FOR ONE YEAR CALENDAR 1989

1) INDUSTRY AGREES FOR 1989 TO A 4000 mT HALIBUT MORTALITY CAP RESULTING FROM A TOTAL CATCH OF 5333 mT USING VARIOUS APPROPRIATE MORTALITY RATES FOR DAP AND 100% MORTALITY IN ALL JOINT VENTURE FISHING OPERATIONS.

2) WHEN THE BERING SEA AREA WIDE BY-CATCH IN ALL TRAWL FISHERIES REACHES 4400 mT CATCH / 3300 mT MORTALITY THEN AREA 1 AND MODIFIED 2H WILL CLOSE FOR THE REMAINDER OF THE YEAR TO ALL BOTTOM TRAWL POLLOCK, COD AND SOLE FISHERIES. AREA 2H IS NEWLY DEFINED AS ALL WATERS OF AREA 513 SOUTH OF 56°30' N. L[illegible]

3) WHEN THE BERING SEA AREA WIDE CUMULATIVE BY-CATCH IN ALL TRAWL FISHERIES REACHES 5333 mT CATCH / 4000 mT MORTALITY THEN THE REMAINDER OF THE BERING SEA AREA WILL CLOSE FOR THE REMAINDER OF THE YEAR TO ALL BOTTOM TRAWL POLLOCK, COD AND SOLE FISHERIES. according to 4 fishing groups & target [illegible] except rockfish, turbot, [illegible], etc.

4) INDIVIDUAL BY-CATCH RATES FOR THE VARIOUS TRAWL FISHERIES WILL BE USED BY NMFS TO MONITOR EACH FISHERY WITH RESPECT TO THE ATTAINMENT OF THE OVERALL CAP. A TEAM OF EXPERTS COMPRISED OF REPRESENTATIVES FROM NWAFC AND IPHC WITH COUNCIL STAFF ASSISTANCE WILL ESTABLISH THESE RATES FOR USE AT THE BEGINNING OF THE YEAR BASED UPON AN AVERAGE OF 3 YEARS OR MORE RECENT REPRESENTATIVE DATA. SUBJECT TO THESE PARAMETERS THE TEAM OF EXPERTS WILL HAVE FULL DISCRETION REGARDING THE USE OF DATA TO CALCULATE THESE RATES. BY JUNE 1, 1989 OBSERVED BY-CATCH RATES FROM THE 1989 FISHERIES WILL BE INCORPORATED INTO SUBSEQUENT RATES TO BE APPLIED FOR THE REMAINDER OF THE YEAR.

AGENDA D-2(c)
DECEMBER 1988

MEMORANDUM

TO: Council, SSC and AP Members

FROM: Clarence G. Pautzke
Executive Director

DATE: November 30, 1988

SUBJECT: Bering Sea/Aleutian Islands Groundfish Fishery Management Plan

ACTION REQUIRED

Review PSC limits for control of crab and halibut bycatch in 1989.

BACKGROUND

In September the Council established the following prohibited species (PSC) limits for C. bairdi, red king crab, and Pacific halibut, distributed among four fisheries (DAP flatfish, DAP other, JVP flatfish, and JVP other) in different areas:

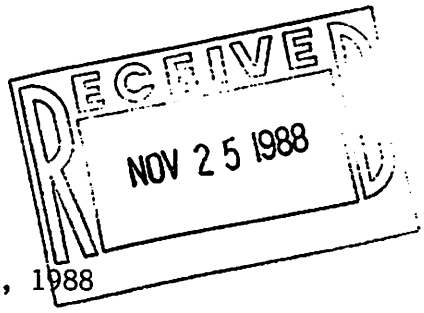
C. bairdi	846,500 crabs in Zone 1 (Area 511)
	1,988,500 crabs in Zone 2 (Areas 513 and 521)
Red king crab	135,000 crabs in Zone 1 (Area 511)
Pacific halibut	3,300 mt of catch for the entire BS/AI

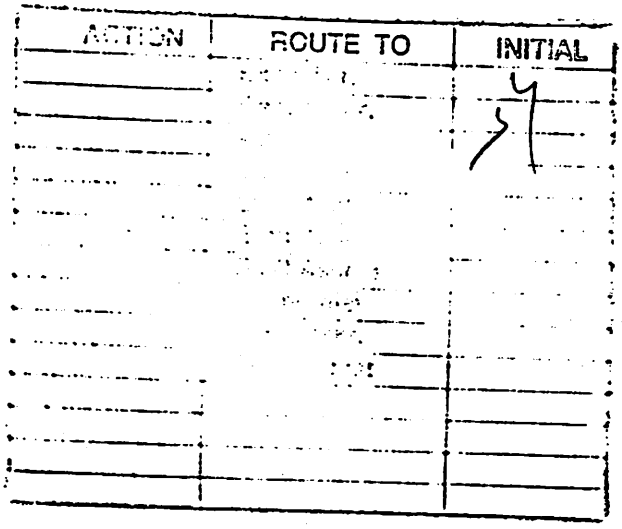
Attainment of these bycatch, or PSC, apportionments by any fishery in an area will result in area closures to bottom trawling. The details of the proposed bycatch control system and an analysis of anticipated impacts on groundfish harvests, costs, bycatch amounts, and benefits were discussed in a paper sent to you on November 28. The model behind that analysis will be described at a special briefing to the SSC and AP early Monday morning and later that day to the Council.

The equitable apportionment of the PSC limits to the four identified fisheries depends upon 1989 groundfish TACs and apportionments to DAP and JVP. Once those figures are set, then the bycatch simulations can be rerun to project crab and halibut bycatch. The Council may then choose to reconsider the PSC limits. Several scenarios can be run on existing models and results presented back to the Council for consideration before final approval of crab and halibut PSC limits for 1989.

588/DZ

AGENDA D-2(c)
DECEMBER 1988
SUPPLEMENTAL





November 21, 1988

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

Dear Mr. Peterson:

I am writing in regards to the Bering Sea Halibut bycatch issue on the agenda for the December council meeting. I would like to go on record as being against any increase in the 1987 bycatch level of 1650 metric tons. I fully support 100% American harvest of fishery recources in the area, but do not support giving the rapidly expanding trawl fishery a "carte blanche" for bycatch of a high unit value species like Halibut in persuit of lower value species such as yellowfin sole, and pacific cod.

I have talked to two different IPHC biologists who both told me they felt that halibut stocks were at historically high levels and had nowhere to go but down,and that patterns of decline in recruitment were beginning to emerge. Why put any additional pressure on the stock?

Foreign fleets have been able to operate at much lower levels of bycatch than is now being requested by the expanding American fleet. I think modifying fishing practices, such as gear modifications or selected fishing at different times of year when the species are more depth stratified, are the keys to maximizing the value of all species as a whole; Not increasing the waste level of one species in order to harvest more of another.

Sincerely,

Brian Harber

Brian Harber
1920 North 47th
Seattle Wash
98105

CHRIS BLACKBURN
MICK STEVENS

MEMORANDUM OF COMMITMENT
Entered into by target rock sole JV operators December 1, 1988

The following US managers of JV fishing operations intend, if allowed, to conduct target JV operations for rock sole during the first quarter of 1989. Concern exists within the JVP sector regarding PSC by-catch in our fishery. Presently the Councils by-catch management regime apportions PSC by-catch caps between JVP flatfish and JVP "other" fisheries and does not differentiate between JVP target rock sole and JVP target yellowfish sole. Therefore, so that we may conduct our fishery in a responsible manner without risking unfair negative impact on other JV operations we individually and collectively pledge to the following actions and controls:

1. To support and supply timely fishery data to the Flounder JV By-catch Steering Committee.

2. To work within the committee to establish a fair apportionment of PSC by-catch amount between our target rock sole operation and the other flounder target JV operations.

3. To individually and collectively terminate our target operations on rock sole when the apportionment or our individual share of the apportionment of the PSC by-catch from our target rock sole operations has been met.

4. To collectively engage The Alaska Groundfish Data Bank to summarize and present to the Council a detailed description of the results, including by-catch performance, of our 1989 target rock sole JV operations.

NORTHERN DEEP SEA FISHERIES

KODAK AND WESTERN TRAWLER GROUP

PROFISH INTERNATIONAL

UNITED PACIFIC

BILL ORR

TRAWL INDUSTRY POSITION ON BY-CATCH CONTROLS

1. By-catch caps on DAH trawl industry are:
   A. Halibut - 3900mt mortality using Council by-catch Committee and Halibut Commission endorsed levels of 100% mortality in JV operations and 50% mortality in DAP operations.
   B. King Crab - 1% of population
   C. Bairdi Tanner Crab - 1% of population

2. Definition of fisheries to be controlled with these by-catch caps are:
   DAP flatfish
   DAP other
   JVP flatfish
   JVP other

"Other" includes bottom trawl for pollock and cod as well as other target fisheries. Over time, as NMFS capabilities improve, bottom trawl for pollock and additionally the cod fishery should be separated. The PSC by-catch in all these "other" fisheries will be calculated and will contribute to the attainment of PSC limits. However any closures instituted would apply to the bottom trawl pollock and cod fisheries only. Midwater pollock and other fisheries in this "other" grouping would not be constrained.

3. The apportionment of by-catch "needs" among these fisheries and by zones will be made by NMFS-Alaska Region following consultations from the trawl industry.

4. As caps are reached, closures apply to the above 4 fishery groups only.

5. Stated goal of managers and Industry should be the maximization of groundfish catch within the established caps.

6. Manageable portions of individual PSC caps which would go unutilized by one of the apportioned fisheries within a particular zone may A) transfer to another zone with the same apportioned fishery if that fishery was closed out of a zone due to attainment of another PSC by-catch limit and B) transfer to any other apportioned fishery within the same zone. Appropriate transfers will be accomplished by NMFS Regional Director.

7. The life span of this interm package of controls must be specified.

8. Comparable PSC by-catch controls will be established by the Council for the line and pot fisheries beginning for the 1990 fishing year. These controls will be established utilizating recent 1989 rates of by-catch interception from these line and pot fisheries.

9. Trawl industry is prepared to expand and participate in research on gear and technology to minimize by-catch and mortality studies.

10. Trawl industry has established "trawl by-catch committee" to act as management liason.

(Submitted as part of the trawl industry position paper submitted 12/7/88)

PARAMETERS FOR NMFS RD TRANSFERS OF PSC BY-CATCH CAPS AMONG FISHERIES

1) 15% of PSC caps will be apportioned to reserves consistent with the reserve system for individual species TACs.

2) When TAC reserves are released for industry utilization, PSC reserves may also be released in apportionments consistent with the needs of the fisheries.

3) A fishery apportioned part of a PSC cap has first right to full utilization of that cap if needed to attain the designated gound-fish catch for that fishery.

4) Transfer of a cap to another zone with its originally apportioned fishery has priority over transfer of a cap to another fishery within the original zone.

5) Any DAP fishery has priority over any JVP fishery to receive in season transfer of additional PSC cap.

6) Transfer of a PSC amount from one fishery to another can only be implemented after NMFS concludes it reasonable to expect the first fishery will not need that portion of the cap to attain the designated groundfish catch for that fishery. Such conclusion will be based upon examination of prevailing patterns in the fishery during the year with regard to seasonal harvest levels, variations in by-catch rates, surveys of the industry regarding anticipated effort and behavior during the remainder of the fishing year.

7) Should more than one fishery compete for reapportionment of surplus PSC amounts, NMFS shall equitably allocate among them.

North Pacific Fishery Management Council

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

605 West 4th Avenue
Anchorage, Alaska 99501

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

Telephone: (907) 271-2809
FAX (907) 271-2817

MEMORANDUM

To: Clarence G. Pautzke, Executive Director

From: Council and NWAFC Staff

Date: December 8, 1988

Subject: "Validation" of the Bering Sea/Aleutian Islands bycatch prediction model

Attached is a summary of the results of a "validation" of the crab and halibut bycatch prediction model using 1988 data. As you know this is not a true validation in the classical sense, but rather a verification of the computational accuracy and calculation procedures used. Also attached is a memorandum from managers of the foreign observer program database at the NWAFC, listing the joint venture catch-to-date in the BS/AI as of October 29, 1988.

The model tracks these data fairly well; differences in the two sets of output are primarily a consequence of different "blending" algorithms (the procedure used to expand the database to account for less than 100% observer coverage).

"Validation" of the bycatch prediction model using 1988 joint venture catch-to-date (Oct. 29, 1988).

Species	Area	Initial Conditions	Model Output	Best Blend Estimate	% Difference
Pollock	BS	785,808			
	AI	40,612			
	Total	826,420		811,688	1.81%
Pacific cod		110,476		108,494	1.83%
Yellowfin sole		199,587		200,879	(0.64%)
Greenland turbot		96		87	10.73%
Arrowtooth flounder		2,520		2,394	5.25%
Other flatfish (includes rock sole)		114,522		111,642	2.58%
Sablefish	BS	13			
	AI	6			
	Total	19		18	5.56%
Other rockfish	BS	74			
(includes P.O.P.)	AI	1,983			
	Total	2,057		2,059	(0.10%)
Atka mackerel		19,564		19,423	0.73%
Squid		173		171	1.29%
Other species		11,782		11,385	3.49%
Total bottom trawl groundfish - JVP flatfish, mt			382,195		
Total bottom trawl groundfish - JVP other, mt			166,809		
Total bottom trawl groundfish, mt			549,004		
Total groundfish in pollock mid-water and Atka mackerel fishery, mt			738,778		
TOTAL GROUNDFISH		1,287,216	1,287,782	1,268,240	1.50%
BYCATCH					
C. bairdi bycatch, animals			701,101	667,000	5.11%
Red king crab bycatch, animals			73,699	74,873	(1.57%)
Halibut bycatch, mt			2,518	2,436	3.36%

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

December 7, 1988

John G. Peterson, Chairman
North Pacific Fishery Management Council

Dear Mr. Peterson:

We have been asked to provide best blend catch and bycatch estimates for the Bering Sea/Aleutians joint venture fishery for the week ending 10/29/88. They are as follows:

Squid	170.8
Yellowfin sole	200,879.0
Flounder wo yfs	111,642.0
Pollock	811,687.6
Pacific cod	108,494.2
Sablefish	18.0
Atka Mackerel	19,422.5
POP	1,519.8
Rockfish wo pop	539.3
Arrowtooth flounder	2,394.3
Herring	348.6
Other fish	11,385.2
Turbots	86.7

Red king crab	74,873
Bairdi king crab	667,000
Other Tanner crab	2,311,000
Halibut	2,436 (mt)

The difference between these figures and those used in the model are due to the methods of extrapolation.

I hope this meets your needs. If you have any questions please call Heather Weikart or Jerry Berger (206) 526-4193.

Sincerely,

Heather G. Weikart

Heather G. Weikart
Fisheries Biologist
Observer Program

Clarification of Cost Submodel for Bycatch Predictions in BS/AI Groundfish Trawl Fisheries
December 8, 1988

For all but one of the scenarios looked at with the bycatch simulation model, the total harvest taken by each fishery is identical in the constrained and unconstrained cases, (1,591,600 t under the industry set-up and 1,426,500 t for the rest). For that reason, gross revenue will be identical for the constrained and unconstrained cases and thus provide no indication of the implications of the proposed bycatch protection measures. Under the model's assumptions, the burden of bycatch control imposed on the trawl fleet will not be in terms of lost gross revenues but in terms of additional costs.

