AGENDA F-3
December, 1980

MEMORANDUM

TO: Council, SSC, and AP Members

FROM: Jim H. Branson
Executive Director

DATE: December 3, 1980

SUBJECT: Draft final reports for Halibut Pot Study and the Natural Resources Consultants' Study on Offshore Chinook and Coho

ACTION REQUIRED

Preliminary review.

BACKGROUND

We have received draft final reports for Contract 81-3, "A Comparison of Halibut and Crab Catches in Side-Entry and Top-Entry Crab Pots and Side-Entry Crab Pots With and Without Tanner Boards" and Contract 80-5, "A Study of the Offshore Chinook and Coho Salmon Fishery Off Alaska".

The Halibut Pot report is in your notebooks for your review and comment. The Salmon report arrived late last week, is very long, and will be printed and distributed for your review shortly after the Council meeting. A limited number of copies of the Salmon report have been made available to the SSC Salmon Working Group to initiate the review.

CP

DRAFT FINAL

A comparison of halibut and crab catches in: (1) side-entry and top-entry crab pots; and (2) side-entry crab pots with and without tanner boards.

CONTRACT NO. 81-3

North Pacific Fishery Management Council

November 20, 1980

Prepared by

Gregg H. Williams

Donald A. McCaughran

Stephen H. Hoag

International Pacific Halibut Commission

and

Timothy M. Koeneman

Alaska Department of Fish and Game

EXECUTIVE SUMMARY

This is the draft final report for contract 81-3 (a comparison of crab and halibut catches in several types of crab pots) between the North Pacific Fishery Management Council (NPFMC) and the International Pacific Halibut Commission (IPHC). Tasks 1 and 2 have been completed. Task 3 entails analysis and reporting of the results, which is the basis for this report.

It is widely known that Pacific halibut (Hippoglossus stenolepis) are captured in pots used in the king and Tanner crab fisheries in the Gulf of Alaska and Bering Sea. Many types of crab pots are used in these fisheries and fishermen report that top-entry pots catch fewer halibut per unit of fishing time than side-entry pots. Using "tanner boards" in side-entry pots is also believed to reduce the incidental catch of halibut. Data have been unavailable, however, to substantiate these hypotheses. At the July 1980 meeting of NPFMC, IPHC and the Alaska Department of Fish and Game (ADF&G) proposed a study to investigate the incidence of halibut and the catch of crab in top-entry and side-entry crab pots and in side-entry pots with "tanner boards". Funding of $50,000 was requested and approved.

The study was divided into two experiments. Experiment I, comparing halibut and Tanner crab catches in side-entry and top-entry crab pots, took five days to complete. Forty pots were fished each day. Experiment II, comparing halibut and Tanner crab catches in side-entry pots with and without "tanner boards", took three days to complete. Twenty pots were fished each day.

Results from Experiment I show a much higher catch of halibut in side-entry pots than in top-entry pots: The catch per pot-lift was 1.43 in side-entry pots, compared to 0.04 for top-entry pots. Side-entry pots also

caught more Tanner crab. Catch per pot-lift was 3.85 in side-entry pots and 2.78 in top-entry pots.

In Experiment II, "tanner boards" reduced the catch of halibut in side-entry pots by 63%. The number of halibut per pot-lift was 0.60 for pots with "tanner boards" and 1.62 for pots without "tanner boards". Perhaps more importantly, the use of "tanner boards" almost eliminated the catch of halibut over 90 cm in length.

Using "tanner boards" resulted in increased Tanner crab catches. Pots with "tanner boards" caught 15.53 crab per pot-lift; pots without "tanner boards" caught 10.34 crab per pot-lift. The increase in catch is likely the result of reducing the size of the tunnel opening and thereby allowing fewer crab to escape the pot.

In view of the data collected during the two studies, we make the following recommendations: (1) Further gear research should be conducted to determine if side-entry pots can be modified to significantly reduce halibut loss with little cost; (2) An observer program should be conducted to confirm the results of this study and establish rates of incidence in the commercial fishery; and (3) The commercial fishery should be monitored to determine if existing regulations on the use of "tanner boards" are being followed.

