630	159	6	0.33	0.00	0.00	0.33	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
	5630	159	7	0.20	0.04	0.00	0.20	1.69	0.00	0.56	0.05	0.00	0.56	1.70	0.00
*	5630	160	4	0.00	0.00	0.36	0.00	0.00	0.45	0.00	0.00	0.96	0.00	0.00	1.04
*	5630	160	5	0.39	0.91	0.00	0.39	0.93	0.00	1.14	2.67	0.00	1.15	2.69	0.00
*	5630	160	6	0.00	0.02	0.22	0.00	0.92	0.22	0.00	0.05	0.47	0.00	0.95	0.47
*	5630	160	7	0.07	0.10	0.00	1.39	1.29	0.00	0.19	0.26	0.00	1.51	1.45	0.00
*	5630	160	8	0.26	0.00	0.00	2.87	0.00	0.00	0.76	0.00	0.00	3.37	0.00	0.00
*	5630	160	9	0.00	0.00	0.14	0.00	0.00	0.44	0.00	0.00	0.41	0.00	0.00	0.72
*	5630	161	4	0.00	0.20	0.00	0.05	0.21	0.00	0.00	0.59	0.00	0.05	0.60	0.00
*	5630	161	5	0.40	0.00	0.53	0.41	0.00	0.53	1.19	0.00	0.53	1.20	0.00	0.53
*	5630	161	6	0.00	0.00	0.57	0.00	0.00	0.57	0.00	0.00	1.60	0.00	0.00	1.60
*	5630	161	7	0.00	0.16	0.00	0.00	0.43	0.00	0.00	0.23	0.00	0.00	0.50	0.00
*	5630	161	8	0.00	2.49	0.45	0.00	2.83	1.66	0.00	7.42	0.55	0.00	7.76	1.77
*	5630	162	6	0.00	0.00	0.38	0.00	0.00	0.38	0.00	0.00	0.71	0.00	0.00	0.71
*	5630	162	8	0.00	0.74	0.00	0.00	0.74	0.00	0.00	0.74	0.00	0.00	0.74	0.00
	5630	164	3	0.00	0.00	0.00	0.00	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.37

Table 11.--Continued.

	Latitude	Longitude	Mo.	Ratios Using Bycatch Impact Costs at the Wholesale Level: Estimate A: King crab only: 82	83	84	Estimate A: All bycatch: 82	83	84	Estimate B: King crab only: 82	83	84	Estimate B: All bycatch: 82	83	84
	5630	164	8	0.00	0.00	0.06	0.00	0.00	0.14	0.00	0.00	0.12	0.00	0.00	0.21
	5630	167	7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5630	168	8	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.05
	5700	158	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5700	158	7	0.00	0.00	0.10	0.12	0.00	0.44	0.00	0.00	0.28	0.12	0.00	0.61
	5700	159	5	0.08	1.28	0.21	0.08	1.65	0.24	0.24	3.72	0.56	0.24	4.08	0.59
	5700	159	6	0.00	1.25	0.12	0.00	1.44	0.21	0.00	3.54	0.29	0.00	3.73	0.38
	5700	159	7	0.13	1.29	0.16	0.28	1.47	0.16	0.36	3.40	0.37	0.51	3.58	0.37
	5700	159	8	0.00	0.00	0.19	0.00	0.00	0.50	0.00	0.00	0.47	0.00	0.00	0.78
	5700	159	9	0.00	0.00	0.11	0.00	0.00	1.24	0.00	0.00	0.32	0.00	0.00	1.45
*	5700	160	4	0.00	0.00	0.45	0.00	0.00	0.46	0.00	0.00	1.33	0.00	0.00	1.34
*	5700	160	5	0.00	3.80	0.60	0.00	4.23	0.68	0.00	11.00	1.67	0.00	11.44	1.75
*	5700	160	6	0.17	1.95	0.28	0.17	2.15	0.32	0.47	5.61	0.72	0.47	5.81	0.77
*	5700	160	7	0.00	1.92	0.16	0.00	2.07	0.23	0.00	5.19	0.34	0.00	5.33	0.41
*	5700	160	8	0.00	0.00	0.31	0.00	0.00	0.42	0.00	0.00	0.78	0.00	0.00	0.90
*	5700	160	9	0.00	0.00	0.18	0.00	0.00	0.77	0.00	0.00	0.50	0.00	0.00	1.09
*	5700	160	10	0.00	0.00	0.19	0.00	0.00	0.99	0.00	0.00	0.57	0.00	0.00	1.37
*	5700	161	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
*	5700	162	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
*	5700	162	5	0.00	0.00	0.61	0.00	0.00	2.99	0.00	0.00	0.70	0.00	0.00	3.08
*	5700	162	8	0.00	0.00	0.63	0.00	0.00	0.77	0.00	0.00	1.45	0.00	0.00	1.59
*	5700	162	9	0.00	0.00	0.22	0.00	0.00	0.24	0.00	0.00	0.67	0.00	0.00	0.69
	5700	163	9	0.00	0.00	0.33	0.00	0.00	0.33	0.00	0.00	1.01	0.00	0.00	1.01
	5700	165	8	0.00	0.00	0.00	0.00	0.07	0.03	0.00	0.00	0.00	0.00	0.07	0.03
	5700	166	8	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.10	0.00
	5700	167	8	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.04	0.00
	5700	169	7	0.00	0.04	0.00	0.00	0.07	0.00	0.00	0.04	0.00	0.00	0.07	0.00
	5700	169	8	0.00	1.04	0.00	0.00	1.22	0.00	0.00	1.60	0.00	0.00	1.79	0.00
	5730	158	5	0.00	0.21	0.05	0.00	0.23	0.09	0.00	0.41	0.09	0.00	0.42	0.13
	5730	158	6	0.16	0.00	0.02	0.32	0.00	0.29	0.46	0.00	0.04	0.62	0.00	0.32
	5730	158	7	0.16	0.00	0.00	0.61	0.00	0.53	0.47	0.00	0.00	0.92	0.00	0.53

Table 11.--Continued.

	Lati-tude	Longi-tude	Mo.	Ratios Using Bycatch Impact Costs at the Wholesale Level: Estimate A: King crab only: 82	83	84	Estimate A: All bycatch: 82	83	84	Estimate B: King crab only: 82	83	84	Estimate B: All bycatch: 82	83	84
	5730	159	5	0.18	0.79	0.36	0.18	1.00	0.38	0.52	2.08	0.82	0.52	2.30	0.84
	5730	159	6	0.19	0.47	1.81	0.32	0.52	1.93	0.57	1.31	4.63	0.70	1.36	4.75
	5730	159	7	0.52	0.91	0.00	0.95	1.41	0.00	1.51	2.58	0.00	1.94	3.08	0.00
	5730	159	8	0.00	0.00	0.11	0.00	0.00	0.49	0.00	0.00	0.29	0.00	0.00	0.67
	5730	159	9	0.00	0.00	0.06	0.00	0.00	0.55	0.00	0.00	0.17	0.00	0.00	0.66
*	5730	160	5	0.16	1.58	0.49	0.16	1.75	0.55	0.49	4.37	1.33	0.49	4.54	1.38
*	5730	160	6	0.00	0.58	0.20	0.00	0.68	0.23	0.00	1.58	0.43	0.00	1.68	0.46
*	5730	160	7	0.00	2.06	0.12	0.00	2.24	0.19	0.00	5.94	0.26	0.00	6.12	0.33
*	5730	160	8	0.00	0.00	0.04	0.00	0.00	0.16	0.00	0.00	0.11	0.00	0.00	0.22
*	5730	160	9	0.00	0.00	0.11	0.00	0.00	0.50	0.00	0.00	0.33	0.00	0.00	0.72
*	5730	161	6	0.33	0.00	0.44	0.33	0.00	0.44	0.84	0.00	1.09	0.84	0.00	1.10
	5730	162	7	0.22	0.00	0.00	0.30	0.00	0.00	0.54	0.00	0.00	0.63	0.00	0.00
	5730	162	8	0.00	0.00	0.68	0.00	0.00	0.68	0.00	0.00	1.13	0.00	0.00	1.13
	5730	163	6	0.00	0.00	0.04	0.00	0.00	0.24	0.00	0.00	0.04	0.00	0.00	0.24
	5730	163	8	0.00	0.01	0.65	0.00	0.34	0.71	0.00	0.01	1.49	0.00	0.34	1.55
	5730	163	9	0.00	0.00	0.28	0.00	0.00	0.28	0.00	0.00	0.76	0.00	0.00	0.76
	5730	164	7	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.00	0.18	0.00
	5730	165	7	0.00	0.00	0.00	0.26	0.00	0.00	0.00	0.00	0.00	0.26	0.00	0.00
	5730	166	6	0.00	0.00	0.00	0.00	0.00	0.23	0.00	0.00	0.00	0.00	0.00	0.23
	5730	166	7	0.00	0.00	0.00	0.19	0.08	0.00	0.00	0.00	0.00	0.19	0.08	0.00
	5730	166	8	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.20	0.00
	5730	167	6	0.00	0.00	0.15	0.00	0.00	0.34	0.00	0.00	0.15	0.00	0.00	0.34
	5730	167	7	0.00	0.00	0.00	0.31	0.10	0.00	0.00	0.00	0.00	0.31	0.10	0.00
	5730	167	8	0.00	0.00	0.00	0.00	0.07	0.03	0.00	0.00	0.00	0.00	0.07	0.03
	5730	168	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5730	168	8	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00
	5800	159	5	0.00	1.63	0.00	0.00	1.87	0.00	0.00	4.39	0.00	0.00	4.63	0.00
	5800	159	6	0.23	0.00	0.00	0.23	0.00	0.00	0.67	0.00	0.00	0.67	0.00	0.00
	5800	159	7	0.63	0.00	0.00	0.84	0.00	0.00	1.90	0.00	0.00	2.11	0.00	0.00
	5800	159	9	0.00	0.00	0.18	0.00	0.00	1.10	0.00	0.00	0.52	0.00	0.00	1.44
	5800	162	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 11.--Continued.