Vessels engaged in commercial fishing activity are subject to a wide range of costs. The components of these costs are influenced by numerous variables, such as level of harvest, time on fishing ground, etc. It is a common practice to term some of these costs as "fixed" since for a given time period the operator pays the same amount regardless of the level of fishing activity that he engages in. Although these types of costs will vary considerably from one vessel class to another and even for individual vessels within each category, they are independent of an individual operation's effort or harvest level. Examples of these types of fixed costs are annual insurance payments, moorage fees, association dues, legal fees, office/accounting, and loan payments. Since it is only relative changes in the "variable" costs that drive the results, the composition of the fixed cost base is not important here.

In addition, for all but one of the scenarios, because we assumed that the total amount of groundfish harvested in each case is the same, those components of cost that vary with harvest level, such as crew share, packaging materials, are also assumed constant.

The only costs that are allowed to vary in the cost submodel are those that are primarily a function of time spent on the grounds or in travel. These components are fuel/oil, groceries, some crew transportation, and maintenance. The single largest component of these is fuel/oil. The actual numbers and the percentage of total costs that these "variable" costs represent vary considerably for different operations. For the purpose of this analysis, we used two representative factory trawlers to depict the domestic fleet and two representative catcher boats for joint venture activity. A brief description of the representative vessels and the associated costs are provided as a footnote to Table 11 in the addendum of December 4th. A more detailed description can be found in an article by Wiese and Burden, in Pacific Fishing (Sept. 1988).

In order to project relevant cost changes, we assumed that this set of "variable" costs is controlled by levels of fishing effort. We then tie them to estimates of increased fishing effort caused by the bycatch controls. Using the total amount of groundfish caught in each quarter, zone, and fishery in both the constrained and unconstrained cases, as provided by the main bycatch simulation model, and using the CPUE estimates presented in Table 10 of the addendum of December 4th, absolute effort was calculated for each fishery and quarter. This was then summed over quarters to provide the annual effort needed in each fishery to harvest all groundfish. The percentage difference for each fishery's annual effort between the unconstrained and constrained cases was then assumed to be proportional to a resultant change in "variable" costs from the unconstrained to the constrained case.

Using that percentage change in variable cost allowed calculation of a new total cost estimate under the bycatch constraints. The percentage difference in total cost for the representative vessels was then applied to the calculated total effort for each fishery, in order to provide a range of increased costs to the industry. For most of these scenarios, since the amount of catch does not change, these changes in costs also reflect the absolute change in net revenues, because gross revenues to the fishery did not change.

For the catch foregone scenario, which does not assume that all catch is made up by increases in effort under the bycatch constraints, a different set of costs had to be included in the "variable" category. Because the fisheries take less harvest during the year, their gross revenues decrease but their costs drop as well. Under

this scenario, our "variable" cost category was expanded to include those costs that are impacted by changes in catch level as well as those that are a function of effort changes. With less harvest taken and less effort expended under the bycatch constraints, the fleet would see a decrease in fuel expenditures, amount given to the crew share, groceries, repair and some maintenance, as well as packaging and other supplies for the processed product. The result is that, although variable costs decreased from the unconstrained to the constrained case, this decrease in cost was not sufficient to fully offset the foregone gross revenue associated with the catch not taken in the constrained case. Consequently, there is a net loss to the trawl industries.

Table 14. Summary of results: predicted change in total groundfish gross revenue and profit and prohibited species catch wholesale value, relative to unconstrained simulations.

Relative Change

Simulation	*Groundfish value lost, millions of dollars* DAP Gross revenue	DAP Increase in costs	JVP Gross revenue	JVP Profits	*Bycatch value saved, thousands of dollars* C. bairdi	Red king crab	Halibut
Council PSC limits	0	$10.1-$36.5	0	$0.3-$1.5	($119)	$58	$11,047
Halibut PSC at 3,900 mt	0	$9.9-$36.6	0	$0.3-$1.5	($117)	$58	$11,047
Groundfish catch foregone	$234	($152.9-$163.3)	$20	$13.1-$14.0	$1,353	$119	$21,493
Doubled flatfish crab bycatch rate	0	$35.9-$45.4	0	$0.5-$3.5	($620)	($887)	$14,219
Industry scenario	0	$96.1-$122.7	0	$0.3-$2.8	$1,252	$743	$13,126
AP TACs (industry)	0	$151.3-$190.2	0	$0.7-$2.6	$2,546	$302	$19,479

Source: DAP groundfish valued at $1.00/lb, wholesale, processed weight, using an overall conversion factor of 27% (Wiese and Burden, 1988).
JVP groundfish valued at $162/mt, ex-vessel, round weight (Wiese and Burden, 1988).
Change in profits is change in revenue minus change in cost (costs are shown in Table 11).
Values for halibut and crab are wholesale present values; unit values are from Table 2.19, BSAI Amendment 12A EA/RIR/IRFA.

Overview of Bycatch Scenarios Considered and Representative Vessels Used
December 8, 1988

Several alternative bycatch protection measures have been analyzed, based upon the Council's bycatch proposal. For each scenario, both an unconstrained and constrained projection of the 1989 fishery was made. These projections were only for the joint venture bottom trawl fishery and the domestic bottom trawl fishery. Harvest amounts and the subsequent bycatch of prohibited species catch for the mid-water trawl pollock fishery, the atka mackerel trawl fishery, and the fixed gear mode fishery are not included in this analysis.

Following are inputs used in the cost submodel:

The representative vessels for the joint venture and domestic trawl fisheries are as follows:

Vessel A for the domestic:	Factory trawler, 200-250'	
	Annual catch	12,300 mt
	Variable cost[1]	$1.41 million
	Total cost	$7.22 million
Vessel B for the domestic	Factory trawler, 125-200'	
	Annual catch	7,400 mt
	Variable cost[1]	$1.02 million
	Total cost	$4.27 million
Vessel A for the joint venture	Catcher boat, 100-150'	
	Annual catch	11,100 mt
	Variable cost[1]	$0.50 million
	Total cost	$1.63 million
Vessel B for the joint venture	Catcher boat, <100'	
	Annual catch	7,600 mt
	Variable cost[1]	$0.33 million
	Total cost	$1.12 million

DAP groundfish is valued at $1.00 per lb, wholesale, processed weight, using an overall conversion factor of 0.27. JVP groundfish is valued at $162 per mt, ex-vessel, round weight.

Gross revenue for the domestic industry is the product of the harvest level converted into processed weight (pounds) and the wholesale price. Gross revenue for the joint venture industry is the product of the ex-vessel price and the total groundfish amount harvested by joint ventures under each scenario.

The main bycatch protection measures proposed and analyzed:

Unconstrained Model: Using the groundfish apportionments approved by the Council in September and allowing no closures of zones or displacement of effort. Note this model serves as the unconstrained case for the first four protection measures analyzed.

1. Council PSC limits
The bycatch model was constrained, using the Council's PSC apportionments for the individual fisheries, as determined in September. The total harvest of groundfish remained equal to the unconstrained level of 1,426,000 t.

2. Halibut PSC at 3,900 mt
The total limit of halibut apportioned as PSC was increased from 3,300 to 3,900 mt. All other PSC limits were identical to the Council PSC limits as set in September. The total harvest of groundfish remained equal to the unconstrained level of 1,426,000 mt.

AGENDA D-2(c)
SUPPLEMENTAL
THURS 12/8

Table 12. Summary of results: predicted total groundfish catch and predicted total prohibited species catch. (Revised)

8-Dec-88

Simulation	*Total groundfish* *catch 1/* (mt)	*gross revenue 2/* ($millions)	*Total bycatch* C. bairdi (animals)	Red king crab (animals)	Halibut (mt)
Unconstrained	1,426,500	635	2,152,000	94,300	8,700
Council PSC limits	1,426,500	635	2,213,000	90,400	6,680
Halibut PSC at 3,900 mt	1,426,500	635	2,212,000	90,400	6,680
Groundfish catch foregone	906,800	380	1,458,000	86,300	4,770
Doubled flatfish crab bycatch rate	1,426,500	635	2,470,000	154,100	6,100
Industry scenario, unconstrained	1,426,500	635	2,557,000	178,800	11,500
Industry scenario	1,426,500	635	1,915,000	128,700	9,100
AP TACs, unconstrained (industry)	1,591,600	825	2,761,189	128,254	12,077
AP TACs (industry)	1,591,600	825	1,455,700	107,935	8,515

1 / Excludes mid-water pollock, Atka mackerel, and groundfish taken with fixed gear.
2 / DAP groundfish valued at $1.00/lb, wholesale, processed weight, using an overall conversion factor of 27% (Wiese and Burden, 1988).
JVP groundfish valued at $162/mt, ex-vessel, round weight (Wiese and Burden, 1988).

Table 13. Summary of results: predicted change in total groundfish catch and prohibited species catch, relative to unconstrained simulations.

Simulation	Relative Change: Groundfish catch (mt)	Bycatch saved: C. bairdi (animals)	Bycatch saved: Red king crab (animals)	Bycatch saved: Halibut (mt)
Council PSC limits	0	(61,000)	3,900	2,020
Halibut PSC at 3,900 mt	0	(60,000)	3,900	2,020
Groundfish catch foregone	(519,700)	694,000	8,000	3,930
Doubled flatfish crab bycatch rate	0	(318,000)	(59,800)	2,600
Industry scenario	0	642,000	50,100	2,400
AP TACs (industry)	0	1,305,489	20,319	3,562

3. Groundfish catch foregone
The September PSC limits were used but harvest levels were allowed to decrease from the unconstrained level of 1,426,000 mt to 906,800 mt.

4. Doubled flatfish bycatch rate
The bycatch rates for crab in the flatfish fisheries were doubled over the rates used in the previous three models. Halibut bycatch rates were not changed.

5. Industry scenario, unconstrained
The model was revised using input from the industry on how each fishery might be distributed over area and quarter if no bycatch restrictions were in place. Bycatch rates in the pollock/cod bottom trawl fishery were adjusted to account for expected differences in the mix of pollock and cod bottom trawling in 1989 relative to 1988. Total harvest level was still at 1,426,000 mt.

6. Industry scenario, constrained
Identical to the model described under the Council PSC limits, except adjusted for the changes listed under industry scenario, unconstrained.

7. AP TACs, unconstrained
Similar to the industry scenario (unconstrained) except adjusted to reflect the TACs proposed at the December meeting, that do not allow for a joint venture fishery except in yellowfin sole and other flatfish. Total catch taken is 1,592,000 mt.

8. AP TACs, constrained
This model uses the industry adjustments on distribution over area and quarters and on the bycatch rates in the pollock/cod fishery, the original PSC limits and the TACs proposed by the Advisory Panel.

[1] These "variable" costs are for all model projections, except the catch foregone scenario. Under the catch foregone model, variable costs are expanded to include costs associated with changes in catch levels.

December 7, 1988

In view of the crowded agenda and limited time to consider a number of very important issues, the undersigned representatives of the Bering Sea groundfish industry have decided to help expedite public testimony in the bycatch issue by not offering individual testimony. Instead, we have selected a group of four individuals who represent JV and DAP trawl industry interests to testify on behalf of all of us. We hereby endores the testimony of Chris Blackburn, Steve Hughs, Bill Orr and Dave Fraser.

[illegible]

Chris Hansen

Bernd O. Bodal

Fred A Yeck

[illegible] (MRCi)

[illegible]

[illegible]

Dave [illegible]

Lyle C. Yeck

Frank B. Bohannon

[illegible]

[illegible]

Thom Smith (ATF)

[illegible] AK Com,

Pete Granger

[illegible] Anderson

[illegible]

[illegible] AC

Ben Hogevoll

[illegible]

Wed am
T.S.
Bycatch

Table 12. Summary of results: predicted total groundfish catch and predicted total prohibited species catch. (Revised)

7-Dec-88

Simulation	*Total groundfish* *catch 1/* (mt)	*gross revenue 2/* ($millions)	*Total bycatch* C. bairdi (animals)	Red king crab (animals)	Halibut (mt)
Unconstrained	1,426,500	635	2,152,000	94,300	8,700
Council PSC limits	1,426,500	635	2,213,000	90,400	6,680
Halibut PSC at 3,900 mt	1,426,500	635	2,212,000	90,400	6,680
Groundfish catch foregone	906,800	317	1,458,000	86,300	4,770
Doubled flatfish crab bycatch rate	1,426,500	635	2,470,000	154,100	6,100
Industry scenario, unconstrained	1,426,500	635	2,557,000	178,800	11,500
Industry scenario	1,426,500	635	1,915,000	128,700	9,100
AP TACs, unconstrained (industry)	1,591,600	825	2,761,189	128,254	12,077
AP TACs (industry)	1,591,600	825	1,455,700	107,935	8,515

1 / Excludes mid-water pollock, Atka mackerel, and groundfish taken with fixed gear.
2 / DAP groundfish valued at $1.00/lb, wholesale, processed weight, using an overall conversion factor of 27% (Wiese and Burden, 1988).
JVP groundfish valued at $162/mt, ex-vessel, round weight (Wiese and Burden, 1988).

Table 13. Summary of results: predicted change in total groundfish catch and prohibited species catch, relative to unconstrained simulations.

Relative Change

Simulation	Groundfish catch (mt)	Bycatch saved C. bairdi (animals)	Red king crab (animals)	Halibut (mt)
Council PSC limits	0	(61,000)	3,900	2,020
Halibut PSC at 3,900 mt	0	(60,000)	3,900	2,020
Groundfish catch foregone	(519,700)	694,000	8,000	3,930
Doubled flatfish crab bycatch rate	0	(318,000)	(59,800)	2,600
Industry scenario	0	642,000	50,100	2,400
AP TACs (industry)	0	1,305,489	20,319	3,562

Table 14. Summary of results: predicted change in total groundfish gross revenue and profit and prohibited species catch wholesale value, relative to unconstrained simulations.

Relative Change

Simulation	*Groundfish value lost, millions of dollars* DAP Gross revenue	DAP Profits	JVP Gross revenue	JVP Profits	*Bycatch value saved, thousands of dollars* C. bairdi	Red king crab	Halibut
Council PSC limits	0	$10.1-$36.5	0	$0.3-$1.5	($119)	$58	$11,047
Halibut PSC at 3,900 mt	0	$9.9-$36.6	0	$0.3-$1.5	($117)	$58	$11,047
Groundfish catch foregone	$234	$152.9-$163.3	$20	$13.1-$14.0	$1,353	$119	$21,493
Doubled flatfish crab bycatch rate	0	$35.9-$45.4	0	$0.5-$3.5	($620)	($887)	$14,219
Industry scenario	0	$96.1-$122.7	0	$0.3-$2.8	$1,252	$743	$13,126
AP TACs (industry)	0	$151.3-$190.2	0	$0.7-$2.6	$2,546	$302	$19,479

Source: DAP groundfish valued at $1.00/lb, wholesale, processed weight, using an overall conversion factor of 27% (Wiese and Burden, 1988).
JVP groundfish valued at $162/mt, ex-vessel, round weight (Wiese and Burden, 1988).
Change in profits is change in revenue minus change in cost (costs are shown in Table 11).
Values for halibut and crab are wholesale present values; unit values are from Table 2.19, BSAI Amendment 12A EA/RIR/IRFA.