TABLE OF CONTENTS

	Page
Executive Summary	1
List of Tables	4
List of Abbreviations and Symbols	5
Acknowledgments	6
Introduction	7
Objectives	8
Method	9
Materials	9
Design	9
Results	11
Analysis	11
Experiment I: Side-Entry Pots versus Top-Entry Pots	11
Experiment II: Side-Entry Pots With and Without "Tanner Boards"	14
Condition of Halibut	16
Conclusions	17
Recommendations	18
Key Words	19
Appendix	20

LIST OF TABLES

Page

Table 1. Summary of data collected during pot comparison studies 12

Table 2. Summary of the results from Analysis of Variance for Experiments I and II 13

LIST OF ABBREVIATIONS AND SYMBOLS

Alaska Department of Fish and Game	ADF&G
centimeter	cm
International Pacific Halibut Commission	IPHC
kilogram	kg
North Pacific Fishery Management Council	NPFMC

ACKNOWLEDGMENTS

INTRODUCTION

Pacific halibut (Hippoglossus stenolepis) stocks in the northeast Pacific and Bering Sea have declined dramatically since the 1950's and 1960's. Although the decline is a result of several factors, incidental catches in the foreign groundfish and domestic crab fisheries have played a major role. Information on the incidental catch of halibut in the crab fishery is lacking, although reports from fishermen and research cruises by the Alaska Department of Fish and Game (ADF&G) suggest that the incidental catch of halibut is substantial. Using incidence rates from ADF&G cruises, the International Pacific Halibut Commission (IPHC) estimates that 1.6 and 2.0 million pounds of halibut were caught in the king and Tanner crab fisheries, respectively, in the Gulf of Alaska during the 1979/1980 season.

Certain pot designs may catch more halibut than other designs. Fishermen report that top-entry pots (either conical or pyramid in shape) catch fewer halibut per unit of fishing time than side-entry pots (rectangular in shape). It has also been suggested that "tanner boards", which reduce the size of the tunnel entrance in side-entry pots, reduce the incidence of halibut. However, data were unavailable to substantiate these hypotheses.

Consequently, ADF&G and IPHC proposed that the North Pacific Fishery Management Council (NPFMC) fund a study to compare the incidence of halibut in top-entry and side-entry pots. The proposal did not include a study on the effect of "tanner boards" because of concern for the amount of time required to compare the two pot types. However, a satisfactory pot-type comparison was accomplished and, therefore, time was available to test the effect of "tanner boards".

Funding by the Council was approved at the July 1980 meeting and the study was conducted during August 1980. The results from the study are provided in this report.

OBJECTIVES

(1) Test the hypothesis that top-entry crab pots catch fewer halibut (per unit soak time) than side-entry (rectangular) pots.

(2) Test the effectiveness of the two pot types in catching crab.

(3) Test the hypothesis that "tanner boards" reduce the catch of halibut in side-entry pots.

Task 1 Devise a statistically appropriate experimental design to meet the project objectives.

Task 2 Subcontract to the Alaska Department of Fish and Game (ADF&G) for a two-week vessel charter to implement the study design.

Task 3 Analyze data from the experiment and report their interpretation relative to objectives.

METHOD

Materials

The 125-foot crab vessel M/V ANTARES was chartered from August 5 to August 18, 1980 for the study. The crew consisted of the captain and four crewmen. Scientific personnel included one ADF&G biologist and two IPHC biologists.

The side-entry pots used in the study belonged to ADF&G, whereas the top-entry pots were leased from a Westport, Washington fisherman. The ADF&G pots, which are used in annual crab index surveys, are 80 inches (203 cm) square on the top and bottom and are 30 inches (76 cm) in height. These pots weigh approximately 750 pounds (340 kg) each. The top-entry pots are 68 inches (173 cm) square at the base, 34 inches (86 cm) square at the top and have a height of 30 inches (76 cm). They weigh approximately 200 pounds (91 kg) each. Tunnel opening dimensions are 8 inches by 36 inches (20 cm by 91 cm) on the side-entry pots; the top-entry pots have round tunnels, 23.5 inches (60 cm) in diameter at the top and 15 inches (38 cm) in diameter at the bottom, and a vertical depth of 9 inches (23 cm). Webbing is a 3.5-inch (9 cm) stretch mesh on the side-entry pots and 7-inch (18 cm) stretch mesh on the top-entry pots. The "tanner boards" used in the study were made of spruce and were 4 inches by 38 inches (10 cm by 97 cm) in size.

Design

The operation was divided into two experiments. Experiment I examined the differences in the halibut and Tanner crab catches in top-entry and side-entry crab pots. This experiment took place from August 8 to August 13 and consisted of five days of setting and hauling pots (setting preceded hauling by one day). Experiment II examined the differences in the halibut and Tanner crab catches

in side-entry pots with and without "tanner boards". It took place from August 13 to August 16 and consisted of three days of setting and hauling pots.