Latitude	Longitude	Mo.	Ratios Using Bycatch Impact Costs at the Wholesale Level: Estimate A: King crab only: 82	83	84	Estimate A: All bycatch: 82	83	84	Estimate B: King crab only: 82	83	84	Estimate B: All bycatch: 82	83	84
5800	162	7	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00
5800	166	6	0.00	0.00	0.00	0.00	0.00	1.59	0.00	0.00	0.00	0.00	0.00	1.59
5800	166	7	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.07	0.00
5800	166	8	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.09	0.00
5800	167	8	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.06	0.00
5830	163	7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5830	167	8	0.00	0.00	0.00	0.00	0.00	0.36	0.00	0.00	0.00	0.00	0.00	0.36
5830	169	8	0.00	0.00	0.00	0.00	0.00	0.16	0.00	0.00	0.00	0.00	0.00	0.16
5900	168	8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5900	169	8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

* Areas within the pot sanctuary.

Table 12.--Estimated effects of optimal closures for the Bering Sea/Aleutian Islands Area I joint venture flounder fishery based on alternative sets of estimates of impact costs per unit of bycatch, by year, 1982-1984.

	Estimated Effect Assuming No Redistribution of Effort (Percent of actual catch that would have occurred with the closure)													Ratio of Bycatch Impact Cost to Value of Groundfish
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	
CLOSURE 1															
	82	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	0.0	50.0	50.0	50.0	50.0	0.21
	83	43.4	52.7	50.2	93.2	95.2	78.7	91.9	82.9	0.0	81.0	83.0	81.9	46.0	0.28
	84	95.4	93.7	99.8	100.0	99.6	99.2	99.5	99.5	100.0	99.3	99.3	99.3	95.5	0.20
CLOSURE 2															
	82	82.7	77.7	86.8	100.0	43.9	86.7	62.9	97.9	0.0	82.4	99.4	79.6	51.7	0.42
	83	27.6	38.1	30.4	82.1	81.2	68.1	82.6	68.9	0.0	70.4	71.1	71.6	47.3	0.51
	84	90.9	88.0	94.0	94.9	97.2	98.0	98.6	92.9	100.0	97.9	97.5	98.1	92.7	0.32
CLOSURE 3															
	82	57.1	73.8	72.3	98.4	92.3	84.4	83.1	73.0	0.0	83.5	76.0	83.9	57.5	0.41
	83	9.8	17.0	10.3	62.5	75.6	50.2	75.5	43.4	0.0	53.7	53.2	56.1	10.4	0.25
	84	67.1	71.4	70.8	90.4	94.4	86.0	94.7	80.7	100.0	87.3	89.7	88.3	67.7	0.40
CLOSURE 4															
	82	39.3	51.1	30.9	98.4	35.9	70.7	45.8	70.5	0.0	65.6	75.4	63.1	35.4	0.59
	83	5.9	13.3	8.3	61.9	56.4	42.7	68.6	38.5	0.0	46.4	44.8	48.8	15.0	0.50
	84	56.0	59.9	47.7	72.5	81.5	77.7	90.7	73.2	93.3	79.8	85.4	81.1	60.7	0.49
CLOSURE 5															
	82	82.1	89.6	92.5	99.6	99.6	96.3	93.9	88.7	0.0	95.4	93.7	95.4	82.4	0.24
	83	28.7	39.1	33.5	85.0	88.9	70.0	87.0	72.1	0.0	72.7	74.1	74.1	31.4	0.28
	84	91.2	88.9	95.1	98.3	99.3	98.2	98.8	93.7	100.0	98.1	97.5	98.3	90.8	0.25

Table 12.--Continued.

Estimated Effect Assuming No Redistribution of Effort (Percent of actual catch that would have occurred with the closure)														Ratio of Bycatch Impact Cost to Value of Groundfish
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	
CLOSURE 6														
82	57.1	59.3	34.1	98.8	25.7	72.5	41.9	83.5	0.0	66.8	89.1	63.3	29.3	0.47
83	8.5	15.0	15.7	63.2	26.2	41.2	40.3	38.9	0.0	40.9	37.2	41.0	16.6	0.45
84	82.9	77.6	72.0	71.6	74.6	91.0	92.3	83.5	100.0	90.9	92.4	91.2	78.3	0.42
CLOSURE 7														
82	51.2	69.3	41.6	97.9	92.0	80.8	78.3	64.0	0.0	79.4	69.9	79.8	51.6	0.52
83	5.9	13.3	8.3	61.9	62.0	43.7	71.9	38.5	0.0	47.8	46.3	50.3	6.4	0.23
84	59.6	67.0	66.0	90.1	94.2	81.2	92.7	78.9	100.0	83.2	85.7	84.2	60.6	0.50
CLOSURE 8														
82	32.2	43.4	27.5	97.9	21.6	60.7	29.0	61.4	0.0	54.2	65.4	51.0	24.5	0.74
83	2.3	9.0	4.3	58.2	17.0	29.5	35.9	31.2	0.0	30.6	25.9	31.1	6.1	0.44
84	40.9	53.1	33.3	69.2	28.7	60.0	69.5	63.4	93.3	61.9	65.9	62.6	39.0	0.57

Table 12.--Continued.

	Estimated Effect Assuming Complete Redistribution of Effort (Percent of actual catch that would have occurred with the closure)													Ratio of Bycatch Impact Lost to Value of Groundfish
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	
CLOSURE 1															
	82	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0	100.0	100.0	100.0	100.0	0.21
	83	53.5	65.1	62.0	115.0	117.4	97.2	113.4	102.4	0.0	100.0	102.4	101.1	56.7	0.28
	84	96.1	94.4	100.5	100.7	100.3	99.9	100.2	100.2	100.7	100.0	100.0	100.0	96.1	0.20
CLOSURE 2															
	82	100.4	94.2	105.3	121.3	53.3	105.2	76.4	118.8	0.0	100.0	120.6	96.6	62.8	0.42
	83	39.2	54.2	43.2	116.7	115.4	96.7	117.4	97.9	0.0	100.0	101.1	101.7	67.2	0.51
	84	92.9	90.0	96.0	97.0	99.4	100.1	100.7	94.9	102.2	100.0	99.6	100.2	94.8	0.32
CLOSURE 3															
	82	68.4	88.4	86.5	117.8	110.5	101.1	99.5	87.4	0.0	100.0	91.0	100.4	68.8	0.41
	83	18.3	31.7	19.1	116.3	140.8	93.5	140.6	80.8	0.0	100.0	99.0	104.5	19.3	0.25
	84	76.9	81.8	81.1	103.5	108.1	98.5	108.4	92.4	114.5	100.0	102.7	101.1	77.5	0.40
CLOSURE 4															
	82	59.9	77.9	47.2	150.0	54.7	107.8	69.8	107.6	0.0	100.0	115.0	96.2	54.0	0.59
	83	12.8	28.7	17.9	133.2	121.4	91.9	147.8	82.9	0.0	100.0	96.5	105.0	32.2	0.50
	84	70.3	75.1	59.8	90.9	102.2	97.4	113.7	91.7	117.0	100.0	107.1	101.6	76.1	0.49
CLOSURE 5															
	82	86.1	93.9	97.0	104.4	104.4	101.0	98.5	93.0	0.0	100.0	98.3	100.1	86.4	0.24
	83	39.4	53.7	46.1	116.8	122.2	96.2	119.6	99.2	0.0	100.0	101.9	101.8	43.1	0.28
	84	93.0	90.6	97.0	100.2	101.3	100.1	100.7	95.5	101.9	100.0	99.4	100.2	92.6	0.25

Table 12.--Continued.

Estimated Effect Assuming Complete Redistribution of Effort (Percent of actual catch that would have occurred with the closure)														Ratio of Bycatch Impact Lost to Value of Groundfish
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	
CLOSURE 6														
82	85.5	88.7	51.1	147.8	38.5	108.5	62.8	125.0	0.0	100.0	133.4	94.8	43.9	0.47
83	20.8	36.6	38.2	154.4	64.1	100.7	98.4	95.0	0.0	100.0	90.9	100.1	40.5	0.45
84	91.2	85.4	79.3	78.8	82.1	100.1	101.5	91.9	110.0	100.0	101.7	100.4	86.1	0.42
CLOSURE 7														
82	64.6	87.3	52.4	123.4	115.9	101.8	98.7	80.7	0.0	100.0	88.0	100.5	65.0	0.52
83	12.3	27.9	17.4	129.5	129.8	91.5	150.5	80.5	0.0	100.0	96.8	105.4	13.5	0.23
84	71.7	80.6	79.4	108.3	113.3	97.7	111.4	94.9	120.2	100.0	103.0	101.3	72.9	0.50
CLOSURE 8														
82	59.4	80.1	50.7	180.7	39.8	112.0	53.5	113.2	0.0	100.0	120.6	94.1	45.2	0.74
83	7.6	29.4	14.0	190.2	55.5	96.4	117.3	101.9	0.0	100.0	84.5	101.5	19.8	0.44
84	66.1	85.9	53.9	111.8	46.4	97.0	112.3	102.5	150.9	100.0	106.6	101.2	63.0	0.57

(1) Year
(2) Female red king crab
(3) Male red king crab
(4) Tanner crab, bairdi
(5) Tanner crab, opilio
(6) Halibut
(7) Flounder
(8) Pacific cod
(9) Pollock
(10) All other groundfish
(11) All groundfish
(12) Effort
(13) Exvessel value of groundfish
(14) Bycatch impact cost

Table 12.--Continued.