Table D-2(b)(1). Preliminary 1989 recommendations for ABC, TAC, DAP, and JVP for Bering Sea/Aleutian Islands Groundfish (metric tons).

		1988		1989 ABC Recommendations		Advisory Panel Recommendations		
Species	Area	TAC	Catch 1/	PT	SSC	TAC	DAP	JVP
Pollock	EBS	1,300,000	1,194,479	1,340,000	1,340,000	1,340,000	1,340,000	0
	AI	45,000	43,594	117,900	117,900	13,450	13,450	0
	Area 515		(Not recognized)	250,000	--	0	0	0
Pacific cod		200,000	183,089	370,600	370,600	209,025	209,025	0
Yellowfin sole		254,000	212,161	241,000	241,000	191,675	51,675	140,000
Greenland turbot		11,200	6,789	20,300	20,300	16,264	16,264	0
Arrowtooth flounder		5,531	4,600	163,700	163,700	6,000	6,000	0
Rock sole		(Previously in other flatfish)		171,000	171,000	80,762	80,762	0
Other flatfish		131,369	137,762	155,900	155,900	87,839	25,890	61,949
Sablefish	EBS	3,400	3,190	2,800	2,300	2,800	2,800	0
	AI	5,000	3,374	3,400	6,200	3,400	3,400	0
Pacific ocean perch	EBS	5,000	1,482	6,000	6,000	5,000	5,000	0
	AI	6,000	2,214	16,600	16,600	6,000	6,000	0
Other rockfish	EBS	400	359	400	400	400	400	0
	AI	1,100	723	1,100	1,100	1,100	1,100	0
Atka mackerel		21,000	21,690	21,000	21,000	20,285	20,285	0
Squid		1,000	446	10,000	10,000	1,000	1,000	0
Other species		10,000	12,519	59,000	59,000	15,000	15,000	0
BS/AI TOTAL		2,000,000	1,828,471	2,950,700	2,703,000	2,000,000	1,798,051	201,949

1989 BS/AI groundfish apportionments, accounting for JVP "bycatch needs" in flatfish fisheries.

(12-05-88)

ANTICIPATED GROUNDFISH APPORTIONMENTS

Species	Area	ABC	TAC	DAP	JVP	TALFF
Pollock	BS	1,340,000	1,340,000	1,280,100	59,900	0
	AI	117,900	13,450	13,450	0	0
Pacific cod		370,600	209,025	190,425	18,600	0
Yellowfin sole		241,000	191,675	51,675	140,000	0
Greenland turbot		20,300	16,264	16,234	30	0
Arrowtooth flounder		163,700	6,000	6,000	0	0
Rock sole		171,000	80,762	79,462	1,300	0
Other flatfish		155,900	87,839	25,890	61,949	0
Sablefish	BS	2,800	2,800	2,800	0	0
	AI	3,400	3,400	3,400	0	0
Pacific ocean perch	BS	6,000	5,000	5,000	0	0
	AI	16,600	6,000	6,000	0	0
Other rockfish	BS	400	400	400	0	0
	AI	1,100	1,100	1,100	0	0
Atka mackerel		21,000	20,285	20,285	0	0
Squid		10,000	1,000	1,000	0	0
Other species		59,000	15,000	15,000	0	0
BS/AI TOTAL		2,700,700	2,000,000	1,718,221	281,779	0

PSC limits (caps) as suggested by the Council and apportionment of those caps to the four fisheries in proportion to predicted annual bycatch. (Industry Scenario - APs TACs)

7-Dec-88

Caps and Allocation of Caps

Overall PSC Limits

Species	Zone 1	Zone 2	BSAI-wide
C. bairdi	846,500	1,988,500	-
Red king crab	135,000	-	-
Halibut	-	-	3,300

Fishery PSC Limits

Species		Zone 1	Zone 2	BSAI-wide
C. bairdi (animals)	DAP-flatfish	21,974	51,620	-
	DAP-other	705,865	1,658,136	-
	JVP-flatfish	111,984	263,061	-
	JVP-other	6,676	15,683	-
		846,500	1,988,500	
Red king crab (animals)	DAP-flatfish	39,230	-	-
	DAP-other	46,151	-	-
	JVP-flatfish	49,506	-	-
	JVP-other	113	-	-
		135,000		
Halibut (metric tons)	DAP-flatfish	-	-	28
	DAP-other	-	-	3,095
	JVP-flatfish	-	-	138
	JVP-other	-	-	39
				3,300

PSC Limit Share, by Fishery

	C. bairdi	Red king crab	Halibut
DAP flatfish	2.60%	29.06%	0.84%
DAP other	83.39%	34.19%	93.79%
JVP flatfish	13.23%	36.67%	4.19%
JVP other	0.79%	0.08%	1.19%

Bycatch Prediction Model
Terry Smith - NPFMC

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QUARTERLY SIMULATION, BY TARGET FISHERY

JANUARY-MARCH, 1989

C. bairdi TANNER CRAB

Bottom Trawl Apportionments (from Part 1)

	DAP	JVP
Flatfish	42,500	127,271
Other fisheries	89,418	92,740

Bottom Trawl Catch Distributions (1988 fishery)

Species	Target: Flatfish	Target: Other
Flatfish	74.7%	9.3%
Other	25.3%	90.7%

Inversion of above

Species	Target: Flatfish	Target: Other
Flatfish	1.386076	-0.142027
Other	-0.386076	1.142027

Total Groundfish, mt

Species	Target: DAP	Target: JVP
Flatfish	46,209	163,235
Other	85,709	56,775

Bottom trawl

Target Fishery	Area	Bycatch Rate (#/mt groundfish)	Bycatch Amount (animals) DAP	JVP	Total
Flatfish	Zone 1- 511	0.92	19,021	67,192	86,212
	513	0.99	25,253	89,209	114,462
	515	0.00	0	0	0
	521	0.00	0	0	0
	All other BS	0.28	18	64	82
	AI - 540	0.00	0	0	0
	TOTAL		44,292	156,465	200,756
Other	Zone 1- 511	1.24	24,061	15,938	39,999
	513	1.02	66,586	44,108	110,694
	515	0.30	379	251	631
	521	0.00	0	0	0
	All other BS	0.00	0	0	0
	AI - 540	0.00	0	0	0
	TOTAL		91,026	60,297	151,324

Off Bottom

		DAP	JVP	
Pollock, mid-water	0.0003	16	24	40
Atka mackerel	0.0000	0	0	0
TOTAL		16	24	40
GRAND TOTAL		135,335	216,786	352,120

Area Assumption (1988 JVP Fishery)

	Area 511	513	514	515	521	522	540
Flatfish	44.5%	55.4%	0.1%	0.0%	0.0%	0.0%	0.0%
Other	22.6%	75.9%	0.0%	1.5%	0.0%	0.0%	0.0%

Total Groundfish, by Area, mt

	511	513	514	515	521	522	540
DAP							
Flatfish	20,568	25,576	64	0	0	0	0
Other	19,405	65,050	0	1,254	0	0	0
JVP							
Flatfish	72,659	90,351	225	0	0	0	0
Other	12,854	43,090	0	831	0	0	0

Status Report, by Area, beginning of period

	511	513	514	515	521	522	540	% Open
DAP								
Flatfish	Open	Open	Open	Open	Open	Open	Open	100.0%
Other	Open	Open	Open	Open	Open	Open	Open	100.0%
JVP								
Flatfish	Open	Open	Open	Open	Open	Open	Open	100.0%
Other	Open	Open	Open	Open	Open	Open	Open	100.0%

Adjusted Total Groundfish, by Area, mt

	511	513	514	515	521	522	540
DAP							
Flatfish	20,568	25,576	64	0	0	0	0
Other	19,405	65,050	0	1,254	0	0	0
JVP							
Flatfish	72,659	90,351	225	0	0	0	0
Other	12,854	43,090	0	831	0	0	0

JANUARY-MARCH, 1989

OTHER TANNER CRAB

Target Fishery	Area	Bycatch Rate (#/mt groundfish)	Bycatch Amount (animals) DAP	JVP	Total
			Bottom trawl		
Flatfish	Zone 1- 511	0.16	3,196	11,290	14,486
	513	2.68	68,457	241,828	310,285
	515	0.00	0	0	0
	521	0.00	0	0	0
	All other BS	0.24	15	54	70
	AI - 540	0.00	0	0	0
	TOTAL		71,668	253,173	324,841
Other	Zone 1- 511	0.28	5,401	3,578	8,979
	513	0.56	36,188	23,972	60,160
	515	0.02	31	21	52
	521	0.00	0	0	0
	All other BS	0.00	0	0	0
	AI - 540	0.00	0	0	0
	TOTAL		41,621	27,570	69,191
			Off Bottom		
			DAP	JVP	
	Pollock, mid-water	0.001	62	92	154
	Atka mackerel	0.000	0	0	0
	TOTAL		62	92	154
	GRAND TOTAL		113,351	280,835	394,186

RED KING CRAB

Target Fishery	Area	Bycatch Rate (#/mt groundfish)	Bycatch Amount (animals) DAP	JVP	Total
			Bottom trawl		
Flatfish	Zone 1- 511	0.514	10,567	37,328	47,895
	513	0.003	82	288	370
	515	0.000	0	0	0
	521	0.000	0	0	0
	All other BS	0.000	0	0	0
	AI - 540	0.000	0	0	0
	TOTAL		10,648	37,616	48,265
Other	Zone 1- 511	0.3609	7,004	4,640	11,644
	513	0.0009	59	39	98
	515	0.0025	3	2	5
	521	0.0000	0	0	0
	All other BS	0.0000	0	0	0
	AI - 540	0.0000	0	0	0
	TOTAL		7,066	4,681	11,747
			Off Bottom		
			DAP	JVP	
	Pollock, mid-water	0.001	55	81	136
	Atka mackerel	0.000	0	0	0
	TOTAL		55	81	136
	GRAND TOTAL		17,769	42,378	60,147

HALIBUT

Target Fishery	Area	Bycatch Rate (mt/mt groundfish)	Bycatch Amount (mt) DAP	JVP	Total
		Bottom trawl			
Flatfish	Zone 1- 511	0.0013	26.7	94.5	121.2
	513	0.0020	50.5	178.3	228.7
	515	0.0000	0.0	0.0	0.0
	521	0.0000	0.0	0.0	0.0
	All other BS	0.0028	0.2	0.6	0.8
	AI - 540	0.0000	0.0	0.0	0.0
	TOTAL		77.4	273.3	350.7
Other	Zone 1- 511	0.0070	135.1	89.5	224.5
	513	0.0105	680.2	450.6	1130.8
	515	0.0189	23.7	15.7	39.4
	521	0.0000	0.0	0.0	0.0
	All other BS	0.0000	0.0	0.0	0.0
	AI - 540	0.0000	0.0	0.0	0.0
	TOTAL		839.0	555.7	1394.7
			Off Bottom DAP	JVP	
	Pollock, mid-water	.00002	1.0	1.5	2.5
	Atka mackerel	.00000	0.0	0.0	0.0
	TOTAL		1.0	1.5	2.5
	GRAND TOTAL		917.4	830.6	1747.9

BYCATCH SUMMARY

JANUARY-MARCH, 1989

	FISHERY			
	DAP		JVP	
Cumulative catch	Flatfish	Other	Flatfish	Other
Total groundfish, mt	46,209	85,709	163,235	56,775
"Target" catch, mt	34,534	77,743	121,994	51,498
C. bairdi cap, Zone 1	71,644	564,432	126,446	83,977
C. bairdi bycatch, Zone 1	19,021	24,061	67,192	15,938
Cap attained?	No	No	No	No
C. bairdi cap, Zone 2	168,299	1,325,899	297,033	197,269
C. bairdi bycatch, Zone 2	25,253	66,586	89,209	44,108
Cap attained?	No	No	No	No
C. bairdi bycatch, all areas	44,292	91,026	156,465	60,297
Red king crab cap, Zone 1	24,801	32,833	69,239	8,127
Red king crab bycatch, Zone 1	10,567	7,004	37,328	4,640
Cap attained?	No	No	No	No
Red king crab bycatch, all areas	10,648	7,066	37,616	4,681
Halibut cap, mt, BSAI	173.6	2531.5	251.3	343.6
Halibut bycatch, mt, BSAI	77.4	839.0	273.3	555.7
Cap attained?	No	No	Yes	Yes

Bycatch Prediction Model
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MONTHLY SIMULATION, BY TARGET FISHERY

APRIL, 1989

C. bairdi TANNER CRAB

Bottom Trawl Apportionments (from Part 1)

	DAP	JVP
Flatfish	36,663	43,181
Other fisheries	173,992	13,150

Bottom Trawl Catch Distributions (1988 fishery)

Species	Target: Flatfish	Target: Other
Flatfish	81.7%	16.2%
Other	18.3%	83.8%

Inversion of above

Species	Target: Flatfish	Target: Other
Flatfish	1.279826	-0.247002
Other	-0.279826	1.247002

Total Groundfish, mt

Species	Target: DAP	Target: JVP
Flatfish	3,946	52,016
Other	206,709	4,314

Bottom trawl

Target Fishery	Area	Bycatch Rate (#/mt groundfish)	Bycatch Amount (animals) DAP	JVP	Total
Flatfish	Zone 1- 511	0.14	1	0	1
	513	1.92	1,010	0	1,010
	515	0.00	0	0	0
	521	9.00	312	6,960	7,272
	All other BS	0.11	79	1,756	1,835
	AI - 540	0.00	0	0	0
	TOTAL		1,402	8,716	10,118
Other	Zone 1- 511	4.06	98,318	0	98,318
	513	2.74	83,459	0	83,459
	515	0.14	172	0	172
	521	8.72	24,831	2,735	27,566
	All other BS	1.38	11,379	1,253	12,632
	AI - 540	0.00	0	0	0
	TOTAL		218,159	3,988	222,147

Off Bottom

		DAP	JVP	
Pollock, mid-water	0.0118	187	174	361
Atka mackerel	0.0000	0	0	0
TOTAL		187	174	361
GRAND TOTAL		219,747	12,878	232,625

Area Assumption (1988 JVP Fishery)

	Area 511	513	514	515	521	522	540
Flatfish	0.6%	40.0%	56.5%	0.3%	2.6%	0.0%	0.0%
Other	35.1%	44.1%	12.0%	1.8%	4.1%	0.0%	2.8%

Total Groundfish, by Area, mt

	511	513	514	515	521	522	540
DAP							
Flatfish	23	1,578	2,228	12	104	1	0
Other	72,575	91,219	24,737	3,743	8,542	72	5,821
JVP							
Flatfish	300	20,807	29,366	157	1,371	16	0
Other	1,515	1,904	516	78	178	1	122