The pots were usually set from 1300 to 1500 hours and hauled back the following morning from 0730 to 1200 hours. Soak time generally averaged 19 hours. Two one-quart plastic containers with chopped herring were used for bait.

In Experiment I, the pots were laid out in a 4 x 10 latin rectangle design. Each pot type occurred in each row and column an equal number of times, allowing depth and horizontal changes in habitat to be removed from the comparison of pot type. A total of 40 pots were fished each day, resulting in a total of 100 observations for each pot type (not adjusting for lost or unbaited pots). The schematic arrangement was:

Line 1	X	O	X	O	X	O	X	O	X	O
2	O	X	O	X	O	X	O	X	O	X
3	X	O	X	O	X	O	X	O	X	O
4	O	X	O	X	O	X	O	X	O	X

In Experiment II, the pots were arranged in a 2 x 10 latin rectangle design. Side-entry pots with "tanner boards" and without "tanner boards" were placed in equal numbers in each row and column to allow the analytical removal of the depth effect and any horizontal change in habitat. The schematic arrangement was:

Line 1	X	O	X	O	X	O	X	O	X	O
2	O	X	O	X	O	X	O	X	O	X

The distance between lines and pots in both experiments was held constant within each day but varied slightly among days. The pots were set along C-Loran lines and the distance between lines varied from 2.25 nautical miles (4.2 kilometers) to 5 nautical miles (9.3 kilometers). The distance between pots within a line varied from 0.25 nautical miles (0.5 kilometers) to 0.50 nautical miles (0.93 kilometers).

All of the halibut and Tanner crab were counted and those halibut alive were tagged. The left otolith was removed from the dead halibut to determine age. Shell condition and sex were recorded for all Tanner crab. All other species caught in the pots were counted and economically important species such as lingcod (Ophiodon elongatus) and Pacific cod (Gadus macrocephalus) were measured.

RESULTS

Table 1 summarizes the overall results from Experiments I and II. Table 2 summarizes the results from the analysis of variance tests. Detailed information on the halibut and Tanner crab catch in each pot is given in Appendix Tables 1 and 2. Summaries of the size composition of the Tanner crab catch for each experiment are in Appendix Tables 3 and 4. Appendix Table 5 shows the catch of species other than halibut and Tanner crab and Appendix Table 6 gives the fishing location for each line of pots.

Analysis

An analysis of variance was performed on each day's results. Within each experiment, each day was considered independently since the fishing locations changed daily. No suitable transformation was obvious, so reliance was placed on the robust properties of the analysis of variance. Results were tested at the $p = 0.01$ level of significance. In Experiment I, data for an unbaited pot and a lost pot were filled in by use of missing plot formula. In Experiment II one pot was lost, and in the analysis the column that contained the missing pot was deleted. Results of the analysis of variance are in Appendix Tables 7 and 8.

Experiment I: Side-Entry Pots versus Top-Entry Pots

The results from Experiment I clearly show a much higher incidence of halibut in side-entry pots than in top-entry pots: the catch per pot-lift was 1.43

Table 1. Summary of data collected during pot comparison studies. Weight of halibut is in pounds, heads-off, eviscerated. Length is fork length in centimeters.

Pot Type	No. of Pot-lifts*	Halibut				Tanner Crab		No. Halibut per crab	No. Other Fish
		No. of Fish	Catch per Pot-lift	Avg. Wgt.	Avg. Lgth	No.	Catch Per Pot-lift		
Experiment I									
Side-entry	98	140	1.43	16.1	88.5	377	3.85	0.37	51
Top-entry	100	4	0.04	6.0	65.5	278	2.78	0.01	2
Total	198	144	0.73	15.8	87.9	655	3.31	0.22	53
Experiment II									
Side-entry w/o Boards	29	47	1.62	15.8	88.4	300	10.34	0.16	3
Side-entry w/ Boards	30	18	0.60	10.6	79.2	466	15.53	0.04	3
Total	59	65	1.10	14.4	85.8	766	12.98	0.08	6

*Excludes lost pots and unbaited pots.

Table 2. Summary of the results from analysis of variance for Experiments I and II. The test for significance was made on the catches between the two pot types in each experiment at the p = 0.01 level.