The optimal closures are for the following sets of impact costs per unit of bycatch:

1. King crab only, exvessel level, lower contribution per female red king crab.
2. All bycatch, exvessel level, lower contribution.
3. King crab only, exvessel level, higher contribution.
4. All bycatch, exvessel level, higher contribution.
5. King crab only, wholesale level, lower contribution.
6. All bycatch wholesale level, lower contribution.
7. King crab only, wholesale level, higher contribution.
8. All bycatch, wholesale level, higher contribution.

It is assumed that trawl-induced mortality equals observed bycatch.

Table 13.--Estimated revenue per unit of effort and ratio of bycatch impact cost to the exvessel value of groundfish for three flounder fleets operating in the Bering Sea/Aleutian Island region Area I by half of one degree areas and by month, 1984.

Lati-tude	Longi-tude	Mo.	Revenue per unit effort ($/minute) J-V	F1	F2	Ratio of bycatch impact cost to exvessel value J-V	F1	F2
5330	168	5	*	0	0	2.94	0.00	0.00
5400	165	1	5	0	0	0.79	0.00	0.00
5400	166	1	5	0	0	0.67	0.00	0.00
5400	166	4	14	0	0	0.45	0.00	0.00
5400	166	8	21	0	0	0.00	0.00	0.00
5400	166	10	10	0	0	0.25	0.00	0.00
5430	164	4	39	0	0	0.27	0.00	0.00
5430	165	4	10	0	0	0.36	0.00	0.00
5500	163	4	*	0	0	0.13	0.00	0.00
5500	164	2	9	0	0	0.24	0.00	0.00
5500	164	3	39	0	0	0.04	0.00	0.00
5500	164	4	14	0	0	0.14	0.00	0.00
5530	162	4	27	0	0	0.69	0.00	0.00
5530	162	6	5	0	0	0.74	0.00	0.00
5530	163	4	16	0	0	0.13	0.00	0.00
5530	165	3	9	0	0	0.10	0.00	0.00
5530	169	8	1	0	0	0.05	0.00	0.00
5600	160	4	9	0	0	0.47	0.00	0.00
5600	160	5	12	0	0	0.33	0.00	0.00
5600	160	8	16	0	0	0.00	0.00	0.00
5600	160	9	5	0	0	0.17	0.00	0.00
5600	161	4	8	0	0	1.05	0.00	0.00
5600	162	4	100	0	0	0.74	0.00	0.00
5600	162	5	125	0	0	1.94	0.00	0.00
5600	166	2	0	4	0	0.00	0.60	0.00
5600	166	3	0	41	0	0.00	0.02	0.00
5600	167	2	0	5	0	0.00	0.38	0.00
5600	167	3	0	45	0	0.00	0.01	0.00
5630	159	5	16	0	0	0.05	0.00	0.00
5630	160	4	12	0	0	0.34	0.00	0.00
5630	160	6	11	0	0	0.17	0.00	0.00
5630	160	9	7	0	0	0.29	0.00	0.00
5630	161	5	11	0	0	0.40	0.00	0.00
5630	161	6	37	0	0	0.43	0.00	0.00
5630	161	8	*	0	0	1.07	0.00	0.00
5630	162	6	11	0	0	0.28	0.00	0.00
5630	164	1	0	2	0	0.00	1.20	0.00
5630	164	3	13	0	0	0.23	0.00	0.00
5630	164	4	0	9	0	0.00	0.00	0.00
5630	164	8	6	0	0	0.09	0.00	0.00
5630	164	9	0	4	0	0.00	0.01	0.00
5630	165	1	0	2	0	0.00	0.38	0.00

Table 13.--Continued.

Latitude	Longitude	Mo.	Revenue per unit effort ($/minute) J-V	F1	F2	Ratio of bycatch impact cost to exvessel value J-V	F1	F2
5630	165	2	0	21	0	0.00	0.01	0.00
5630	165	3	0	16	0	0.00	0.00	0.00
5630	165	4	0	16	0	0.00	0.00	0.00
5630	165	10	0	4	0	0.00	0.01	0.00
5630	165	12	0	7	0	0.00	0.27	0.00
5630	166	2	0	15	0	0.00	0.33	0.00
5630	166	3	0	19	0	0.00	0.00	0.00
5630	166	10	0	4	0	0.00	0.01	0.00
5630	167	3	0	32	0	0.00	0.00	0.00
5630	168	2	0	8	0	0.00	0.90	0.00
5630	168	3	0	35	0	0.00	0.00	0.00
5630	168	8	4	0	0	0.02	0.00	0.00
5700	158	7	7	0	0	0.28	0.00	0.00
5700	159	5	20	0	0	0.18	0.00	0.00
5700	159	6	15	0	0	0.15	0.00	0.00
5700	159	7	18	0	0	0.12	0.00	0.00
5700	159	8	13	0	0	0.33	0.00	0.00
5700	159	9	5	0	0	0.77	0.00	0.00
5700	160	4	49	0	0	0.35	0.00	0.00
5700	160	5	22	0	0	0.51	0.00	0.00
5700	160	6	21	0	0	0.24	0.00	0.00
5700	160	7	17	0	0	0.16	0.00	0.00
5700	160	8	13	0	0	0.30	0.00	0.00
5700	160	9	16	0	0	0.49	0.00	0.00
5700	160	10	6	0	0	0.63	0.00	0.00
5700	161	6	40	0	0	0.00	0.00	0.00
5700	162	5	369	0	0	1.90	0.00	0.00
5700	162	8	7	5	27	0.56	0.68	0.07
5700	162	9	*	0	33	0.18	0.00	0.08
5700	163	8	0	6	0	0.00	0.51	0.00
5700	163	9	9	0	32	0.25	0.00	0.03
5700	164	10	0	0	24	0.00	0.00	0.01
5700	164	11	0	0	22	0.00	0.00	0.08
5700	165	1	0	2	0	0.00	0.00	0.00
5700	165	8	3	0	0	0.01	0.00	0.00
5700	165	9	0	5	0	0.00	0.00	0.00
5700	165	11	0	0	37	0.00	0.00	0.00
5700	165	12	0	3	0	0.00	0.57	0.00
5700	166	9	0	5	0	0.00	0.01	0.00
5700	166	10	0	7	0	0.00	0.01	0.00
5700	166	12	0	11	0	0.00	0.05	0.00
5700	167	10	0	6	0	0.00	0.01	0.00
5700	167	12	0	6	0	0.00	0.45	0.00

Table 13.--Continued.

Latitude	Longitude	Mo.	Revenue per unit effort ($/minute) J-V	F1	F2	Ratio of bycatch impact cost to exvessel value J-V	F1	F2
5730	158	5	8	0	0	0.06	0.00	0.00
5730	158	6	7	0	0	0.18	0.00	0.00
5730	158	7	7	0	0	0.32	0.00	0.00
5730	159	5	14	0	0	0.29	0.00	0.00
5730	159	6	13	0	0	1.43	0.00	0.00
5730	159	8	8	0	0	0.31	0.00	0.00
5730	159	9	9	0	0	0.34	0.00	0.00
5730	160	5	15	0	0	0.41	0.00	0.00
5730	160	6	15	0	0	0.17	0.00	0.00
5730	160	7	14	0	0	0.13	0.00	0.00
5730	160	8	11	0	0	0.10	0.00	0.00
5730	160	9	9	0	0	0.32	0.00	0.00
5730	161	6	16	0	0	0.33	0.00	0.00
5730	162	7	0	0	32	0.00	0.00	0.08
5730	162	8	6	8	31	0.51	0.25	0.04
5730	162	9	0	4	0	0.00	0.11	0.00
5730	163	6	1	0	25	0.15	0.00	0.27
5730	163	7	0	0	29	0.00	0.00	0.07
5730	163	8	7	7	32	0.53	0.12	0.05
5730	163	9	8	5	29	0.21	0.07	0.07
5730	163	11	0	0	26	0.00	0.00	0.21
5730	164	6	0	0	8	0.00	0.00	0.29
5730	164	7	0	0	26	0.00	0.00	0.11
5730	164	8	0	6	0	0.00	0.00	0.00
5730	164	9	0	5	27	0.00	0.25	0.17
5730	164	10	0	0	34	0.00	0.00	0.03
5730	164	11	0	0	37	0.00	0.00	0.07
5730	165	9	0	6	37	0.00	0.00	0.01
5730	165	10	0	0	34	0.00	0.00	0.00
5730	165	11	0	6	0	0.00	0.17	0.00
5730	165	12	0	8	0	0.00	0.00	0.00
5730	166	1	0	5	0	0.00	0.01	0.00
5730	166	6	31	0	0	0.07	0.00	0.00
5730	166	9	0	6	0	0.00	0.03	0.00
5730	166	10	0	3	28	0.00	0.01	0.05
5730	166	11	0	12	0	0.00	0.01	0.00
5730	166	12	0	10	0	0.00	0.04	0.00
5730	167	1	0	3	0	0.00	0.00	0.00
5730	167	6	8	0	0	0.23	0.00	0.00
5730	167	8	2	0	0	0.01	0.00	0.00
5730	167	10	0	6	33	0.00	0.01	0.00
5730	167	11	0	10	0	0.00	0.00	0.00
5730	167	12	0	9	0	0.00	0.02	0.00
5730	168	1	0	3	0	0.00	0.00	0.00
5730	168	11	0	10	0	0.00	0.04	0.00
5800	159	9	52	0	0	0.69	0.00	0.00

Table 13.--Continued.