Status Report, by Area, beginning of period

	511	513	514	515	521	522	540	% Open
DAP								
Flatfish	Open	Open	Open	Open	Open	Open	Open	100.0%
Other	Open	Open	Open	Open	Open	Open	Open	100.0%
JVP								
Flatfish	Closed	Closed	Open	Closed	Open	Open	Open	59.1%
Other	Closed	Closed	Open	Closed	Open	Open	Open	19.0%

Adjusted "Monthly" Total Groundfish, by Area, mt

	511	513	514	515	521	522	540
DAP							
Flatfish	8	526	743	4	35	0	0
Other	24,192	30,406	8,246	1,248	2,847	24	1,940
JVP							
Flatfish	0	0	16,557	0	773	9	0
Oth	0	0	908	0	31	3	214

APRIL, 1989

OTHER TANNER CRAB

Bottom trawl

Target Fishery	Area	Bycatch Rate (#/mt groundfish)	Bycatch Amount (animals) DAP	JVP	Total
Flatfish	Zone 1- 511	0.48	4	0	4
	513	7.55	3,973	0	3,973
	515	0.00	0	0	0
	521	3.02	105	2,334	2,439
	All other BS	2.30	1,709	38,095	39,804
	AI - 540	0.00	0	0	0
	TOTAL		5,790	40,429	46,219
Other	Zone 1- 511	0.36	8,668	0	8,668
	513	5.12	155,792	0	155,792
	515	0.00	0	0	0
	521	0.79	2,248	248	2,495
	All other BS	38.35	317,151	34,930	352,081
	AI - 540	0.00	0	0	0
	TOTAL		483,859	35,177	519,036

Off Bottom

		DAP	JVP	
Pollock, mid-water	0.0088	139	130	269
Atka mackerel	0.0000	0	0	0
TOTAL		139	130	269
GRAND TOTAL		489,788	75,737	565,525

RED KING CRAB

Bottom trawl

Target Fishery	Area	Bycatch Rate (#/mt groundfish)	Bycatch Amount (animals) DAP	JVP	Total
Flatfish	Zone 1- 511	0.03	0	0	0
	513	0.03	14	0	14
	515	0.01	0	0	0
	521	0.20	7	157	164
	All other BS	0.12	89	1,980	2,068
	AI - 540	0.00	0	0	0
	TOTAL		110	2,137	2,247
Other	Zone 1- 511	0.18	4,357	0	4,357
	513	0.01	429	0	429
	515	0.00	0	0	0
	521	0.04	127	14	141
	All other BS	0.00	26	3	29
	AI - 540	0.00	0	0	0
	TOTAL		4,939	17	4,956

Off Bottom

		DAP	JVP	
Pollock, mid-water	0.0017	26	24	50
Atka mackerel	0.0006	0	2	3
TOTAL		26	27	53
GRAND TOTAL		5,075	2,180	7,256

BYCATCH SUMMARY

APRIL, 1989

HALIBUT

Target Fishery	Area	Bycatch Rate (mt/mt groundfish)	Bycatch Amount (mt) DAP	JVP	Total
			Bottom trawl		
Flatfish	Zone 1- 511	0.00	0.0	0.0	0.0
	513	0.01	3.5	0.0	3.5
	515	0.00	0.0	0.0	0.0
	521	0.02	0.6	13.3	13.9
	All other BS	0.00	0.8	17.7	18.5
	AI - 540	0.00	0.0	0.0	0.0
	TOTAL		5.0	31.1	36.0
Other	Zone 1- 511	0.01	146.4	0.0	146.4
	513	0.01	428.4	0.0	428.4
	515	0.01	17.8	0.0	17.8
	521	0.01	32.1	3.5	35.6
	All other BS	0.01	61.7	6.8	68.5
	AI - 540	0.01	10.5	1.2	11.6
	TOTAL		696.9	11.5	708.3
			Off Bottom		
			DAP	JVP	
	Pollock, mid-water	0.0001	1.0	0.9	1.9
	Atka mackerel	0.0019	0.7	7.7	8.4
	TOTAL		1.7	8.6	10.3
	GRAND TOTAL		703.5	51.1	754.6

	FISHERY			
	DAP		JVP	
Cumulative catch	Flatfish	Other	Flatfish	Other
Total groundfish, mt	47,524	154,612	180,574	58,213
"Target" catch, mt	35,608	135,499	136,155	52,703
C. bairdi cap, Zone 1	71,644	564,432	126,446	83,977
C. bairdi bycatch, Zone 1	19,022	122,378	67,192	15,938
Cap attained?	No	No	No	No
C. bairdi cap, Zone 2	168,299	1,325,899	297,033	197,269
C. bairdi bycatch, Zone 2	26,575	174,876	96,169	46,843
Cap attained?	No	No	No	No
C. bairdi bycatch, all areas	45,694	309,185	165,181	64,285
Red king crab cap, Zone 1	24,801	32,833	69,239	8,127
Red king crab bycatch, Zone 1	10,567	11,361	37,328	4,640
Cap attained?	No	No	No	No
Red king crab bycatch, all areas	10,759	12,005	39,753	4,697
Halibut cap, mt, BSAI	173.6	2531.5	251.3	343.6
Halibut bycatch, mt, BSAI	82.3	1535.8	304.4	567.2
Cap attained?	No	No	Yes	Yes

ALASKA CRAB COALITION

3901 Leary Way (Bldg.) N.W., Suite #6 • Seattle, WA 98107 • (206) 547-7560 • FAX (206) 547-0130

DATE: November 30, 1988

TO: JOHN G. PETERSON, CHAIRMAN
NORTH PACIFIC FISHERY MANAGEMENT COUNCIL
P.O. Box 103136
Anchorage, Alaska 99510

FROM: Arni Thomson, Executive Director
Alaska Crab Coalition

RE: COUNCIL ANNOUNCEMENT OF INTENT TO RECONSIDER SEPTEMBER BYCATCH DECISION ON BEHALF OF THE TRAWL INDUSTRY; OCTOBER 27TH, 1988. (AMENDMENT 12A, BS/AI FMP)

The ACC does not concur with the necessity for reconsidering the bycatch limits established at the September Council Meeting.

Further, the ACC does not feel the action is justified as based on the trawlers' petition, legal comment and economic brief attached to the Council memorandum.

Attached herewith is the ACC response to those materials.

An additional technical comment on the Council's bycatch model and revised economic analysis will be presented in testimony at the December 5 - 9 Council Meeting.

CONTENTS:

1. MFCMA NATIONAL STANDARDS COMMENTARY: Theodore G. Kronmiller, Patton, Boggs & Blow, Washington, D.C.

2. COST-BENEFIT ANALYSIS OF BYCATCH MEASURES IN THE BERING SEA: Dr. David G. Raboy, Chief Economic Consultant, Patton, Boggs & Blow, Washington, D.C.

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November 23, 1988

MEMORANDUM

We have been requested to review the adoption by the North Pacific Fishery Management Council ("NPFMC") of Amendment 12a to the Bering Sea/Aleution Islands Groundfish Management Plan ("FMP"). Amendment 12a provides a bycatch control program which limits the impact of trawling on crab and halibut.

We have been asked to take into account not only the bycatch restrictions and the record which formed the basis of the decision by the NPFMC, but also a legal memorandum, dated October 28, 1988, and a study of "economic transfers" dated October 21, 1988, which were prepared by Mundt, MacGregor, Happel, Falconer, Zilany and Hall and Natural Resources Consultants, respectively. The legal memorandum and economic study, prepared on behalf of trawling interests, challenge the NPFMC's action.

For reasons set forth below, we conclude that the arguments presented in the legal memorandum are unpersuasive. Moreover, as reflected in a separate analysis, we find the economic study to be unconvincing.

We believe that the following points arising out of our review are of central importance:

- The trawlers' legal and economic analyses proceed from a fundamentally flawed premise, i.e., that the "needs"

of the trawl sector are controlling in any decision concerning the allocation of fishery resources, and that the Council is thus required to facilitate the unconstrained development of DAP trawling at the expense of the mature pot and longline sectors of the American industry. There is absolutely no support in the Magnuson Fishery Conservation and Management Act, 16 U.S.C. § 1801 et. seq. ("Act") for such a position. See 50 C.F.R. § 602.15(C). One cannot exclude the possibility that the OY for groundfish should be reduced. See 50 C.F.R. § 602.16.

- The trawlers' legal memorandum appears to construe conservation extremely narrowly, i.e., as management designed solely to avoid harm to the resource. The law is clear, however, that conservation is defined as wise use, and that avoidance of waste is an important conservation objective. 16 U.S.C. § 1801(b)(1), § 1851(a)(1), § 1853(a)(1)(A); S. Rpt. No. 94-416, 1975, reprinted in A Legislative History of the Fishery Conservation and Management Act of 1976, Committee on Commerce (1976), at 75, 685). See 50 C.F.R. § 602, 16(b); § 602.17(d)(1); 50 C.F.R. Subpt. B. App. A at 452. The declared DAP "needs", which are far in excess of the historical experience in the JVP sector, cannot be reconciled with conservation principles. Significantly, the regulations state, "to the extent practicable, FMPs should provide a suitable buffer in favor of conservation". 50 C.F.R. § 602.16(c)(2). The decision of the NPFMC to limit bycatch approximately to historical levels is not merely justified, but clearly mandated, by the conservation requirements of the Act.

- The trawlers' legal memorandum challenges the action of the NPFMC for failure to produce a cost/benefit analysis. However, the record contains substantial consideration of relative costs and benefits of the bycatch limits. Doubtless, trawl interests would prefer to forget their previous experience in a judicial challenge of adoption by the NPFMC and the Department of Commerce of Amendment 14 to the Gulf of Alaska Groundfish Fishery Management Plan. Nevertheless, the District and Circuit Courts, in Alaska Factory Trawler Association, et al., v. Malcolm

Baldridge (sic), Secretary of Commerce and Fishing Vessel Owners' Association, No. 86-4410 (9th Cir. November 6, 1987) made it clear that the law does not require a formal cost/benefit analysis. Id., slip op. at 4, 16. The applicable regulations clearly state, "The supporting analyses for FMPs... need not produce an elaborate, formalistic cost/benefit analysis." 50 C.F.R. § 602.17(d).

- The trawlers' legal memorandum refers to procedural irregularities in the NPFMC determination of bycatch limits. Not surprisingly, the memorandum ignores the law on the subject, the Alaska Factory Trawlers case. Procedural irregularities that do not affect the decision of the Secretary of Commerce on the FMP amendment or result in improper material being added to the administrative record do not affect the legal validity of the management measure. Id., slip op. at 13, 514, 17, 18; citing Louisiana V. Baldrige, 558 F.Supp. 625, 630 n.1 (E.D.La. 1982).

- The trawlers' legal memorandum and economic study complain that the bycatch measures adopted by the NPFMC are excessively restrictive. However, the law, found again in Alaska Factory Trawlers, makes clear that there is no requirement to choose the least restrictive alternative. Id., slip op. at 18 ("The Secretary does not have to choose the least restrictive alternative to remedy the perceived problem").

Further arguments presented by the trawlers' legal memorandum merit little response. Contrary to the view expressed in that memorandum, the NPFMC decision does not violate National Standard No. 1 of the Act. 16 U.S.C. § 1851(1). Nothing in that provision, or in any other, requires that a fishery be "fully prosecuted", when conservation is not assured. Wasteful levels of bycatch are not justified by a need to achieve the optimum

yield in fisheries. The trawlers' declared "needs" are grossly in excess of historical experience and are clearly wasteful. With fishing practices that provide bycatch at, or even somewhat below, historical levels, the optimum yield in the trawl fisheries can be achieved. Any NPFMC action to permit wasteful fishing practices would, however, violate the conservation requirements of the Act. See 50 C.F.R. 602.11(b).

National Standard No. 2, 16 U.S.C. § 1851(2), is not violated by the bycatch measures adopted in the NPFMC. Clearly, the historical bycatch levels in the relevant trawl fisheries, including the most recent data from 1988, support the adopted limits. There is no scientific justification for permitting the unprecedented, wasteful levels of bycatch which the trawlers claim to need. See 50 C.F.R. § 602.12.

National Standard No. 4, 16 U.S.C. § 1851(4), is well accommodated by the decision of the NPFMC. The record is not inconsistent with the statutory and regulatory requirements cited in the trawlers' legal memorandum. It bears repeating that a formal cost/benefit analysis is not legally required. 50 C.F.R. § 602.17(d). There is ample evidence in the record to support the NPFMC decision as "fair and equitable" in allocating fishing privileges, as required by the statute and the applicable regulation. 50 C.F.R. § 602.14(c)(3). It would be unfair and

inequitable to allocate trawl bycatch species in the wasteful manner proposed by the trawlers. Moreover, as noted, the conservation requirements of the Act would be violated by such action.

The NPFMC bycatch restrictions, in reality, do promote efficiency, in accordance with National Standard No. 5. 16 U.S.C. § 1851(5). Here too, the avoidance of waste is important to the analysis. The adopted restrictions are calculated to constrain, in a fair and reasonable manner, the operations of trawl vessels that otherwise would have an excessive impact on bycatch species.

The notion that the NPFMC decision violates National Standard No. 7, 16 U.S.C. § 1851(7) is simply frivolous. The record reflects ample consideration of the relative costs and benefits of the alternatives considered and chosen by the NPFMC. To the extent practicable, the bycatch limits minimize costs, in accordance with the Act. Having in mind the conservation requirements of the Act, the costs that should be most minimized are those associated with wasteful fishing practices.

In conclusion, we maintain that the trawlers' legal memorandum and economic study offer no persuasive justification for a revision of Amendment 12a to the FMP, as adopted by the

NPFMC. Rather, it is clear that any revision along the lines of that suggested by the stated needs of the trawlers in their legal memorandum and economic study would violate the conservation requirements of the Act.

Cost-Benefit Analysis of Bycatch Measures in the Bering Sea

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November 28, 1988

Executive Summary

1. There are both private and social costs associated with the incidental bycatch of crab and halibut by the groundfish fleet. Private costs include the foregone potential harvest to the line and pot sectors. Social costs include adverse effects on already depressed crab populations. In addition, lack of effective bycatch measures incidentally encourages over-intensive harvest of groundfish, resulting in social costs in the form of the risk of reduced groundfish stocks.

2. Calculation of the cost of bycatch must be done carefully. One serious drawback of previous studies is that they don't include unobserved/incidental crab mortality from contact with trawl gear. The existence of such mortality is recognized by experts and government bodies. The actual cost of bycatch to the crab sector may be up to 15 times higher than previously recorded, once unobserved/incidental mortality is accounted for. Unobserved/incidental mortality may also have an important impact on outyear crab populations.

3. Bycatch restrictions are justified on a cost-benefit basis. This has been confirmed in several studies. The costs of such restrictions to the trawl fleet must be measured correctly. Only the most restrictive of measures would cause area closures. Trawl boats may, in some instances, have to move to areas of less catch per unit of effort. The <u>incremental</u> cost

of such activity is relevant for a cost-benefit analysis. In addition, lost gross revenue is not the relevant cost measure. The effects on the trawl industry must be measured on the basis of revenue net of costs.