Experiment I

	Day 1	Day 2	Day 3	Day 4	Day 5
Catch of halibut	Significant difference (F=27.07)	Significant difference (F=73.14)	Significant difference (F=35.87)	Significant difference (F=9.61)	Significant difference (F=41.22)
Catch of Tanner crab	No significant difference (F=0.03)	Significant difference (F=11.36)	No significant difference (F=0.06)	Significant difference (F=4.14)	No significant difference (F=0.36)

Experiment II

	Day 1	Day 2	Day 3
Catch of halibut	Significant difference (F=12.50)	No significant difference (F=2.75)	Significant difference (F=10.49)
Catch of Tanner crab	No significant difference (F=0.08)	No significant difference (F=0.68)	Significant difference (F=10.67)

for side-entry pots, compared to 0.04 for top-entry pots. The average size of halibut was lower for top-entry pots (6.0 pounds versus 16.1 pounds), but the sample size (four fish) was small. The analysis of variance showed that top-entry pots caught significantly fewer halibut on each of the five days of the experiment (Table 2).

Side-entry pots also caught more Tanner crab. Catch per pot-lift was 2.78 in top-entry pots and 3.85 in side-entry pots. However, the analysis of variance shows that there was no significant difference in the crab catches by the two pot types for three days, although on four days more Tanner crab were caught in side-entry pots than in top-entry pots. These results may be somewhat biased by the larger size mesh on the top-entry pots, which would allow some female and smaller male crab to escape.

An overall comparison between the two pot types may be made by examining the ratio of the number of halibut per Tanner crab. In this experiment the ratio differed greatly: side-entry pots caught 0.37 halibut per Tanner crab and top-entry pots caught 0.01 halibut per Tanner crab (Table 1). This further illustrates the significantly lower halibut catch in top-entry pots.

Experiment II: Side-Entry Pots With and Without "Tanner Boards"

In Experiment II, "tanner boards" reduced the catch of halibut in side-entry pots by 63%. The number of halibut per pot-lift was 0.60 for pots with "tanner boards" and 1.62 for pots without "tanner boards" (Table 1). However, the analysis of variance indicates that on only two of the three days of the experiment the catch of halibut was significantly lower in the pots with "tanner boards".

Perhaps more importantly, halibut caught in pots using "tanner boards" averaged smaller in length and weight than those caught in pots not using

"tanner boards" (Table 1). A more detailed examination shows that "tanner boards" reduce the catch of all sizes encountered in the study, but almost eliminate the catch of halibut over 90 cm in length. The catch per pot-lift by length group was as follows:

	Length Group (cm)					
	<70	70-79	80-89	90-99	100-109	109>
w/o boards	0.10	0.45	0.31	0.34	0.14	0.21
w/ boards	0.07	0.23	0.23	0.03	0.03	0.00

Using "tanner boards" resulted in increased Tanner crab catches. Pots with "tanner boards" caught 15.53 crab per pot-lift; pots without "tanner boards" caught 10.34 crab per pot-lift (Table 1). On one day of the experiment there was a significant increase in the number of Tanner crab caught in pots using "tanner boards". On the other days more crab were caught in pots using "tanner boards", but the analysis of variance procedure indicates the difference in the catches between the two pot types was not statistically significant (Table 2).

The increased crab catches by pots using "tanner boards" is likely the result of increased retention of crabs by the pots. Because the tunnel opening faces upward in side-entry pots, crab crawling on the top of the tunnel in the pot find it relatively easy to drop through the opening and escape the pot. Placing the boards over the tunnel opening decreases the size of the opening and makes it difficult for crab to escape the pot in this manner. Hence, more crab are retained by the pot.

The number of halibut per crab was 75% lower when "tanner boards" were used. Pots without "tanner boards" caught 0.16 halibut per crab and pots with "tanner boards" caught 0.04 halibut per crab (Table 1).

Condition of Halibut

Nearly all of the halibut caught suffered from minor abrasions caused by either struggling in the pot or being in contact with crab. However, most (79%) of the halibut were active and considered to have a high survival potential. About 10% were dead and these were partially eaten by sand fleas.

These results, however, should not be extended to the commercial fishery, where fishing conditions are considerably different. Soak times are generally much longer than what was made in these experiments. In addition, higher catch rates of over 100 legal crab per pot will probably reduce the viability of halibut considerably.