Latitude	Longitude	Mo.	Revenue per unit effort ($/minute) J-V	F1	F2	Ratio of bycatch impact cost to exvessel value J-V	F1	F2
5800	163	7	0	0	31	0.00	0.00	0.10
5800	163	8	0	5	27	0.00	0.60	0.18
5800	163	9	0	4	0	0.00	0.55	0.00
5800	164	7	0	0	25	0.00	0.00	0.18
5800	164	8	0	4	28	0.00	1.00	0.20
5800	164	9	0	4	0	0.00	0.32	0.00
5800	164	12	0	2	0	0.00	0.00	0.00
5800	165	9	0	4	0	0.00	0.00	0.00
5800	166	6	3	0	0	0.94	0.00	0.00
5800	166	8	5	0	0	0.00	0.00	0.00
5800	166	9	0	6	22	0.00	0.02	0.20
5800	166	11	0	9	12	0.00	0.23	0.13
5800	166	12	0	19	0	0.00	0.00	0.00
5800	167	1	0	4	0	0.00	0.00	0.00
5800	167	10	0	5	38	0.00	0.02	0.00
5800	167	11	0	0	23	0.00	0.00	0.07
5800	167	12	0	4	0	0.00	0.00	0.00
5800	168	10	0	9	35	0.00	0.00	0.01
5800	168	11	0	10	27	0.00	0.01	0.03
5800	168	12	0	7	0	0.00	0.00	0.00
5800	169	10	0	9	28	0.00	0.00	0.00
5800	169	11	0	10	0	0.00	0.00	0.00
5800	169	12	0	4	0	0.00	0.05	0.00
5830	164	7	0	0	25	0.00	0.00	0.23
5830	164	8	0	3	0	0.00	0.96	0.00
5830	167	8	5	0	0	0.21	0.00	0.00
5830	168	10	0	7	43	0.00	0.07	0.00
5830	168	11	0	6	0	0.00	0.00	0.00
5830	168	12	0	5	0	0.00	0.00	0.00
5830	169	8	4	0	0	0.10	0.00	0.00
5830	169	10	0	8	0	0.00	0.00	0.00
5830	169	11	0	9	0	0.00	0.00	0.00
5830	169	12	0	6	0	0.00	0.00	0.00
5900	168	8	4	0	0	0.00	0.00	0.00
5900	169	8	5	0	0	0.00	0.00	0.00

F1 is the Japanese large trawler fleet.
F2 is the Japanese flounder mothership fleet.
* The value is not available.
Note that bycatch in the foreign fisheries is limited by measures in the Bering Sea/Aleutian Islands region PMP.

APPENDIX

Data used to estimate impact per metric ton of bycatch.

Weight at Age
(kg)

Age	King crab 1/	Bairdi 2/	Opilio 2/	Halibut 3/
4	--	0.15	0.09	1.38
5	0.87	0.28	0.17	2.73
6	1.25	0.44	0.26	4.69
7	1.65	0.61	0.36	7.25
8	2.05*	0.79	0.46	10.35
9	2.44	0.97	0.55	13.87
10	2.81	1.15	0.64	17.71
11	--	1.31*	0.72	21.71*
12	--	--	0.79	--
13	--	--	0.85*	--

* The average size in target fishery.

Mortality at age not accounted for by target catch

(% removal)

Age	King crab 4/	Tanner crab 2/	Halibut 5/
4	--	49	18
5	60	44	18
6	41	37	18
7	47	30	18
8	47	22	18
9	47	22	18
10	--	22	18
11	--	22	18
12	--	22	--
13	--	22	--

Prices

($ per pound round weight)

	King crab 6/	Bairdi 6/	Opilio 6/	Halibut 5/
Ex-vessel	3.00	1.40	0.30	1.00
Wholesale	4.00	1.71	0.96	1.65

Round weight to product weight

Conversion factors 7/

	King crab	Tanner	Halibut
Ex-vessel	1.00	1.00	0.75
Wholesale	0.57	0.47	0.75

Sources:

1/ Reeves, J. E. and R. Marasco, 1980. An evaluation of alternative management options for the southeastern Bering Sea king crab fishery. NWAFC.

2/ Somerton, D. A., 1981. Life history and population dynamics of two species of Tanner crab, (Chionoecetes bairdi and C. opilio, in the eastern Bering Sea with implications for the management of commercial harvests. University of Washington dissertation.

3/ Myhre, R. J., 1974. Minimum size and optimum age of entry for Pacific halibut. International Pacific Halibut Commission.

4/ Reeves, J. E., 1985. NWAFC, Personal communication. Estimated average annual mortality between 1981 and 1985.

5/ Hoag, S. H., 1985. IPHC, Personal communication.

6/ Fishery Market News, NMFS, various issues September and October 1985.

7/ Thompson, B. G., 1979. Conversion factors for fishery products. NMFS memorandum. Washington D.C.

LITERATURE CITED

Bakkala, R.G., G.G. Thompson, and A.M. Shimada, 1985. Pacific cod. In R.G. Bakkala and L.L. Low (editors), Condition of groundfish resources of the eastern Bering Sea and Aleutian Islands region in 1985. Unpubl. rep., 232 p., Northwest and Alaska Fish. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NE, Seattle, WA 98115 (submitted to the International North Pacific Fisheries Commission in October 1985).

Berger, J., J. Wall, and R. Nelson, Jr., 1985. Summary of U.S. observer sampling of foreign and joint venture fisheries in the northeast Pacifi Ocean and eastern Bering Sea, 1984. (Document submitted to the annual meeting of International North Pacific Fisheries Commission, Tokyo, Japan, October 1985), Northwest and Alaska Fisheries Center, National Marine Fisheries Service, NOAA, Building 4, BIN C15700, 7600 Sand Point Way NE, Seattle, WA 98115.

Johnsen, W.W., 1985. Speech to north Pacific Fisheries Management Council concerning detrimental effect of on bottom trawling on king, tanner cra stocks and other incidental species. Typewritten report, 9 p.

June, J.A., and A.M. Shimada, 1985. Pacific cod (Gadus macrocephalus) predation on five species of crab in the eastern Bering Sea. Unpubl. manuscr., 36 pp. Northwest and Alaska Fisheries Center, Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NE, BIN C15700, Seattle WA, 9811

Loverich, Gary, 1985. Letter to the North Pacific Management Council, dated 12-3-85, 9 p.

Griffin, K.L., M.F. Eaton, and R. Otto. An observer program to gather in-season and post-season on-the-grounds red king crab catch data in th southeastern Bering Sea. NPFMC Doc. #22, 39 p.

A BIOLOGICAL AND ECONOMIC ANALYSIS OF THE BYCATCH OF PROHIBITED SPECIES IN THE BERING SEA AREA I JOINT VENTURE FLOUNDER FISHERY

Addendum 2

Analysis of Proposals to Limit Bycatch of Prohibited Species in the Bering Sea Area I Joint Venture Flounder Fishery: A Relative Evaluation Using 1985 MRC Catch Data

Prepared by

NPFMC Staff

January 1986

This paper compares the impact and control costs for 11 proposals submitted to the NPFMC which attempt to deal with the problem of prohibited species, particularly red king crab, in the Eastern Bering Sea. Each proposal is analyzed as to how it would have affected only the joint venture flounder fishery and its bycatch of king crab, Tanner crab and halibut. This addendum is a companion to and employs the same basic approach as Addendum 1 to this report. Addendum 2 examines the proposal from the perspective of the 1985 fishery while Addendum 1 uses 1984 harvest data and an average of 1982-1984 harvest data.

The 1985 catches of groundfish and the bycatch rates of each of the bycatch species were provided in 1/2 degree latitude by 1 degree longitude squares by Marine Resources Company (MRC). U.S. observer data, which provides detailed information on all joint venture harvests is not yet available for 1985. Therefore, we should present some qualifications. First, we used only data from the MRC joint venture flounder fishery. MRC accounted for 68% of the joint venture flounder harvest within the Pot Sanctuary, making the company the most important, though not the only, participant. Bycatches from the remainder of the 1985 joint venture fisheries and all 1985 domestic and foreign fisheries are not included in this analysis. Second, we assume no redistribution of effort by trawlers to reduce control costs of the decreased flounder catch. The analysis, therefore, overstates the impacts on the joint venture trawlers. Third, the relative comparisons between proposals examines only the flounder/bycatch tradeoff. Since some proposals suggest total closures to all fishing or total trawl closures (both bottom and midwater trawling) the present analysis provides an incomplete estimate of the impacts of these proposals.