4. The bycatch rates which the trawl fleet argues are necessary in order to reach potential are questionable. The rates are out of line with the historical evidence as represented by actual bycatch rates noted by onboard observers with the JVP fleet.

5. Bycatch measures, besides encouraging "clean" fishing, may encourage conservation among trawl boats with respect to their own target fisheries.

I. The Role of Cost-Benefit Analysis

Over the last ten years many policymakers and economists have placed increasing faith in market forces to foster economic growth and to efficiently allocate scarce resources. Yet even the most ardent believer in markets would concede that conflicts can arise in a market system and that the market may not be capable of healing itself. In such cases intervention from outside sources may be necessary and a way must be sought to judge the efficacy of such intervention.

There are several types of conflict that can arise between parties pursuing their economic wellbeing in a market setting. In the first instance, one party may participate in an activity that infringes upon another party. There may be no incentives for the first party to cease or modify its behavior so as to minimize the economic damage inflicted upon the second party. When one entity's activity causes harm to the activity of another entity, it is known as a "negative externality". The private actions of one entity are inflicting unexpected private costs on another entity. One industry's actions are reducing the profitability or income of another industry. Thus, one important "market failure" occurs when the actions of one group inflict private costs on another private entity.

There is, however, another type of market failure which affects society as a whole. In this case a private entity may undertake activities which result in economic damage to society

in general. For example, it may be that society places a greater value on certain scarce resources than private companies making their living off of those resources. Private companies may have less concern for the future availability of resources than does society as a whole. They may assign a lower value to a given stock of resources in the future than does the public at large and, therefore, extract the resources at a rate desirable to the private entity but not desirable to the nation.

When a failure of the market occurs whereby a private entity is inflicting damage on another private entity and/or society, it may be appropriate for government to intervene. This is not an inevitable result; some times private parties can negotiate their difficulties. But if some type of regulation is needed, a way must be found to determine whether any potential regulation improves the situation or results in a situation that is worse than the initial problem itself. A market failure imposes costs potentially on private entities and society and bestows benefits on the entity responsible for the failure. But a regulation results in costs and benefits as well. New costs are imposed upon the responsible parties, and hopefully, benefits are bestowed upon the injured party and/or society. It must be determined whether, on balance, the regulation does more harm than good.

This is the purpose of cost-benefit analysis. This type of analysis allows the costs imposed upon the injuring party to be

weighed against the benefits to the injured party and/or society. Cost-benefit analysis, however, is a very tricky business and can produce perverse results if not done correctly. All costs and benefits, both social and private, must be accounted for and they must be measured correctly. Failure to account for all costs, or a mistake in measurement, can qualitatively change the results of the analysis. Because of the imprecise nature of cost-benefit analysis, the results should always be interpreted with caution.

Incidental bycatch of prohibited species (PSC) and the groundfish trawling industry

Both types of problems exist in the case of the groundfish fishery off Alaska in the Bering Sea and in the vicinity of the Aleutian Islands. The trawl fleet that operates in Exclusive Economic Zone (EEZ) fishes for cod, pollock, yellowfin sole and other flatfish. By April 1988, 1,775 permits had been issued to fish groundfish in the Gulf of Alaska and the Bering Sea.[1/] Of those licensed to fish groundfish, 214 catcher and 49 catcher/processor vessels employed trawl gear and conducted bottom trawling.[2/] Because trawl gear is not selective, it will

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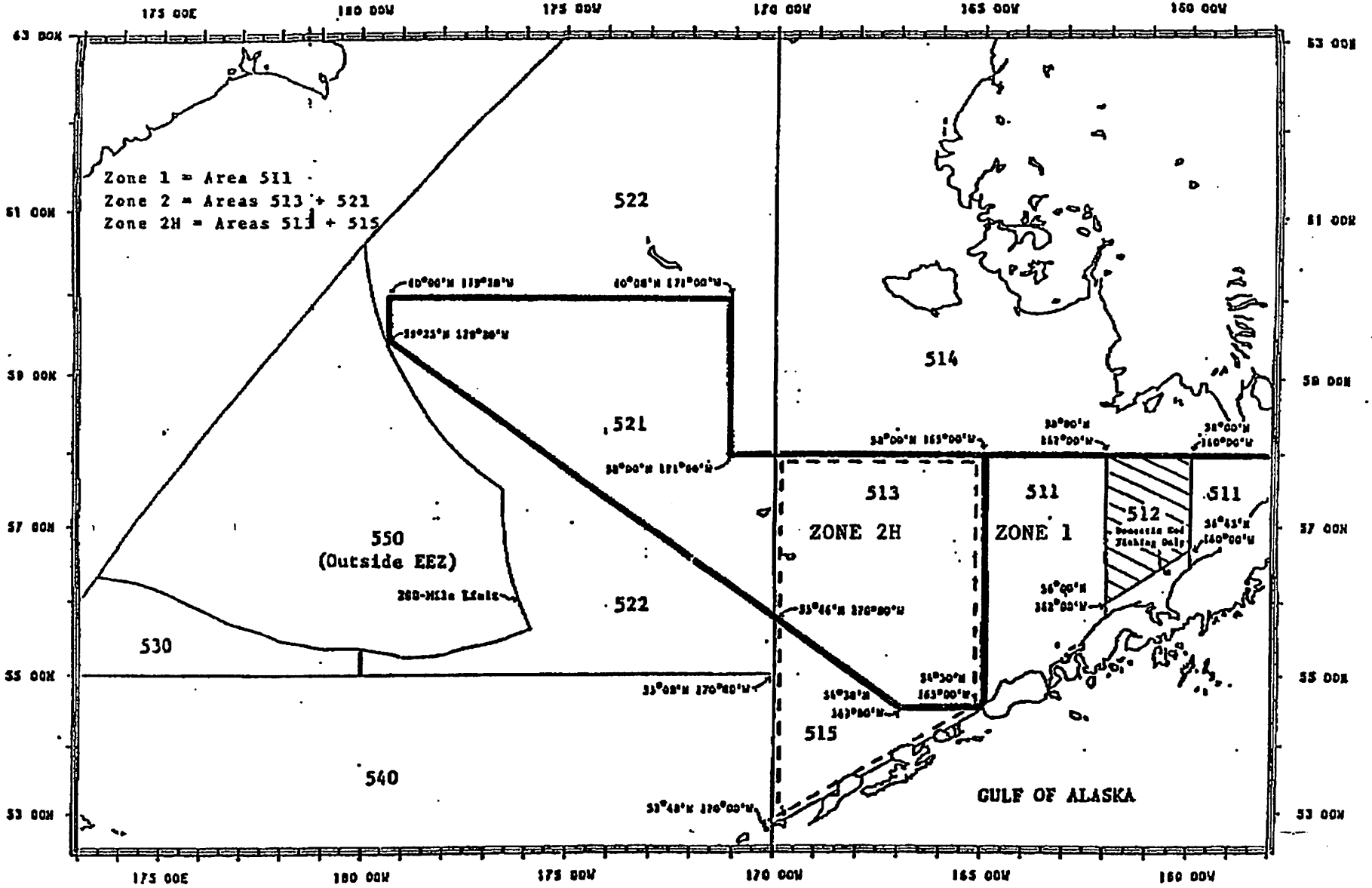
1/ "Bycatch Controls: Amendment 12A to the Fishery Management Plan for the Groundfish Fishery of the Bering Sea/Aleutian Islands" North Pacific Fishery Management Council, Sept. 16, 1988, p. 2. (Thereinafter" NPFMC analysis") see the following chartlet which describes areas covered by the amendment.

2/ Id. at 4.



ZONES IN BERING SEA/AI FOR CONTROL OF CRAB AND HALIBUT BYCATCH; AMENDMENT 12A, BS/FMP, 1989

harvest species other than the target species particularly where trawling is hard on bottom. The incidental bycatch of the trawl fleet often includes king crabs, tanner crabs, and halibut. Issues surrounding the bycatch of crab will be the focus of this paper.

This bycatch constitutes a "negative externality" in every sense of the word. The incidental bycatch results in a lower potential harvest for those whose target fishery is crab or halibut. The extent of this damage is a matter of some debate and issues involved in this debate will be one topic of this paper.

Beyond the private costs of bycatch imposed upon those in the crab industry, there are social costs that must be considered. Crab populations have been depressed in many areas and rebuilding scarce crab stocks to optimum levels must be a public goal. The extent to which the bycatch inhibits this goal must be considered on top of any private costs.

If regulations exist to control the bycatch, then costs may be imposed on the trawl fleet. These costs could result from curtailed operations if regulations are strict enough. But any costs imposed must be measured correctly. In some cases regulations may force conservation upon the trawl fleet. The future benefit of such conservation must be subtracted from the contemporaneous costs associated with foregone harvest to arrive at a meaningful private cost of regulation. In addition,

regulation may create incentives to improve gear or switch to other types of gear (for instance, more intensive use of line fisheries). This may lead to greater efficiencies in ground fishing which, again, must be subtracted from current losses.

Finally, there has been much concern, lately, that groundfish fisheries are being harvested over-intensively.3/ Certainly groundfish stocks are not immune to diminution of their populations. A regulation directed at bycatch, which incidentally causes less intensive harvesting of groundfish, may bestow a further benefit on society -- more effective maintenance of groundfish stocks. Moreover, loss of productivity of the trawl fleet may simply be temporary; the target species survive and reproduce, and are available for harvest later, with less impact on non-target species. These benefits would also have to be measured and subtracted from the current cost of regulation to the trawl fleet.

There are many potentially conflicting issues involved in a cost-benefit analysis of bycatch measures. The following points are in order:

- All private and social benefits from limiting bycatch must be considered.

3/ See, for instance, the North Pacific Fishery Management Council (NPFMC) October 20, 1988 memorandum. The NPFMC expresses dismay at a "continued decline in pollock biomass" which is "substantially below the most pessimistic projection from 1987."

- Extreme care must be taken to account for the extent of incidental damage and measure the negative externality correctly.

- All negative and positive consequences of regulating the trawl fleet must be considered. Beyond the immediate apparent costs inflicted upon the trawl fleet, there may be countervailing effects that heretofore have not been considered.

This paper will address the various issues involved in a cost-benefit analysis of bycatch measures. It will provide some estimates of the magnitudes of social and private costs of lack of bycatch management as well as to comment on the costs of regulation to the trawl fleet. Several preliminary attempts at cost-benefit analysis have already been offered. A survey of the results is worthwhile.

Previous Cost-benefit Calculations

A paper issued in October 1985 by the Office of the Chief Fisheries Scientist of the Alaska Department of Fish and Game included estimates of the economic effects of bycatch.[4/] This paper compared the economic value (the "legal male equivalent" value) of the incidental crab catch to the joint venture harvest of yellowfin sole in the domestic fishery.[5/] The paper presented

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4/ "Management Implications of the Incidental Catch of King Crab in the U.S. Joint Venture Fisheries for Yellowfin Sole in the Eastern Bering Sea." Office of the Chief Fisheries Scientist, Division of Commercial Fisheries, Alaska Department of Fish and Game, October 16, 1985 (hereinafter "Chief Fisheries Scientist analysis").

5/ Id. at 6.

a range of estimates. If the bycatch harvest rate were 20 king crabs per metric ton (mt), then the value of the bycatch would have exceeded the value of the yellowfin sole harvest. At the bycatch rate of 10 crabs per mt, the bycatch value was more than half the total value of the yellowfin sole harvest, and if the bycatch rate were 5 crabs per mt, the bycatch value would be over one quarter of the value of the target fishery harvest. The paper points out that the actual 1985 bycatch rate was 8.29 crabs per mt.

According to the paper, the total value of the joint venture harvest was approximately $16,700,000. The value of incidentally caught king crabs was $7,600,000 and the value of other species bycatch was $4,185,000. Thus the total bycatch value was $11,785,000, 70 percent of the value of the targeted catch. The directed king crab harvest was valued at $16,400,000. The bycatch value was almost half the actual value of the directed king crab harvest. In addition, the paper notes:

> These incidental values probably represent an underestimate of the total value of coincidental species mortality. Only crabs which end up on the surface in trawl codends are counted. Crabs which may have been crushed by the gear are not accounted for. In addition, incidentally caught female crab are not assigned an economic value.6/

The NPFMC document on Amendment 12A also contained a section on cost-benefit analysis. This paper notes the

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6/ Id. at 7.

complexity of a full fledged analysis:

> The impacts of each alternative would, theoretically, include changes in revenue, costs, and profits affecting harvesters, processors, wholesalers, retailers, and consumers. The change in future product flow would be estimated and the revenue change at each level measured and added across levels. Such an analysis would be able to compare the total changes associated with each of the alternatives; however, such an indepth and comprehensive analysis is beyond the scope of available data, so a more accessible means of comparison is used.7/

The NPFMC estimates make assumptions as to bycatch, and assume a natural mortality rate of 22 percent per year for all tanner crabs, and 30 percent for red king crabs. The Council also assigns an economic value to female crabs. All tanner crabs are assumed to reduce harvest potential 4 years hence and king crabs are assumed to reduce potential 2 years hence. In other words, if the crabs had not been removed in the bycatch, they would have matured and been fully recruited to the target fishery in the years stated. Thus the values must be discounted to the current equivalent value. A conversion factor is used to convert halibut to an adult equivalent value. In the case of both crab and halibut, 100 percent bycatch mortality is assumed.

No provision is made for unobserved/incidental crab mortality associated with contact with trawl gear although this possibility is recognized earlier in the document.8/ Thus the

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7/ NPFMC analysis, supra at 57.

8/ See id. at 13.

damage estimates to the directed crab fishery of groundfish bycatch are understated.

The Council, in its document, presents four alternatives for bycatch management. The first would allow existing regulations to expire. The second continues the existing regulations. The third would set bycatch limits based on a percentage (1 percent) of existing estimated PSC stocks. The fourth alternative calls for stricter numerical caps for each species. Table 1 shows the estimated economic loss from bycatch to the target fisheries under the four alternatives as estimated by the NPFMC.

These estimates will be the starting point for testing the implications of other assumptions concerning the effects of trawling on crab populations. It is noted, however, that the Council adopted a variant of the alternatives. In the next section, the economic loss to the crab industry will be estimated incorporating estimates of unobserved/incidental crab mortality due to contact with trawl gear.

It should be mentioned that the Council believes that only the fourth alternative would actually restrict groundfish harvests. The others might force relocation of effort to "areas of (potentially) lower catch per unit of effort. When the harvesters move due to bycatch constraints, their costs would increase for the same amount of catch, resulting in decreased profits of some unknown magnitude."[9/]

Table 1

Estimate of Economic Loss
from Bycatch for 1989
for Bering Sea/Aleutian Island Area
(present value in $ millions)

	(C. Bairdi)	Other Tanner Crab	Red King Crab	Halibut	Total
Alternative 1 Do Nothing					
Exvessel	-	$ .44	$ 16.63	$ 6.28	$23.40
Wholesale	-	$ 1.02	$ 23.91	$ 8.29	$33.22
Alternative 2 Continue Amendment 10					
Exvessel	$ 1.12	-	$ 1.03	$15.37	$17.52
Wholesale	$ 1.55	-	$ 1.48	$20.29	$23.32
Alternative 3 1% of Population					
Exvessel	$ 1.88	$ .56	$ 1.30	$19.26	$23.00
Wholesale	$ 2.59	$ 1.15	$ 1.87	$25.41	$31.02
Alternative 4 Stricter Limits					
Exvessel	$ .35	$ .54	$ .94	$ 2.41	$ 4.24
Wholesale	$ .49	$ 1.14	$ 1.35	$ 3.19	$ 6.17

Source: North Pacific Fishery Management Council
September 16, 1988

9/ Id. at 59.