CONCLUSIONS

1. Halibut catches are substantially lower in top-entry crab pots than in side-entry crab pots.
2. Crab catches are somewhat lower in top-entry crab pots than in side-entry crab pots.
3. The use of "tanner boards" reduces the catch of halibut in side-entry pots and almost eliminates the catch of halibut over 90 cm in length.
4. Crab catches are much higher in side-entry crab pots when "tanner boards" are used.

RECOMMENDATIONS

In view of the data collected during the two studies, the following recommendations are made:

(1) Further gear research should be conducted to determine if side-entry pots can be modified to significantly reduce halibut loss with little cost. Ideas include: (a) an escape opening under the door panel to allow small halibut to leave the pot; (b) a vertical bar half-way across the tunnel opening to prevent large halibut from entering the pot; (c) an escape opening in the top of the pot which would allow fish of all species to escape.

(2) An observer program should be conducted to confirm the results of this study and establish rates of incidence in the commercial fishery.

(3) The commercial fishery should be monitored to determine if existing regulations on the use of tanner boards are being followed.

KEY WORDS

Pacific halibut

Tanner crab

incidental catch

crab pots

APPENDIX

Table 1. Detailed catch data from Experiment I: Comparison of crab and halibut catches in top-entry (TE) and side-entry (SE) crab pots. 21

Table 2. Detailed catch data from Experiment II: Comparison of crab and halibut catches in side-entry crab pots with (WB) and without (WOB) tanner boards. 26

Table 3. Size composition of the Tanner Crab catch in Experiment I by sex and pot type. Carapace width is in mm. 28

Table 4. Size composition of the Tanner Crab catch in Experiment II by sex and pot type. Carapace width is in mm. 29

Table 5. Catch of species other than halibut and crab by experiment and pot type. 30

Table 6. Fishing locations during Experiments I and II. 31

Table 7. Results from analysis of variance on Experiment I. 32

Table 8. Results from analysis of variance on Experiment II. 33

Appendix Table 1. Detailed catch data from Experiment I: Comparison of crab and halibut catches in top-entry (TE) and side-entry (SE) crab pots.

Date	Line	Pot Type	Depth (fathoms)	Soak (hours)	Halibut Number	Halibut Lengths (cm)	Number of Tanner Cra
August 9	1	SE	33	22:41	0		0
		TE	35	22:43	0		0
		SE	37	22:46	1	103	0
		TE	41	22:52	0		0
		SE	45	22:55	1	49	0
		TE	50	22:59	0		1
		SE	53	23:03	3	82, 120, 72	1
		TE	56	23:07	0		6
		SE	60	23:12	1	87	18
		TE	63	23:18	1	54	21
August 9	2	TE	32	24:08	0		0
		SE	36	24:04	Not	Baited	0
		TE	39	23:59	0		0
		SE	43	23:57	2	81, 83	0
		TE	45	23:52	0		0
		SE	47	23:49	2	87, 112	0
		TE	50	23:45	0		0
		SE	53	23:40	0		0
		TE	55	23:35	0		1
		SE	57	23:33	2	83, 107	5
August 9	3	SE	30	24:06	6	76, 94, 81, 86, 68, 95	0
		TE	32	24:08	0		0
		SE	35	24:13	2	84, 107	0
		TE	38	24:16	0		0
		SE	40	24:17	1	60	0
		TE	42	24:21	0		0
		SE	45	24:24	2	99, 80	0
		TE	47	24:27	0		0
		SE	50	24:30	2	65, 87	0
		TE	52	24:33	0		0
August 9	4	TE	30	24:55	0		0
		SE	33	24:51	2	94, 99	0
		TE	36	24:49	0		0
		SE	38	24:46	2	74, 84	0
		TE	40	24:43	0		0
		SE	42	24:41	2	122, 109	0
		TE	44	24:39	0		0
		SE	45	24:38	2	73, 73	0
		TE	47	24:37	0		0
		SE	50	24:31	1	93	1

Appendix Table 1. Detailed catch data from Experiment I: Comparison of crab and halibut catches in top-entry (TE) and side-entry (SE) crab pots.