The analysis provides comparisons of changes in the value of bycatch of king crab, Tanner crab and halibut versus the change in the value of directed flounder trawling. The decrease in bycatch would be a benefit while the decrease in directed trawling would be a cost of the proposed solution. These estimates should not be seen as the actual gains or losses of each proposal, but rather the potential costs and benefits assuming no adjustments in fishing patterns are made and examining only the flounder trawl catch versus the bycatch of king crab, Tanner crab, and halibut. As such, the results may

provide useful information for judging the impacts of each proposal relative to one another.

Procedure

First, the bycatch amounts for 1985 for king crab, Tanner crab, and halibut were calculated using the data provided by MRC. Second, the exvessel and wholesale values of the nondirected catches as well as the exvessel value of the directed trawl catch were calculated for each 1/2 degree latitude by 1 degree longitude square. The final step in the analysis is to eliminate those areas that each proposal suggested should be closed to bottom trawling and to recompute the impact and control costs. Chart 1 shows the areas that were included in this analysis.

(Chart 1 is located at end of document)

The totals of bycatch and directed catch in that area for the 1985 MRC fishery are shown below.

Bycatches (# of animals) and MRC Joint Venture Groundfish Catch (mt)

King Crab	Tanner Crab	Halibut	Groundfish(mt)
408,000	192,000	136,000	92,000

As each proposal is imposed on the 1985 MRC fishery, there is a resulting decrease in the bycatches which leads to an increased value to those who target on the bycatch species. There is also a reduction in the groundfish value since, again, we assume they do not redistribute their effort. There will in all likelihood be a cost imposed on the trawlers since they would no longer be able to utilize their preferred pattern of effort distribution. In reality, however, some segment of the fleet will fish elsewhere in the Bering Sea. However, movement into new grounds not only results in unknown catches of groundfish but also unknown bycatches of crab and halibut. Value estimates for the tonnages of bycatches and directed harvests were taken from the report, "A Biological and Economic Analysis of the Bycatch of Prohibited

Species in the Bering Sea Area I Joint Venture Flounder Fishery," by Jerry Reeves and Joe Terry. An explanation of the estimation procedure is found in the section Estimated Bycatch Impact Cost and in the Appendices. The values listed in Table 1 were used.

The female king crab value is per crab, while all others are per metric ton. The female red king crab is treated differently because of its extremely low population and its reproductive potential. There are two estimates of value for each female red king crab. This is due to the use of two spawner-recruit relationships and thus two different estimates of contribution to future biomass. There are also two assumptions used for the value of Tanner crab since the species composition of the 1985 catch of Tanner crab (bairdi and opilio) is not known. The first method assumes a 100% bairdi catch. The second method assumes a split of 63% bairdi, 37% opilio, which is the 1984 Bering Sea joint venture Tanner crab bycatch composition. Lastly, wholesale estimates of value of bycatches are provided along with exvessel estimates. However, estimates at the wholesale level for the flounder fishery are not provided. This is because the joint venture fishery does not market fish at the wholesale level in the United States.

Table 2 gives estimates of changes in value for the combined bycatch species and the directed flounder fishery. Each proposal is listed separately with a high and low estimate. The low estimate for bycatch species uses the lowest values when there is a choice. The low estimate uses exvessel values, the lower contribution per female, and the lower bairdi composition of Tanner crab catch. The high estimate uses wholesale values of bycatch, the highest contribution per female red king crab and assumes that the bairdi composition of the Tanner crab bycatch is 100%. The net figure is the change in value of the bycatch (a benefit) minus the change in value of the groundfish catch (a cost). Again, we emphasize that these values "not" be interpreted as total effects of the individual proposals. They are estimates of a comparison between changes in the value of bycatch and the value of the joint venture flounder fishery. These estimates should be used in judging the relative restrictiveness of each proposal with regard to the flounder fishery only. No inference can be made regarding the impact on any other trawl fishery.

TABLE 1

Values of Bycatch and Directed Catch in the
MRC Joint Venture Flounder Fishery

($/metric ton, unless otherwise noted)

Male		Female*(Method 1)		Female *(Method 2)	
Exvessel	Wholesale	Exvessel	Wholesale	Exvessel	Wholesale
$1,670	$2,220	$8.70	$11.60	$26.40	$35.20

Tanner Crab (Method A)		Tanner Crab (Method B)	
Exvessel	Wholesale	Exvessel	Wholesale
$1,500	$1,830	≅$1,100	≅$1,500

Halibut		JV Groundfish
Exvessel	Wholesale	Exvessel
$3,900	$6,500	$133

*per crab value

Table 2.

CHANGES IN VALUES OF MRC 1985 BYCATCHES AND DIRECTED CATCHES IN AREAS INSIDE AND ADJACENT TO THE POT SANCTUARY

EFFECTS OF PROPOSALS LOW - (EXVESSEL VALUES, 63% BAIRDI, 38% OPILIO TANNER CRAB RATIOS, 2.7 LB. CONTRIBUTION)

HIGH - (WHOLESALE VALUES, 100% BAIRDI, 8.2 LB CONTRIBUTION)

	LOW			HIGH		
PROPOSAL/SPONSOR	BYCATCH VALUE	GROUNDFISH VALUE	NET	BYCATCH VALUE	GROUNDFISH VALUE	NET
	(Values in Thousands of Dollars)					
IA/Crab Coalition	$2,600	$10,900	($8,300)	$6,700	$10,900	($4,200)
IB/FVOA	$3,000	$12,200	($9,200)	$7,800	$12,200	($4,400)
IIB/Flounder Trawlers (method 1)	$2,100	$4,900	($2,800)	$5,500	$4,900	$600
IIB/Flounder Trawlers (method 2)	$600	$3,300	($2,700)	$2,000	$3,300	($1,300)
IIIA/NPFVOA	$3,000	$12,000	($9,000)	$7,800	$12,000	($4,200)
IIIC/UFMA	$3,000	$12,200	($9,200)	$7,800	$12,200	($4,400)
IVA/NPFMC Member	$3,000	$12,200	($9,200)	$7,800	$12,200	($4,400)
IVB/NPFMC Member	$3,000	$12,000	($9,000)	$7,800	$12,000	($4,200)
IVC/NPFMC Member	$2,800	$11,700	($8,900)	$7,300	$11,700	($4,400)
Consolidated Trawl Proposal (method 1)	$2,700	$9,100	($6,400)	$7,300	$9,100	($1,800)
Consolidated Trawl Proposal	$2,500	$9,100	($6,600)	$6,900	$9,100	($2,200)

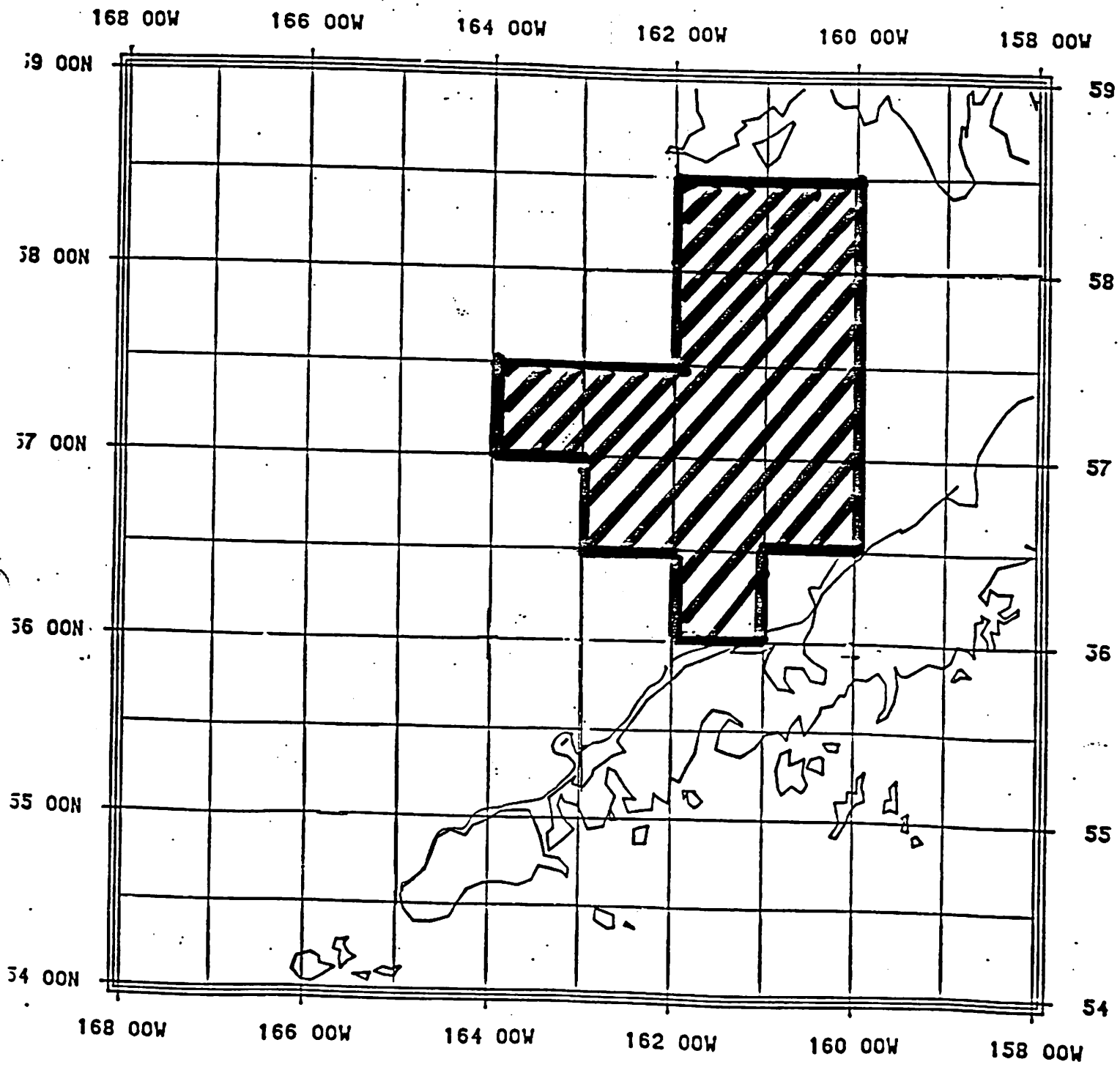
Some proposals have identical or near identical net values even though the proposals differ in major ways. This is due to the omissions of impacts of the various proposals on fisheries other than the flounder trawl fishery. Also some proposals were not analyzed in this framework since they do not affect the joint venture flounder trawlers.