The final analysis to be reported here was produced by Natural Resource Consultants (NRC).[10/] The NRC analysis attempts to measure the economic loss to the line and pot sectors from bycatch, and compare the lost value of bycatch to potential trawl fleet losses under various regulatory scenarios. Assumptions as to the time lost to recruitment had the animals not been incidentally caught are different from the NPFMC assumptions. It is not specified what natural mortality assumptions are made but they appear to be different from those of the NPFMC.[11/]

Further, NRC presents two bounds on the costs, based on the assumed mortality of the bycatch itself. Most observers assume 100 percent mortality for bycatch. This is discussed in the next section. NRC produces estimates based on 75 and 100 percent mortality.

The estimate of total costs imposed upon target fisheries (crab and halibut) from the bycatch restrictions adopted by the Council is $18.45 to $24.62 million, according to NRC. The Council, on the other hand, estimated the cost of its original

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10/ "Analysis of Economic Transfer Between Fisheries Resulting From Trawl By-Catches" Natural Resource Consultants. October 21, 1988 (hereinafter, "NRC analysis").

11/ For king crab the NPFMC assumed a 2 year lag to recruitment with a .3 mortality rate. Under this assumption, the number of adult males lost downstream would be 66,150, not the 44,550 estimated by NRC. Further, since recruitment is assumed by NPFMC to occur in 2 years, the discount factor would be less than that assumed by NRC. Thus, if the NPFMC assumptions are accepted, the NRC estimates of loss associated with bycatch of king crab are understated.

alternative 3 at $31.02 million. Neither estimate incorporates unobserved/incidental crab mortality due to contact with trawl gear.

The NRC then presents a meaningless statistic. It compares the total gross revenue of the trawl industry to its estimate of the bycatch value. It is unclear what the purpose of this statistic is but it has nothing to due with an economic cost-benefit calculation. Even if the analysis were solely focusing on private interests the relevant comparison would be between the incremental benefit to line and pot industries from controlling bycatch and the incremental cost to the trawl fleet of controlling bycatch -- not total gross revenues.

This incremental comparison should be made on the basis of net revenues not gross revenues. This was stressed in a recent analysis performed for the International Pacific Halibut Commission.[12/] Different activities have different associated costs. The economic benefits of an activity are measured by value-added or profit, not gross revenues. This is conceded by NRC:

> We recognize that a comparison of gains and losses in terms of gross wholesale value can be misleading if the costs of production differs greatly between the by-catch and the groundfish species.

12/ Robert L. Stokes, The Economics of Halibut Bycatch Regulation, International Pacific Halibut Commission, November, 1988.

As with other studies, the NRC provides no data on the incremental costs to the trawl fleet deriving from various regulatory scenarios. Instead, the study merely speculates on the effects of area closures while providing no specific empirical evidence on the probability of such an occurrence. The NRC study expresses concern that fisheries may have to shut down by mid-year. In fact, the JVP fleet achieved almost all of its quota by mid-year in 1988.

There are other aspects of the NRC study which require clarification. The first concerns their calculation of prices for groundfish and halibut. In addition, the tables do not provide total allowed catch (TAC) by species or the origin of bycatch rates.

Summary and Remainder of the Paper

A detailed, sophisticated cost-benefit analysis of bycatch measures has not been attempted. Some efforts have focused solely on the private costs to line and pot fisheries of incidental bycatch. Even these efforts must be expanded to incorporate new issues -- especially to take account of unobserved/incidental crab mortality due to contact with trawl gear. Other issues such as bycatch rates, mortality, and the economic value of females must be addressed as well. In the next section, the private and social costs of bycatch will be discussed in more detail. In the final section, a commentary will be offered on the measurement of costs of bycatch management to the trawl industry and any incidental costs or benefits to society that may result from regulation.

II. Private and Social Costs of Bycatch

Private Costs

Much of the existing cost benefit analysis has focused solely on the private costs to line and pot fisheries from bycatch. Several issues must be resolved before these private costs can be quantified. First, a bycatch rate must be agreed upon. It is beyond the purview of this paper to analyze bycatch rates and, therefore, rates provided by the NPFMC will be accepted. In fact, the bycatch rate issue is of more than casual interest. The NRC study refers to proposed bycatch formulas necessary "to meet industry needs". The study states that numerical caps of 400,000 king crab and 6,300,000 C. Bairdi crab are necessary to allow the groundfish fleet to reach its potential. The NRC study indicates a joint DAP-JVP catch in the Eastern Bering Sea and Aleutian Islands of 1,818,744 mt in 1988.[13/] Thus, NRC believes that a bycatch rate of 3.46 crab/mt for C. Bairdi in the major bottom trawl fisheries, and .04-.14 crab/mt for red king crab would be necessary. In reality, the Zone 1 rate for king crab would be much higher due to the fact that king crab reside 90-95 percent in Zone 1.[14/]

13/ NRC analysis, supra at 7.

14/ NPFMC analysis, supra at 8.

It is unclear why the levels of bycatch proposed by NRC are so high. The observer program on foreign vessels has yielded very useful information on bycatch rates in the JVP fleet. Bycatch rates have been steadily trending downward. In 1988, the JVP average bycatch rate for Zones 1, 2, and 3 C. Bairdi crab was .5 crab/mt. In Zone 1, the rate for red king crab was .22 crab/mt.

Factoring stated bycatch rates with numbers of crab and halibut indicates that the NRC study is predicated upon a TAC of 1.2 million mt for 1989, with a C. Bairdi bycatch of 6.5 times that of JVP for the same TAC in 1988. It is difficult to justify such a result, i.e., a numerical cap of 4 million vs. 600,000 C. Bairdi crab.

Another issue is the average age of bycatch relative to the age of recruitment to the fishery. Once again, the NPFMC figure of 2 years to recruitment, had crabs not been incidentally caught, is accepted for king crab and 4 years is given for tanner crabs. Other areas of potential controversy are the average weight at recruitment, the recovery rate for sale, and average prices. These issues have not generated much conflict elsewhere and therefore, NPFMC estimates will be used here.

Three other areas are more controversial. These are bycatch mortality assumptions, the economic value of females, and unobserved/incidental mortality from contact with trawl gear.

The mortality issue concerns whether any of the incidental bycatch is expected to survive. The normal assumption is that 100 percent of the bycatch dies and therefore is permanently lost to potential harvest. The NRC study argued, however, that it was possible that as much as 25 percent of the bycatch would survive and, therefore, be returned to the sea.

It is not within the scope of this study to independently assess bycatch mortality. Nonetheless, other papers have addressed the issue. The previously cited paper from the Alaska Department of Fish and Game makes reference to actual trawling practices:

> King crab caught in the JV trawl fishery are subject to conditions which result in almost 100% mortality. Catcher vessels transfer trawl cod-ends containing the entire catch from a trawl tow directly to the processing vessel without sorting the catch. Because of the transfer procedure and further delays aboard the processing vessel, trawl cod-ends may remain unsorted for up to eight to ten hours. Oxygen depletion, compression, and abrasion in the trawl cod-ends causes very high crab mortality. Sorting catches immediately aboard the relatively small catcher vessels is not feasible in most cases.15/

An unanswered question is whether impacts in large factory trawler operations are different. The lack of observer data accounts for this uncertainty.

Further, lack of observers on domestic factory trawlers means there is little incentive to improve sorting to diminish

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15/ Chief Fisheries Scientist analysis, supra at 2.

mortality of bycatch. Absent evidence to suggest a different result, reliance can only be placed upon the assumption of 100 percent mortality[16/].

A second issue concerns assigning an economic value to incidentally caught female crabs. In the interest of maintaining stocks females cannot be retained by the target fishery. But due to 100 percent mortality of bycatch, the procreative potential of incidentally caught females is wholly lost to the crab fishery. An economic value should be based on the expected number of adult males that would be foregone due to the loss of females.

This concern for incidentally caught females was expressed by the National Marine Fisheries Service in 1986.[17/] The Alaska Department of Fish and Game noted:

> The incidental harvest of king crabs could directly result in recruitment overfishing since trawl fisheries result in 100% mortality of female crabs.[18/]

16/ NPFMC analysis, supra at 57.

17/ Quarterly Report Northwest and Alaska Fisheries Center, National Marine Fisheries Service (NMFS), U.S. Department of Commerce, January-February-March 1986, p. 28 (hereinafter, "NMFS analysis").

18/ Chief Fisheries Scientist analysis, supra at 4.

The 1988 NMFS survey showed a 47 percent decline in pre-recruit king crabs.[19] The quota for the directed crab fishery was 39 percent less in 1988 than in 1987.

As a result of the additional economic loss associated with the bycatch of females, the NPFMC study reports a factor to assign an economic value to females:

> During periods of low abundance, female crabs may be worth more, per crab, to the spawning population than in years of high abundance. In order to allow for this, a value to the future fishery is used for female crabs. For red king crab, Reeves and Terry (1986) used boundaries of 2.7 and 8.2 pounds based on estimated female mortality rates, past harvests and optimal levels of spawners. The average of these two levels, 5.5 pounds, is similar to the average rate of directed harvests, 5.8 lb./crab (ADF&G, 1988). Therefore, females will be counted on an equal basis with males for impacts on future directed harvests. The same procedure will be followed for tanner crabs with an average weight for C. Bairdi at time of directed harvest of 2.2 lb./crab and an average weight of 1.2 lb./crab for C. Opilio (ADF&G, 1988).[20]

Once again, it is beyond the scope of this paper to independently measure the economic value of females. As with the other

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19/ B.G. Stevens, R.A. MacIntosh and K.L. Stahl-Johnson. Status of Stocks of Commercially Important Crab Species in the Eastern Bering Sea in 1988, National Marine Fisheries Service, September 1988.

20/ NPFMC analysis, supra at 59.

assumptions, for purposes of this survey paper, the NPFMC assumption on the economic value of females will be accepted.

The final issue is the most controversial. This concerns the incidental mortality of crabs struck, but not retained, by trawl gear. The existence of such unobserved/incidental mortality was acknowledged by the National Marine Fisheries Service:

> The actual ratio [of crab deaths to bycatch] may, however, lie somewhere between 1.0 and 15.8, depending on the mortalities (as yet unmeasured) inflicted by the trawl on crabs that are encountered but not caught.[21/]

The Alaska Department of Fish and Game states that its impact estimates are understated due to lack of this unobserved/incidental mortality:

> These incidental values probably represent an underestimate of the total value of the incidental species mortality, only crabs which end up on the surface in trawl codends are counted. Crabs which may have been crushed by the gear are not accounted for.[22/]

This phenomenon is also acknowledged by the NPFMC:

> Bycatch mortality is the sum of (1) bycatch retained, (2) non-retained bycatch that is dead or dies soon after release, and (3) individuals that are somehow killed by the gear but are not observed in the landed bycatch. There can be a

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21/ NMFS analysis, supra at 28.

22/ Chief Fisheries Scientist analysis, supra at 7.

> great deal of variability in mortality depending upon gear and mode of operation as well as size and condition of the individuals present.[23]

A paper by David T. Hoopes provides evidence of unobserved/incidental crab mortality:

> United States scientists have examined king and tanner crabs from 428 trawl hauls since the spring of 1968. They have concluded from these examinations that trawling is a source of crab mortality, especially during the molting period. At that time soft-shelled crabs may be severely damaged in a trawl by both active mechanical action and the sheer crushing weight of a large catch. Such damage within the trawl can be assessed but little is known about the possibility of crabs that are not retained in the cod end being damaged by the passage of a trawl over the bottom.[24]

No definitive experimental data exists on unobserved/incidental mortality. An interesting attempt to extrapolate unobserved/incidental mortality from bycatch was performed by Wes Johnsen in 1985.[25] Johnsen's analysis considered the bottom characteristics of trawl gear to determine the extent of contact of trawl gear with the ocean floor. Since crabs do not differentiate between the trawl opening and other trawl gear, it is logical to assume that the ratio of crabs

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23/ NPMFC analysis, supra at 13.

24/ David T. Hoopes "Effects of Trawling on Bering Sea Crab Stocks" U.S. Bureau of Commercial Fisheries, International North Pacific Fisheries Commission, 1974 p. 7.

25/ Wes Johnsen "Effects of Bottom Trawling on Crab Stocks of the Bering Sea" September, 1985.

killed to bycatch bears a relationship to total width of trawl gear in contact with the ocean floor to the trawl opening. In Johnsen's words:

> [I]t is possible to come up with a ratio by dividing the swept non-capture spread by the capture spread and multiplying crabs caught by it to give a hypothetical value to the potential number of crabs harmed.[26/]

Johnsen estimates that the ratio may be as high as 15.21 to 1.[27/]

Our survey suggests that many sources consider unobserved/incidental crab mortality to be a relevant issue. Further, current thinking places an upper bound for the ratio of incidental mortality to bycatch at 15 to 1. Given this thinking, it is appropriate to recalculate the NPFMC estimates for the economic impacts of bycatch measures, assuming different ratios for unobserved/incidental mortality to bycatch. The NPFMC assumes 1 to 1. Alternatives here are 5 to 1, 10 to 1 and 15 to 1. Table 2 presents these estimates.

26/ Wes Johnsen id at 1.

27/ Id. at 3.

Table 2

Estimates of Economic Loss from Bycatch
for Bering Sea/Aleutian Islands Area --
Total Crab Bycatch [a/] under 4 Mortality Assumptions
(present value in $ millions)
(all other assumptions from NPFMC)

	Ratio of unobserved/incidental mortality to bycatch			
	1 to 1	5 to 1	10 to 1	15 to 1
Alternative 1 Do Nothing				
Exvessel	$17.12	$ 86.62	$171.23	$256.85
Wholesale	$24.93	$124.67	$249.33	$374.00
Alternative 2 Continue Amendment 10				
Exvessel	$ 2.16	$ 10.78	$ 21.55	$ 32.33
Wholesale	$ 3.03	$ 15.17	$ 30.34	$ 45.51
Alternative 3 1% of population				
Exvessel	$ 3.74	$ 18.68	$ 37.35	$ 56.03
Wholesale	$ 5.61	$ 28.06	$ 56.12	$ 84.18
Alternative 4 Stricter Limits				
Exvessel	$ 1.84	$ 9.19	$ 18.38	$ 27.57
Wholesale	$ 2.98	$ 14.92	$ 29.83	$ 44.75

a/ Values sum loss for all tanner and king crabs.

As can be seen, unobserved/incidental mortality can greatly affect the costs imposed on the crab target fishery from bycatch in the groundfish trawl fisheries. Table 3 incorporates the value of the halibut bycatch, based on NPFMC estimates, to give ranges for the total value of bycatch in the Bering Sea/Aleutian Island area. The low estimate assumes a 1 to 1 ratio of such mortality to bycatch for crabs. The high range assumes a 15 to 1 ratio. Under the high range, if there were no restrictions on bycatch, the trawl fleet would impose an external cost on the line and pot fleet of $382,286,000 (based on wholesale prices). This is almost 60 percent of the total gross revenue projected by NRC for the entirety of DAP and JVP enterprises.

Assuming the high estimate, even Alternative 4 is justified on a cost-benefits basis based on a crude gross revenue comparison.[28/] The NPFMC has estimated that Alternative 4 would result in foregone revenues to the JVP and DAP fleets totalling $116,917,000, based on exvessel prices.[29/] Alternative 4, under the high assumption, would result in benefits to the line and pot industries of $233,145,000, based on exvessel prices. This results in a benefit-cost ratio of almost 2. If the incidental mortality to bycatch ratio is assumed to be 10 to 1, Alternative 4 would result in line and pot sector benefits of $156,720,000.

28/ As stated above, the analysis should be refined to incorporate net revenue calculations. Thus, the alternative 4 analysis is purely illustrative.

29/ NPFMC analysis, supra at 61.

This results in a benefit-cost ratio of 1.34, clearly justifying the alternative from an economic perspective.

Table 3

Estimates of Total Economic Loss for 1989
from Crab and Halibut Bycatch
for Bering Sea/Aleutian Island Sea
(present value in $ millions)

	Low Range [a]	Mid-Range [b]	Mid-Range [c]	High Range [d]
Alternative 1 Do Nothing				
Exvessel	$23.40	$ 92.90	$177.51	$263.13
Wholesale	$33.22	$132.96	$257.62	$382.29
Alternative 2 Continue Amendment 10				
Exvessel	$17.52	$ 26.15	$36.92	$ 47.70
Wholesale	$23.32	$ 35.41	$50.63	$ 65.80
Alternative 3 1% of Population				
Exvessel	$23.00	$ 37.94	$56.61	$ 75.29
Wholesale	$31.02	$ 53.47	$81.53	$109.59
Alternative 4 Stricter Limits				
Exvessel	$ 4.24	$ 11.6	$20.79	$ 29.98
Wholesale	$ 6.17	$ 18.11	$33.02	$ 47.94

a/ Based on a 1 to 1 ratio of unobserved crab mortality to bycatch.

b/ Based on a 5 to 1 ratio of unobserved crab mortality to bycatch.

c/ Based on a 10 to 1 ratio of unobserved crab mortality to bycatch.

d/ Based on a 15 to 1 ratio of unobserved crab mortality to bycatch.

When it comes to measuring private cost inflicted upon the crab industry from bycatch, no issue is more important than that of unobserved/incidental mortality. Different assumptions on such mortality have major, qualitative implications for cost-benefit analysis of bycatch measures. If moderate or high levels of such mortality are assumed, even the strictest NPFMC alternative is justified from an economic perspective, based solely on a comparison of private costs and benefits.30/ In addition, the social costs must be considered.

Social Costs of Bycatch

The NPFMC and Department of Commerce develop regulations governing bycatch under authority of the Magnuson Fishery Conservation and Management Act. The very existence of the Act is illustrative of society's conservation goals. If not properly managed, reproduction rates will be less than the amount necessary to maintain an equilibrium population and certain fish stocks can become non-renewable scarce resources. This would be especially unfortunate because it is unnecessary. Environmental factors being equal, with proper management sufficiently productive rates can be maintained and adequate populations can exist indefinitely. Therefore, when populations are depressed, the issue of conservation is particularly sensitive.

30/ The NPFMC estimates on costs to the trawl fleet may be overstated as will be discussed in Section III.

Crab populations in the Bering Sea are still depressed. According to the NPFMC both tanner and king crab populations are well below the optimum.[31] There is a social cost associated with any activity that exacerbates the already critical state of crab stocks. As stated by the NPMFC:

> When abundant fish and crab resources are involved there is essentially no biological risk associated with anticipated levels of bycatch. However, when any population is reduced to a low level, potential for risk appears and accelerates rapidly as the population declines further....[32]

The existence of bycatch today affects population tomorrow. This is especially critical if it is believed that actual crab mortality may be several multiples of actual bycatch. Further, the bycatch and unobserved/incidental mortality do not discriminate between males and females.

There is almost certainly a relationship between incidental or unobserved mortality and population levels although the magnitude of the effect is, at this time, unknown. According to the NPFMC, "[a]lthough the impact of bycatch is real, it is difficult to anticipate with any degree of certainly what impact it has on eventual directed harvests."[33]

31/ NPFMC analysis, supra at 14.

32/ Id. at 26.

33/ Id. at 28.

The fact that such a population oriented social cost of bycatch exists indicates that the purely private costs stated earlier understate the total costs of bycatch. Some measure of the population effects should be quantified and added to the private costs discussed earlier.

III. Social and Private Implications of Restricting Bycatch

Any bycatch management regulations must be assumed to impose some costs on the trawl fleet. Any regulations that did not impose initial costs would, by definition, be ineffective. Any significant reduction in bycatch must involve modification of behavior on the part of the trawl fleet. These costs must be measured correctly.

Certain regulations may cause trawlers to locate to areas of lower catch per unit of effort (CPUE). Such moves may cause a reduction in revenue and profit. It is only this incremental loss of revenue that should show up as a cost to the trawl fleet, not total gross revenue. The NPFMC has stated that only very strict numerical caps will result in area closures.

At any rate, gross revenue is not the relevant economic statistic. The previously cited NRC study erroneously relied on gross revenue. As was pointed out in a recent cost-benefit analysis performed for the International Pacific Halibut Commission, revenues net of costs must be compared. The report suggested that bycatch restrictions would convey a net benefit on society.[34/] Trawl fishing also is indiscriminate with respect to the harvest of juveniles. Mesh sizes are not regulated in these

fisheries despite extensive use of mesh restrictions in North Atlantic Countries.35/

A final social consideration is in order. In the 1960s and 1970s certain groundfish populations became seriously depleted due to over-intensive harvesting. The implications of the expanding DAP fleet for equilibrium populations are not yet understood, but one incidental aspect of stricter bycatch measures may be greater groundfish conservation. This would convey a social benefit.

However private costs to the trawl fleet are measured, countervailing benefits from greater conservation and greater private efficiency must be accounted for. Only when all costs and benefits are incorporated will the analysis be truly meaningful for policy purposes.

34/ Robert L. Stokes, supra.

35/ Peter T. Hagan and O.A. Mathisen Fishery Management Techniques in the North Atlantic, School of Fisheries and Science, University of Alaska, June, 1984.

ADDENDUM

ANALYSIS OF CRAB AND HALIBUT BYCATCH IN DAP AND JVP FLATFISH AND OTHER GROUNDFISH FISHERIES IN THE BERING SEA/ALEUTIAN ISLANDS FOR 1989

Prepared by Staff of the
North Pacific Fishery Management Council
and the Northwest and Alaska Fisheries Center

Anchorage, Alaska

December 4, 1988

Council and NWAFC Staff met with the industry and interested public at the NWAFC in Seattle on Thursday, December 1, 1988. The purpose of the meeting was to (1) present the methodology used to estimate bycatch under the system Council approved by the Council at its September, 1988 meeting; (2) present the results of the various scenarios examined; and, (3) solicit advice from industry on how the model might be improved.

The first two of these items have been presented in the parent analytical document. The purpose of this addendum is to summarize the changes to the model suggested by industry and to highlight the preliminary analysis of a scenario based on those recommendations.

Although discussion focused on all aspects of the simulation model, two particular areas were deemed most important: adjusting bycatch rates in the DAP and JVP other fisheries (pollock/cod bottom trawl) to account for differences in the shares of pollock and cod in the aggregated fisheries, and better accounting for area distribution of each fishery, by quarter.

Accordingly, the database was reexamined to allow estimation of separate bycatch rates for the cod and pollock fisheries. These separate rates were then combined into a blended bycatch rate (weighted average) for the other bottom trawl fishery using the estimates of total tonnage for each of the two fisheries by quarter and by user group (Table 1). The reestimated bycatch rates are displayed in Table A1.

The model was also revised to accommodate industry suggestions on how each fishery might be distributed by quarter and area in 1989 assuming the fleet was not constrained by bycatch. The unconstrained simulation was then rerun to provide an estimate of unconstrained bycatch and to provide a means of equitably apportioning the Council approved PSC limits. The revised fishery PSC apportionments are listed in Table A2.

Results of this new scenario (Table A3, Tables 12, 13, and 14 [revised]) indicate that, for the unconstrained fisheries, total bycatch is predicted to be for C. bairdi, 2.557 million animals, for red king crab, 179 thousand animals, and for halibut, 11,500 mt. These increases, relative to the earlier unconstrained bycatch estimate, are due to increases in the weighted average catch rate for the other fishery and the greater preference expressed by industry for areas 511, 513, and 515.

Under the Council approved PSC limits the JVP flatfish fishery is expected to simultaneously attain the PSC apportionments for C. bairdi and halibut near the end of the first quarter, the DAP other fishery its halibut apportionment in May, the DAP flatfish fishery and the JVP other fishery their halibut apportionments in July, and the JVP other fishery its C. bairdi PSC apportionment in Zone 2 in November (Table A3).

Total predicted C. bairdi bycatch is 1,915,000 animals, a decrease of 642,000 animals from the unconstrained case. Total red king crab bycatch is predicted to be 128,700 animals, a decrease of 50,100 animals from the unconstrained scenario and total halibut bycatch is estimated to be 9,100 mt, a decrease of 2,400 mt from that predicted under the assumption of no PSC limits.

It has not yet been possible to evaluate the cost to the groundfish fleet of the relocation of effort to accommodate the closures, but the present value of bycatch saved is $1.25 million for C. bairdi, $743 thousand for red king crab, and $13.1 million for halibut, all relative to the unconstrained scenario.

Table A1. Bycatch rates used to estimate DAP and JVP "other" fishery bycatch (pollock/cod bottom trawl) under industry scenario.

Area	Quarter	*DAP* Cod Share	*JVP* Cod Share	*DAP RATES* Red king crab	C. bairdi	O. tanner	Halibut (mt/mt)	*JVP RATES* Red king crab	C. bairdi	O. tanner	Halibut (mt/mt)
511	1	29%	100%	0.4330	1.2119	0.2603	0.0063	0.2200	1.2900	0.3100	0.0081
513	1	29%	100%	0.0007	1.5367	0.9489	0.0056	0.0009	0.9900	0.5300	0.0107
515	1	29%	100%	0.0010	0.1247	0.0116	0.0298	0.0035	0.4300	0.0400	0.0112
511	2	9%	50%	0.1836	3.8107	0.3555	0.0063	0.2000	2.6750	0.3350	0.0071
513	2	9%	50%	0.0148	2.8196	5.3656	0.0146	0.0085	2.1800	3.2500	0.0102
514	2	9%	50%	0.0011	0.4536	11.2376	0.0015	0.0021	0.8800	23.3900	0.0042
515	2	9%	50%	0.0000	0.0126	0.0000	0.0353	0.0000	0.0700	0.0000	0.0258
521	2	9%	50%	0.0472	7.0576	0.7878	0.0113	0.0800	5.6800	1.3700	0.0193
522	2	9%	50%	0.0108	0.3600	4.7372	0.0026	0.0600	2.0000	3.5400	0.0145
511	3	12%	0%	0.0440	2.2316	0.1252	0.0042	0.0200	2.3600	0.1000	0.0037
513	3	12%	0%	0.0088	0.7268	5.3504	0.0135	0.0100	0.5000	6.0500	0.0017
514	3	12%	0%	0.0000	0.3548	16.4424	0.0015	0.0000	0.3500	17.8200	0.0016
515	3	12%	0%	0.0000	0.0168	0.0000	0.0017	0.0000	0.0000	0.0000	0.0000
521	3	12%	0%	0.0144	1.9760	0.9800	0.0056	0.0000	1.7000	0.8300	0.0024
522	3	12%	0%	0.0144	0.6208	0.3024	0.0064	0.0000	0.1600	0.0600	0.0033
513	4	12%	50%	0.0000	1.6512	29.7132	0.0029	0.0000	2.3200	16.9300	0.0069
515	4	12%	50%	0.0000	0.0012	0.0000	0.0030	0.0000	0.0050	0.0000	0.0123
521	4	12%	50%	0.0144	2.4952	2.8632	0.0096	0.0600	3.1450	2.5250	0.0180

Table A2. PSC limits (caps) as suggested by the Council and apportionment of those caps to the four fisheries in proportion to predicted annual bycatch. (Industry Scenario)

Caps and Allocation of Caps

Overall PSC Limits

Species	Zone 1	Zone 2	BSAI-wide
C. bairdi	846,500	1,988,500	-
Red king crab	135,000	-	-
Halibut	-	-	3,300

Fishery PSC Limits

	Species	Zone 1	Zone 2	BSAI-wide
	C. bairdi			
DAP-flatfish	(animals)	56,821	133,478	-
DAP-other		407,086	956,280	-
JVP-flatfish		161,955	380,446	-
JVP-other		220,638	518,297	-
		846,500	1,988,500	
	Red king crab			
DAP-flatfish	(animals)	14,952	-	-
DAP-other		4,359	-	-
JVP-flatfish		109,044	-	-
JVP-other		6,644	-	-
		135,000		
	Halibut			
DAP-flatfish	(metric tons)	-	-	118
DAP-other		-	-	2,257
JVP-flatfish		-	-	186
JVP-other		-	-	740
				3,300

PSC Limit Share, by Fishery

	C. bairdi	Red king crab	Halibut
DAP flatfish	6.71%	11.08%	3.57%
DAP other	48.09%	3.23%	68.38%
JVP flatfish	19.13%	80.77%	5.62%
JVP other	26.06%	4.92%	22.43%

Table A3. Predicted groundfish catch and prohibited species bycatch assuming the PSC limits of Table A2 are in place, by period and fishery.