The analysis of proposal IIB (the joint venture flounder proposal) contains a weakness not found in the others. Proposal IIB has in it both a cap and an area closure effective June 1. In this proposal, we assumed that the areas with the lowest bycatch rates were fished first so as to maximize their catch of groundfish given their bycatch constraint. When applying the June 1 closure, we were forced to assume that no fishing occurred after that date in the closed area and that they did not redistribute their effort during April and May, which would most likely occur.

Table 3. CHANGES IN MRC 1985 BYCATCHES AND DIRECTED CATCHES
(In Areas Inside and Adjacent to Pot Sanctuary)

PROPOSAL/SPONSOR	KING CRAB MALE	KING CRAB FEMALE	TANNER CRAB	HALIBUT	GROUNDFISH (mt)
Status Quo Catches	261,000	147,000	192,000	136,000	92,000
IA/Crab Coalition					
Change in Catch	214,000	124,000	172,000	120,000	79,000
Remaining Catch	47,000	23,000	20,000	16,000	13,000
IB/FVOA					
Change in Catch	260,000	145,000	191,000	136,000	89,000
Remaining Catch	1,000	2,000	1,000	0	3,000
IIB/Flounder Trawlers (method 1)					
Change in Catch	144,000	100,000	131,000	103,000	37,000
Remaining Catch	117,000	47,000	61,000	33,000	55,000
IIB/Flounder Trawlers (method 2)					
Change in Catch	202,000	96,000	158,000	125,000	67,000
Remaining Catch	59,000	51,000	34,000	11,000	25,000
IIIA/NPFVOA					
Change in Catch	259,000	145,000	191,000	136,000	85,000
Remaining Catch	2,000	2,000	1,000	0	7,000
IIIC/UFMA					
Change in Catch	260,000	145,000	191,000	136,000	89,000
Remaining Catch	1,000	2,000	1,000	0	3,000
IVA/NPFMC Member					
Change in Catch	260,000	145,000	191,000	136,000	89,000
Remaining Catch	1,000	2,000	1,000	0	3,000
IVB/NPFMC Member					
Change in Catch	259,000	145,000	191,000	136,000	85,000
Remaining Catch	2,000	2,000	1,000	0	7,000
IVC/NPFMC Member					
Change in Catch	242,000	138,000	189,000	123,000	85,000
Remaining Catch	19,000	9,000	3,000	13,000	7,000
Consolidated Trawler Proposal (method 1)					
Change in Catch	202,000	140,000	167,000	113,000	67,000
Remaining Catch	59,000	7,000	25,000	23,000	25,000
Consolidated Trawler Proposal (method 2)					
Change in Catch	214,000	127,000	167,000	113,000	67,000
Remaining Catch	47,000	20,000	25,000	23,000	25,000

CHART 1. AREAS FISHED BY MRC IN 1985 INSIDE AND ADJACENT TO POT SANCTUARY



Bert Larkins 1/15/86
Public Testimony

Coalition for Open Ocean Fisheries

Building C-3, Room 218
Fishermen's Terminal
Seattle, Washington 98119
(206) 285-3383

January 10, 1986

Mr. Jim H. Branson
Executive Director
North Pacific Fishery Management Council
P. O. Box 103136
Anchorage, AK 99510

Dear Jim:

The Coalition for Open Ocean Fisheries strongly supports the proposal recently sent to you by Fred Yeck concerning the Bering Sea trawl/king crab controversy.

That proposal reflects the unified views of those components of the U.S. trawl industry which take at least three-quarters of the domestic groundfish catch from the Eastern Bering Sea. It also represents additional significant restraints designed to further mitigate much of the incidental impact trawling may have on those prohibited species fully utilized by other American fishermen.

Although this Coalition favors a minimum of regulatory constraints that impede efficient access to all harvestable fishery resources, it is also sensitive to the legitimate needs of other users and to the requirements of conservation. We are particularly impressed by the diversity of interests that have come together in developing the unified trawler proposal and their willingness to accept substantial limitations to their activites even though the technical record clearly shows that they were not a cause of the decline in crab stocks.

Another impressive feature of the unified trawl proposal is the fact that further trawl concessions have been agreed to even in the absence of any movement or willingness to negotiate on the part of many of the non-trawl interests. This Coalition strongly advocates industry rather than regulatory agency

solutions to fishery problems. In this regard, the time spent and the results achieved by at least the trawl component of the domestic fishing industry are indicative of a responsible and rational approach to fishery management.

For the Coalition:

H. A. Larkins

HAL:ko

Richard Draves 1/15/86

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927 NORTH NORTHLAKE WAY, SUITE 110, SEATTLE, WASHINGTON 98103
TEL (206) 545-7271 FAX (206) 547-4968 TELEX 320036 NISSUI SEA

January 15, 1986

James O. Campbell, Chairman
North Pacific Fishery Management Council
Centennial Building
Sitka, Alaska

Re: Crab/Halibut Bycatch Issue

Dear Mr. Campbell,

We are writing to express our concern over the potential negative impact on our joint venture programs of the crab/halibut bycatch issue.

We are the owners of the vessels scheduled to participate in the 1986 Nippon Suisan joint venture program, which represents appoximately forty percent of the negotiated JVP for Japan, or approximately 235,500 mt, including 22,900 mt of yellowfin sole. This tonnage represents a thirty-three percent increase over last year and an ex-vessel value of some $23,000,000. Some of us have been associated with Nippon Suisan since 1981.

Northern Deep Sea Fisheries actively supported the Consolidated Trawler Proposal for the Eastern Bering Sea Bycatch Regulations, but we would like the Council to understand that if it adopts a closure, the area described in this proposal is the maximum area that our yellowfin joint venture program can accept, although potentially having a serious impact on tonnage. Any greater area could also severely impact our summer pollock fishery.

We appreciate the Council's efforts to resolve the issue in a fair and reasonable manner.

Sincerely,

Northern Deep Sea Fisheries, Inc.

James O. Campbell, Chairman
North Pacific Fishery Management Council
15 January 1986

F/V American Eagle

F/V Gun Mar and F/V Mar Gun

F/V Neahkahnie

F/V Peggy Jo

F/V Progress

F/V Silver Sea

F/V Starboard & F/V Starfish

F/V U.S. Dominator

F/V Vesteraalen

PB/lml

Original letter mailed 1/15/86
to Anchorage Office

TABLE : SSC Analysis of Yellowfin Sole/King Crab Closure Proposals[1/]

Proposal	Percent of Female King Crab Population Within The Proposed Closure (1984-85)	King Crab Bycatch CAP 6	Percent of C. Bairdi Population Within The Proposed Closure 3/ (1984-85)	1985 MRC Flounder Fishery Catch Displacement 4/	TC cap 6
IA	91		43	86	
IB, IIIC.2, IVA	97		40	97	~~yes~~
IIB	2/	155,000	2/	73	yes
IIIA, IVB	96		35	92	
IVC	99		40	92	
Consolidated Trawl	73-85	155,000	25-32	73	yes

1/ The impact of the proposals on halibut was not examined in detail because the status of the stock was not a concern.

2/ The proposal will close an area after June 1. It is not possible to calculate a comparable percentage.

3/ Includes only small males, prerecruit males, and females.

4/ These data are for the MRC flounder fishery only and were developed using information for 1985.

5/ 73% was derived by excluding geographical squares containing the 25-fathom line and 85% includes the squares.