BYCATCH SUMMARY

JANUARY-MARCH, 1989

	FISHERY			
	DAP		JVP	
Cumulative catch	Flatfish	Other	Flatfish	Other
Total groundfish, mt	46,209	85,709	163,235	56,775
"Target" catch, mt	34,534	77,743	121,994	51,498
Percent of annual catch	36%	11%	57%	27%
C. bairdi cap, Zone 1	56,821	407,086	161,955	220,638
C. bairdi bycatch, Zone 1	21,366	0	150,951	18,310
Cap attained?	No	No	Qtr end	No
C. bairdi cap, Zone 2	133,478	956,280	380,446	518,297
C. bairdi bycatch, Zone 2	22,812	116,793	0	42,155
Cap attained?	No	No	No	No
C. bairdi bycatch, all areas	44,178	119,821	150,951	60,465
Red king crab cap, Zone 1	14,952	4,359	109,044	6,644
Red king crab bycatch, Zone 1	11,870	0	83,860	3,123
Cap attained?	No	No	No	No
Red king crab bycatch, all areas	11,943	63	83,860	3,123
Halibut cap, mt, BSAI	118	2,257	186	740
Halibut bycatch, mt, BSAI	76	687	212	571
Cap attained?	No	No	Yes	No

APRIL, 1989

	FISHERY			
	DAP		JVP	
Cumulative catch	Flatfish	Other	Flatfish	Other
Total groundfish, mt	47,524	154,612	180,574	58,213
"Target" catch, mt	35,608	135,499	136,155	52,703
Percent of annual catch	37%	19%	51%	16%
C. bairdi cap, Zone 1	56,821	407,086	161,955	220,638
C. bairdi bycatch, Zone 1	23,732	7,873	150,951	19,592
Cap attained?	No	No	Qtr end	No
C. bairdi cap, Zone 2	133,478	956,280	380,446	518,297
C. bairdi bycatch, Zone 2	22,812	283,896	0	43,200
Cap attained?	No	No	No	No
C. bairdi bycatch, all areas	46,559	292,911	152,790	62,826
Red king crab cap, Zone 1	14,952	4,359	109,044	6,644
Red king crab bycatch, Zone 1	11,899	379	83,860	3,218
Cap attained?	No	No	No	No
Red king crab bycatch, all areas	11,989	1,309	85,932	3,223
Halibut cap, mt, BSAI	118	2,257	186	740
Halibut bycatch, mt, BSAI	77	1,847	231	591
Cap attained?	No	No	Yes	No

MAY, 1989

	FISHERY			
	DAP		JVP	
Cumulative catch	Flatfish	Other	Flatfish	Other
Total groundfish, mt	48,839	223,515	197,913	59,651
"Target" catch, mt	36,682	193,255	150,316	53,909
Percent of annual catch	38%	28%	56%	17%
C. bairdi cap, Zone 1	56,821	407,086	161,955	220,638
C. bairdi bycatch, Zone 1	26,099	15,746	150,951	20,874
Cap attained?	No	No	Qtr end	No
C. bairdi cap, Zone 2	133,478	956,280	380,446	518,297
C. bairdi bycatch, Zone 2	22,812	448,999	0	44,245
Cap attained?	No	No	No	No
C. bairdi bycatch, all areas	48,940	466,001	154,628	65,187
Red king crab cap, Zone 1	14,952	4,359	109,044	6,644
Red king crab bycatch, Zone 1	11,929	759	83,860	3,314
Cap attained?	No	No	No	No
Red king crab bycatch, all areas	12,034	2,555	88,004	3,322
Halibut cap, mt, BSAI	118	2,257	186	740
Halibut bycatch, mt, BSAI	79	3,007	249	612
Cap attained?	No	Yes	Yes	No

JUNE, 1989

	FISHERY			
	DAP		JVP	
Cumulative catch	Flatfish	Other	Flatfish	Other
Total groundfish, mt	50,155	292,418	215,252	61,089
"Target" catch, mt	37,757	251,012	164,477	55,114
Percent of annual catch	39%	36%	61%	17%
C. bairdi cap, Zone 1	56,821	407,086	161,955	220,638
C. bairdi bycatch, Zone 1	28,466	15,746	150,951	22,155
Cap attained?	No	No	Qtr end	No
C. bairdi cap, Zone 2	133,478	956,280	380,446	518,297
C. bairdi bycatch, Zone 2	22,812	448,999	0	45,289
Cap attained?	No	No	No	No
C. bairdi bycatch, all areas	51,320	494,031	156,466	67,547
Red king crab cap, Zone 1	14,952	4,359	109,044	6,644
Red king crab bycatch, Zone 1	11,959	759	83,860	3,410
Cap attained?	No	No	No	No
Red king crab bycatch, all areas	12,080	2,965	90,076	3,422
Halibut cap, mt, BSAI	118	2,257	186	740
Halibut bycatch, mt, BSAI	81	3,148	268	633
Cap attained?	No	Yes	Yes	No

	JULY, 1989				AUGUST, 1989				SEPTEMBER, 1989			
	FISHERY				FISHERY				FISHERY			
	DAP		JVP		DAP		JVP		DAP		JVP	
Cumulative catch	Flatfish	Other	Flatfish	Other	Flatfish	Other	Flatfish	Other	Flatfish	Other	Flatfish	Other
Total groundfish, mt	61,263	368,222	238,293	110,875	72,371	444,026	261,335	160,662	83,480	519,830	284,377	210,448
"Target" catch, mt	45,406	322,243	180,344	101,897	53,055	393,474	196,210	148,680	60,705	464,705	212,077	195,463
Percent of annual catch	48%	46%	67%	31%	56%	55%	74%	45%	65%	65%	80%	58%
C. bairdi cap, Zone 1	56,821	407,086	161,955	220,638	56,821	407,086	161,955	220,638	56,821	407,086	161,955	220,638
C. bairdi bycatch, Zone 1	28,466	15,746	150,951	45,655	28,466	15,746	150,951	45,655	28,466	15,746	150,951	45,655
Cap attained?	No	No	Qtr end	No	No	No	Qtr end	No	No	No	Qtr end	No
C. bairdi cap, Zone 2	133,478	956,280	380,446	518,297	133,478	956,280	380,446	518,297	133,478	956,280	380,446	518,297
C. bairdi bycatch, Zone 2	31,901	448,999	0	89,101	31,901	448,999	0	173,738	31,901	448,999	0	258,375
Cap attained?	No	No	No	No	No	No	No	No	No	No	No	No
C. bairdi bycatch, all areas	68,446	531,008	189,809	134,859	84,521	567,985	223,153	219,495	100,596	604,962	256,496	304,132
Red king crab cap, Zone 1	14,952	4,359	109,044	6,644	14,952	4,359	109,044	6,644	14,952	4,359	109,044	6,644
Red king crab bycatch, Zone 1	11,959	759	83,860	3,609	11,959	759	83,860	3,609	11,959	759	83,860	3,609
Cap attained?	No	No	No	No	No	No	No	No	No	No	No	No
Red king crab bycatch, all areas	13,666	3,510	90,815	3,821	14,022	4,056	91,554	3,821	14,378	4,602	92,292	3,821
Halibut cap, mt, BSAI	118	2,257	186	740	118	2,257	186	740	118	2,257	186	740
Halibut bycatch, mt, BSAI	111	3,447	320	751	136	3,747	371	871	161	4,046	423	990
Cap attained?	Qtr end	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

	OCTOBER, 1989				NOVEMBER, 1989				DECEMBER, 1989			
	FISHERY				FISHERY				FISHERY			
	DAP		JVP		DAP		JVP		DAP		JVP	
Cumulative catch	Flatfish	Other	Flatfish	Other	Flatfish	Other	Flatfish	Other	Flatfish	Other	Flatfish	Other
Total groundfish, mt	98,443	614,102	307,418	260,234	113,406	708,374	330,460	310,021	128,370	802,646	353,502	359,807
"Target" catch, mt	71,452	555,003	227,944	242,246	82,200	645,300	243,811	289,030	92,947	735,598	259,677	335,813
Percent of annual catch	77%	77%	87%	72%	88%	88%	93%	86%	100%	100%	100%	100%
C. bairdi cap, Zone 1	56,821	407,086	161,955	220,638	56,821	407,086	161,955	220,638	56,821	407,086	161,955	220,638
C. bairdi bycatch, Zone 1	28,466	15,746	150,951	45,655	28,466	15,746	150,951	45,655	28,466	15,746	150,951	45,655
Cap attained?	No	No	Qtr end	No	No	No	Qtr end	No	No	No	Qtr end	No
C. bairdi cap, Zone 2	133,478	956,280	380,446	518,297	133,478	956,280	380,446	518,297	133,478	956,280	380,446	518,297
C. bairdi bycatch, Zone 2	31,901	448,999	0	414,953	31,901	448,999	0	571,531	31,901	448,999	0	571,531
Cap attained?	No	No	No	No	No	No	No	Yes	No	No	No	Yes
C. bairdi bycatch, all areas	128,885	650,948	289,639	460,710	157,174	696,934	323,182	617,288	185,463	742,920	356,526	629,983
Red king crab cap, Zone 1	14,952	4,359	109,044	6,644	14,952	4,359	109,044	6,644	14,952	4,359	109,044	6,644
Red king crab bycatch, Zone 1	11,959	759	83,860	3,609	11,959	759	83,860	3,609	11,959	759	83,860	3,609
Cap attained?	No	No	No	No	No	No	No	No	No	No	No	No
Red king crab bycatch, all areas	15,498	5,281	93,031	6,808	16,618	5,959	93,770	9,795	17,738	6,638	94,509	9,795
Halibut cap, mt, BSAI	118	2,257	186	740	118	2,257	186	740	118	2,257	186	740
Halibut bycatch, mt, BSAI	255	4,419	475	1,886	349	4,791	527	2,782	443	5,183	579	2,904
Cap attained?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 12. Summary of results: predicted total groundfish catch and predicted total prohibited species catch. (Revised)

Simulation	*Total Groundfish catch 1/* (mt)	*Total Bycatch* C. bairdi (animals)	Red king crab (animals)	Halibut (mt)
Unconstrained	1,426,500	2,152,000	94,300	8,700
Council PSC limits	1,426,500	2,213,000	90,400	6,680
Halibut PSC at 3,900 mt	1,426,500	2,212,000	90,400	6,680
Groundfish catch foregone	906,800	1,458,000	86,300	4,770
Doubled flatfish crab bycatch rate	1,426,500	2,470,000	154,100	6,100
Industry scenario, unconstrained	1,426,500	2,557,000	178,800	11,500
Industry scenario	1,426,500	1,915,000	128,700	9,100

1 / Excludes mid-water pollock, Atka mackerel, and groundfish taken with fixed gear.

Table 13. Summary of results: predicted change in total groundfish catch and prohbited species catch, relative to unconstrained simulation.

Relative Change

Simulation	Groundfish catch (mt)	C. bairdi (animals)	Red king crab (animals)	Halibut (mt)
Council PSC limits	0	61,000	(3,900)	(2,020)
Halibut PSC at 3,900 mt	0	60,000	(3,900)	(2,020)
Groundfish catch foregone	(519,700)	(694,000)	(8,000)	(3,930)
Doubled flatfish crab bycatch rate	0	318,000	59,800	(2,600)
Industry scenario	0	(642,000)	(50,100)	(2,400)

Table 14. Summary of results: predicted change in total groundfish gross revenue and profit and prohibited species catch value, relative to unconstrained simulation.

Relative Change

Simulation	*Groundfish value lost, millions of dollars* DAP Gross revenue	DAP Profits	JVP Gross revenue	JVP Profits	*Bycatch value lost, thousands of dollars* C. bairdi (animals)	Red king crab (animals)	Halibut (mt)
Council PSC limits	0	$10.1-$36.5	0	$0.2-$1.5	$119	($58)	($11,047)
Halibut PSC at 3,900 mt	0	N/A	0	N/A	$117	($58)	($11,047)
Groundfish catch foregone	$234	N/A	$20	N/A	($1,353)	($119)	($21,493)
Doubled flatfish crab bycatch rate	0	N/A	0	N/A	$620	$887	($14,219)
Industry scenario	0	N/A	0	N/A	($1,252)	($743)	($13,126)

Source: DAP groundfish valued at $1.00/lb, wholesale, processed weight, using an overall conversion factor of 27% (Wiese and Burden, 1988).
JVP groundfish valued at $162/mt, ex-vessel, round weight (Wiese and Burden, 1988).
Change in profits is change in revenue minus change in cost (costs are shown in Table 11).
Values for halibut and crab are wholesale present values; unit values are from Table 2.19, BSAI Amendment 12A EA/RIR/IRFA.

Table 10. Estimated catch per unit effort by area, fishery, and quarter.

Metric tons per hour, 1987

Fishery/ Quarter	Areas 511	513	514	515	521	522	540
Flatfish							
1	14.8	10.9	6.7	0.0	0.0	0.0	0.0
2	16.5	4.0	7.2	4.0	3.8	2.2	0.0
3	0.0	7.5	7.5	0.0	4.0	3.2	0.0
4	0.0	7.5	8.0	0.0	0.0	0.0	0.0
Pollock-Cod Bottom Trawl							
1	13.7	6.2	0.0	3.0	0.0	0.0	0.0
2	10.0	6.0	3.8	4.2	12.4	4.2	10.2
3	6.3	9.6	3.0	4.2	9.4	3.2	8.5
4	0.0	10.1	3.0	4.2	4.2	0.0	0.0

Metric tons per day, 1988

Fishery/ Quarter	Areas 511	513	514	515	521	522	540
Flatfish							
1	72.2	73.1	48.0	0.0	0.0	0.0	0.0
2	53.5	53.4	51.7	64.2	39.2	44.3	0.0
3	0.0	64.7	54.3	0.0	53.0	64.6	0.0
4	0.0	63.3	56.2	0.0	0.0	0.0	0.0
Pollock-Cod Bottom Trawl							
1	48.8	51.9	0.0	37.7	0.0	0.0	0.0
2	81.0	41.5	103.1	53.1	38.7	20.3	25.0
3	66.0	93.2	82.4	51.0	92.2	61.2	45.6
4	0.0	45.8	13.7	50.0	71.5	0.0	0.0

Notes: Both measures of catch per unit of effort were generated using NMFS Observer Program data for the joint venture fisheries. The catch per hour trawled data are for 1987; however, if no data were available for an area, quarter, and fishery, estimates were made by adjusting 1987 data for other cells using 1988 catch per day on grounds data. The catch per processing vessel day on grounds data are for 1988. A value of 0.0 appears in each cell for which no fishing occurred in 1988.

Table 11. Estimated effects on effort and harvesting cost by fishery, measure of effort, and harvest cost scenario.

Estimated effects based on catch per hour data

	Percentage Change			Change in Total Cost ($ million)	
Fishery	Effort	TC A	TC B	A	B
Joint Venture Flatfish	-2.4	-0.7	-0.7	-0.3	-0.3
Joint Venture Other BT	19.2	5.8	5.7	1.8	1.8
Domestic Flatfish	-0.5	-0.1	-0.1	-0.0	-0.1
Domestic Other BT	33.1	6.5	7.9	30.4	36.6
Total				31.8	38.0

Estimated effects based on catch per day data

	Percentage Change			Change in Total Cost ($ million)	
Fishery	Effort	TC A	TC B	A	B
Joint Venture Flatfish	1.2	0.4	0.4	0.2	0.1
Joint Venture Other BT	1.7	0.5	0.5	0.2	0.2
Domestic Flatfish	1.0	0.2	0.2	0.2	0.2
Domestic Other BT	10.8	2.1	2.6	9.9	11.9
Total				10.5	12.4

Notes: TC denotes total harvesting and processing costs. The two base case cost scenarios are A and B. With case A for domestic fisheries, catch, the portion of variable cost assumed to depend on CPUE, and total cost per vessel year are 12,300 metric tons, $1.41 million, and $7.22 million, respectively. The corresponding values for case B in domestic fisheries are 7,400 metric tons, $1.02 million, and $4.27 million. For joint ventures, case A catch, portion of variable cost dependent upon CPUE, and total cost per vessel year are 11,100 mt, $0.5 million, and $1.63 million, respectively. Joint venture case B values are 7,600 mt, $0.33 million, and $1.12 million.