6 applies to JV flounder & <>

Add Add'l Clm: F

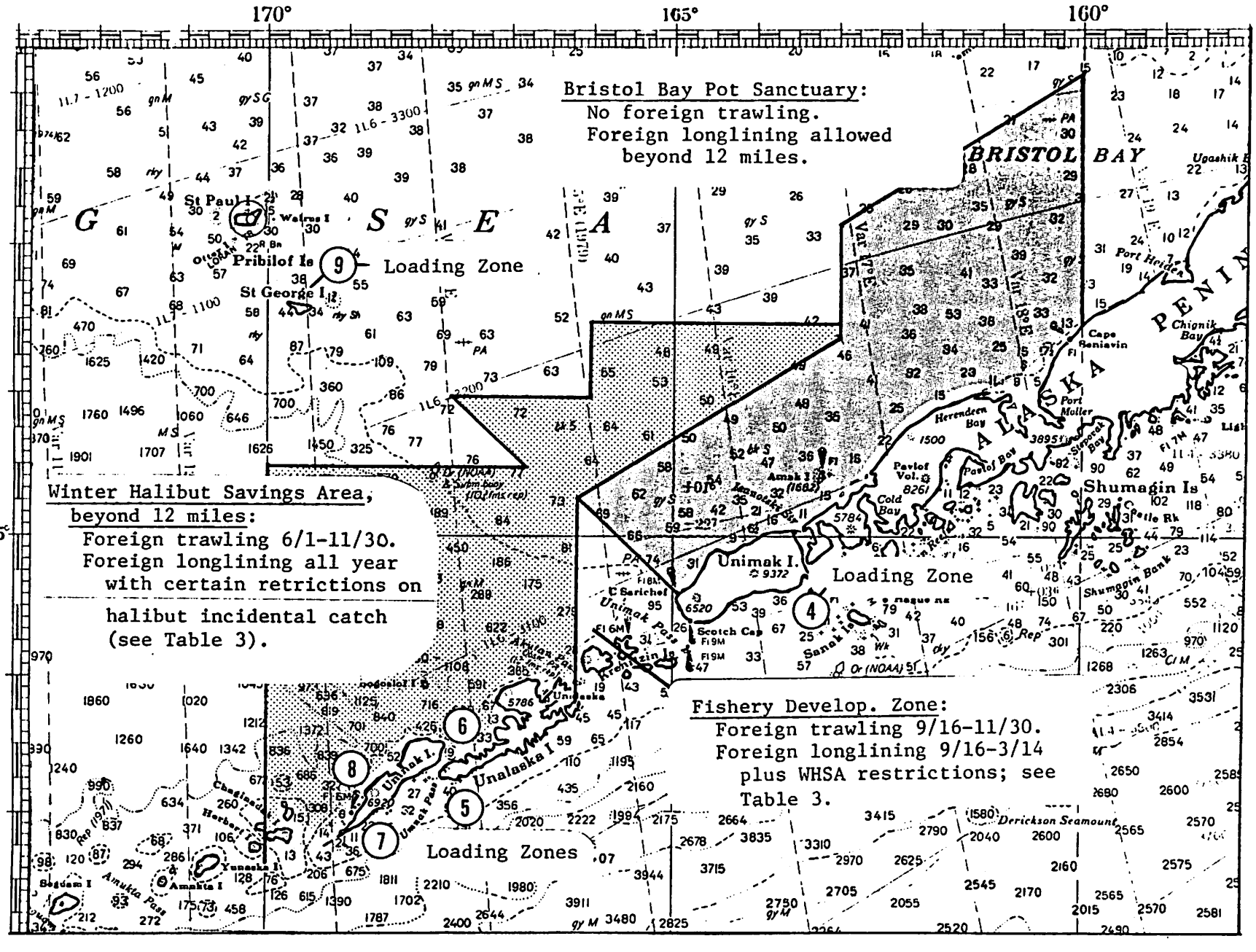
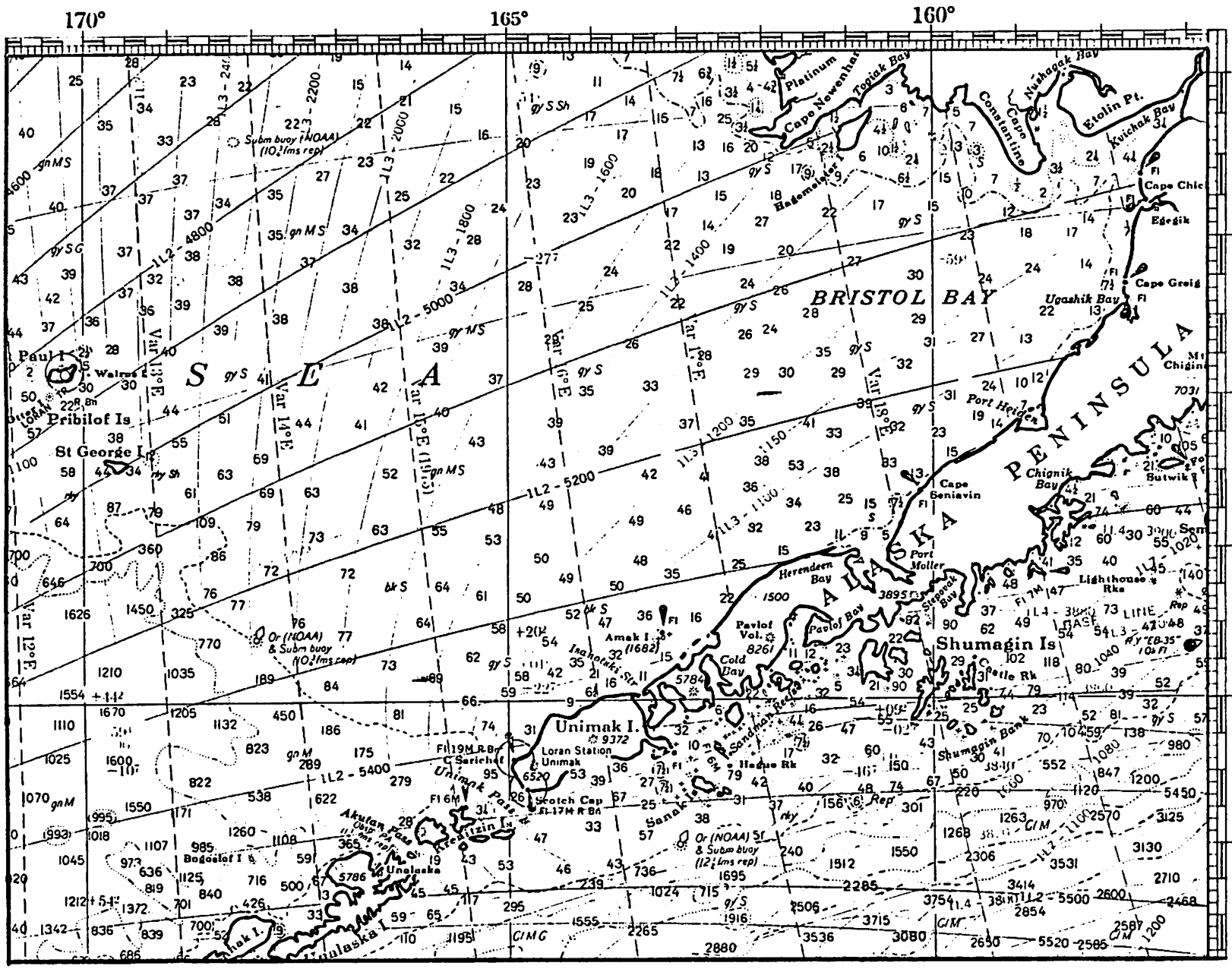
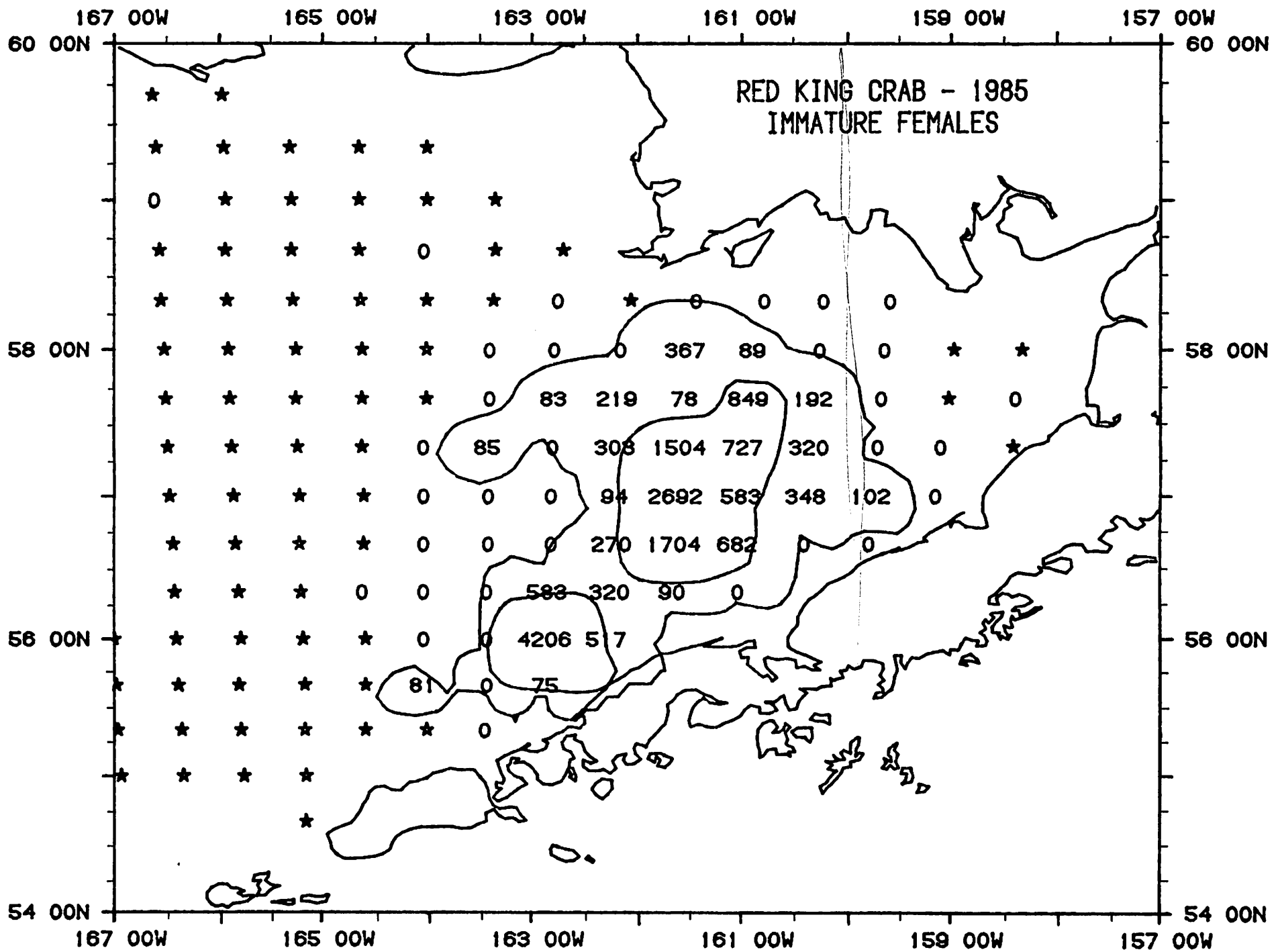


Fig. 4 Bristol Bay Pot Sanctuary, Winter Halibut Savings Area, and the U.S. Fishery Development Zone of the Bering Sea and Aleutian Islands Groundfish Plan.



CHARTLET 6 - BRISTOL BAY

Bob otto 4/17/86



0 = KC e on these but not the KC ....

C-3

4

ALASKA FACTORY TRAWLER ASSOC.
180 NICKERSON
SUITE 110
SEATTLE, WA 98109
206/285-5139

January 11, 1986

Mr. Jim Branson
North Pacific Fishery Management Council
411 West 4th Avenue
Anchorage, Alaska 99510

Dear Jim:

The Alaska Factory Trawler Association (AFTA) would like to offer comments on the proposals for incidental catches of king crab by the trawl fishery in the Bering Sea.

We are perplexed at the potential application of these bycatch restrictions to the DAP cod fishery, as all of the initial deliberations of the Council and all of the research of the NMFS has been directed at the joint venture flounder fishery. Only in late November did the domestic cod and pollock fishermen enter the discussions. The application of any restrictions to the DAP fishery should be viewed in this context and should only be applied to the DAP fishery as a last resort.

AFTA, being comprised mainly of crab fishermen, however, is extremely concerned about the problem and feels that some interim action should be taken to address bycatches of red king crab by fishing gear. Actions taken to address the problem, however, must be viewed in the context of impact on the fishermen who must make the sacrifice.

The members of AFTA have decided, in the spirit of compromise in the industry negotiations, to support a one year moratorium of all fishing in a designated area. The area is that which the MRC data shows the vast majority of king crab were incidentally harvested by the flounder fleet - between 160 and 162 degrees and south of 58 degrees to the 25 fathom curve along the Alaska Peninsula.

AFTA is agreeing to this limited mortorium in spite of the fact that there has been no demonstrated impact on the crab stocks by the trawl fishery, and especially the limited domestic (DAP) fishery for cod and pollock. We have no intention to waive our

first priority rights to bycatch species as DAP fishermen. That principle is prescribed by law - if there is to be a cessation of fishing because of unavailability of a species, the DAP fishery is the last to go.

There has been a guilty-until-proven-innocent mentality prevailing in this exercise. In support of our position, AFTA would like to offer third-party data for a factory trawler operation in the southeastern Bering Sea. An Alaska Department of Fish and Game observer on board a factory trawler fishing for cod in the Unimak area observed a king crab bycatch of 17/1000ths of one crab. This was an official observation by ADF&G in 1984 of 42 tows by a standard factory trawler.

Our vessels, numbering 12, need access to the area within 25 fathoms for the "summer" cod fishery near Port Moller. This fishery is a large portion of the total cod catch. To deny it to a relatively small number of cod trawlers would impose costs far beyond the potential saving which are thought to be made by a closure in this area.

AFTA thinks that the joint trawler proposal is an impressive start toward easing pressure on stocks for a period of further fact-finding. It is a substantial sacrifice by all trawlers at a time when we can least afford it. We request that the Council receive it with that consideration and adopt the trawl industry proposal.

Sincerely

Edward D. Evans
Executive Director

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JAMES O CAMPBELL, CHAIRMAN MPFMC (HOLD FOR
ARRIVAL JANUARY 14)
SHEEEATIKA LODGE
330 SEWARD ST
SITKA AK 99835

I AM THE OWNER AND OPERATOR OF THE F/V CONFIDENCE AND NO TRAWLING EAST OF 164 DEGREES IN THE EASTERN BEARING SEA AND A SEALING ON BYCATCH OF CRAB AND HALIBUT IN ADJACENT AREAS
JAN KRISTIANSEN, STEVE HAFFARMAN, RICK NIELSEN, DAVE OLSON, DENNIS NIELSEN AND JIM SAGE

1239 EST

MGMCOMP MGM

Form L-01342 1601557

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JAN 16, 1986

JAMES CAMPBELL, CHAIRMAN
NORTH PACIFIC MANAGEMENT COUNCIL

DEAR JIM,

Please convey to the other council members that I omitted an important part of my oral testimony.

I could accept the trawler's coalition alternative I with the following modifications: King crab by-catch cap based upon a percentage of female king crab; and damage to stocks calculated as 4 times greater that observed crab in cod-ends.

Thank you,

Vern Hall

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Redrafted AP recomm. —
1/16/86 17:20

(1) In the area defined as 163 30' west to 58 15' north and then east to the shore there shall be no fishing allowed during calendar year 1986 except provided for as follows:

(a) Domestic (DAH) trawling on cod shall be allowed in waters of 25 fathoms or less within 163 30' west to 58 15' north and then east to 160 providing domestic observers are on all fishing and processing vessels engaged in the fishery subject to the proviso that a mechanism exists to close fishing in the event of any perceived damage to king crab and the observer is a NMFS approved observer. Further, NMFS shall develop the procedures necessary to implement the above observer program for presentation at the March Council meeting.

(b) Subject to the results of the Summer Crab/Groundfish Survey, a fall 1986 trawl and/or directed crab fishery may be allowed, subject to Council approval, in the event survey results establish the crab resource can sustain a fishery without further damage.

(c) A mid-water pollock trawl fishery shall be allowed west of 163 .

(2) In the area defined as that portion of the Pot Sanctuary west of 163 30', there shall be a PSC limit of 25,000 halibut. This PSC limit shall not apply to mid-water trawl operations. The AP requests the Council to develop a PSC limit on crab within this area.

(3) In the area outside of that described in paragraph 1 above, a PSC limit of K 100K shall apply to all trawl activities.

C-b 200K
had 40K (in area outside of existing Pot Sanctuary)
H - amend 1/2 KC (red) per tow instead of 100K cap —
w/ OK of second —

Advisory Panel recommendation on item C-8/D-3(a)

In order to establish greater flexibility in both the Gulf of Alaska and the Bering Sea, the Regional Director shall develop regulatory amendment authority as outlined in Bob McVey's letter of 12-10-85.

In the Gulf of Alaska, the AP recommends that 50 CFR Section 672.24(b)(2) be amended by adding the following:

When the Regional Director determines that the share of the sablefish OY assigned to any type of gear for any year and any area or district under this paragraph may be taken before the end of that year, the Regional Director, in order to provide adequate bycatch amounts to ensure continued groundfish fishing activity by that gear group shall by rule-related notice prohibit directed fishing for sablefish by persons using that type of gear for any period of that year. It is the intent of the regulation to minimize any PSC (waste) over the OY allocation.

unanimously

1985 MRC GROUNDFISH CATCH AND CRAB BYCATCH IN PROPOSED NO-FISHING AREA

(160° W--162° W; 58° N southward to 25 fa. curve)

Area	April--May						Total Season					
	Bottomfish		King Crab		Tanner Crab		Bottomfish		King Crab		Tanner Crab	
	MT	%	no.	%	no.	%	MT	%	no.	%	no.	%
350-05	4,617	10.1	44,162	19.4	16,670	20.9	4,932	3.2	52,468	9.5	15,872	3.8
350-06	2,514	5.5	26,634	11.7	10,528	13.2	9,312	6.0	67,279	12.2	27,104	6.5
350-15	3,017	6.6	3,415	1.5	2,552	3.2	3,017	2.0	3,415	0.6	2,552	0.6
350-16	7,999	17.5	52,357	23.0	14,756	18.5	32,519	21.1	232,515	42.1	101,918	24.4
350-25	5,211	11.4	45,073	19.8	10,050	12.6	5,211	3.4	45,073	8.2	10,050	2.4
350-26	-	-	-	-	-	-	4,345	2.8	16,231	2.9	20,441	4.9
350-35	-	-	-	-	-	-	10,788	7.0	30,928	5.6	29,239	7.0
350-36	-	-	-	-	-	-	-	-	-	-	-	-
Proposed no-fishing area	23,358	51.1	171,641	75.4	54,556	68.4	70,124	45.5	447,909	81.1	207,176	49.6
All areas	45,709	100	227,640	100	79,761	100	154,118	100	552,292	100	417,696	100

Jeanne Gardner
on 11/5/86