Date	Line	Pot Type	Depth (fathoms)	Soak (hours)	Halibut Number	Halibut Lengths (cm)	Number of Tanner Cra
August 10	5	TE	32	16:51	0		0
		SE	32	16:54	1	58	0
		TE	32	16:55	0		0
		SE	33	16:58	2	83, 111	0
		TE	34	17:01	0		0
		SE	35	17:03	2	-, -	0
		TE	36	17:07	0		0
		SE	41	17:08	1	75	0
		TE	50	17:10	0		0
		SE	57	17:13	2	62, 78	0
August 10	6	SE	41	18:06	2	92, 84	0
		TE	42	18:04	0		0
		SE	43	18:00	1	82	0
		TE	45	17:56	0		0
		SE	47	17:53	2	107, 106	0
		TE	50	17:49	0		0
		SE	52	17:46	0		0
		TE	56	17:41	1	85	0
		SE	62	17:37	3	77, 100, 91	
		TE	75	17:34	0		0
August 10	7	TE	47	18:10	0		0
		SE	48	18:13	2	94, 64	0
		TE	49	18:15	0		0
		SE	50	18:16	2	71, 84	1
		TE	52	18:17	0		0
		SE	53	18:19	2	81, 82	0
		TE	55	18:21	0		0
		SE	57	18:23	3	67, 89, 81	0
		TE	61	18:30	0		0
		SE	67	18:31	2	103, -	0
August 10	8	SE	53	19:03	2	61, 75	0
		TE	53	19:00	0		0
		SE	53	18:57	0		1
		TE	54	18:54	0		0
		SE	55	18:51	1	61	2
		TE	55	18:49	0		0
		SE	56	18:46	2	108, 94	1
		TE	58	18:43	0		0
		SE	63	18:39	1	91	0
		TE	66	18:34	0		

Appendix Table 1. Detailed catch data from Experiment I: Comparison of crab and halibut catches in top-entry (TE) and side-entry (SE) crab pots.

Date	Line	Pot Type	Depth (fathoms)	Soak (hours)	Halibut Number	Halibut Lengths (cm)	Number of Tanner Cra
August 11	9	SE	56	17:56	1	81	0
		TE	57	17:58	0		0
		SE	58	18:01	1	96	0
		TE	57	18:03	0		3
		SE	59	18:06	3	83, 108, 106	3
		TE	61	18:10	0		3
		SE	62	18:13	1	104	1
		TE	63	18:16	0		0
		SE	64	18:19	2	110, 86	0
		TE	67	18:22	0		0
August 11	10	TE	53	19:03	0		0
		SE	53	18:59	2	140, -	0
		TE	54	18:57	0		0
		SE	55	18:55	3	92, 71, 89	1
		TE	55	18:52	0		0
		SE	56	18:49	1	116	0
		TE	58	18:46	0		0
		SE	60	18:43	0		0
		TE	63	18:41	0		0
		SE	67	18:37	3	118, 110, 84	0
August 11	11	SE	46	19:03	4	80, 98, 76, 77	0
		TE	46	19:06	0		0
		SE	48	19:09	2	89, 77	0
		TE	49	19:11	0		0
		SE	51	19:13	1	128	0
		TE	53	19:16	0		0
		SE	55	19:18	1	74	0
		TE	59	19:21	0		0
		SE	63	19:23	1	76	0
		TE	68	19:26	0		0
August 11	12	TE	40	19:51	0		0
		SE	40	19:49	1	70	0
		TE	40	19:47	0		0
		SE	42	19:44	1	98	0
		TE	45	19:42	0		0
		SE	47	19:39	1	119	0
		TE	50	19:37	1	58	0
		SE	54	19:34	2	112, 82	0
		TE	59	19:31	0		0
		SE	71	19:28	1	93	0

Appendix Table 1. Detailed catch data from Experiment I: Comparison of crab and halibut catches in top-entry (TE) and side-entry (SE) crab pots.

Date	Line	Pot Type	Depth (fathoms)	Soak (hours)	Halibut Number	Halibut Lengths (cm)	Number of Tanner Cra
August 12	13	TE	25	15:52	0		0
		SE	38	15:55	2	69,94	0
		TE	50	15:58	0		2
		SE	60	16:03	1	117	5
		TE	66	16:05	0		5
		SE	72	16:08	0		9
		TE	78	16:10	0		18
		SE	83	16:13	0		27
		TE	89	16:14	0		15
		SE	91	16:20	0		14
August 12	14	SE	44	16:56	3	61,61,76	0
		TE	54	16:53	0		2
		SE	62	16:50	0		6
		TE	67	16:47	0		6
		SE	75	16:44	0		17
		TE	79	16:42	0		14
		SE	83	16:38	0		22
		TE	86	16:34	0		22
		SE	91	16:31	0		3
		TE	94	16:28	0		26
August 12	15	TE	24	17:00	0		0
		SE	38	17:01	2	92,77	2
		TE	46	17:06	0		1
		SE	52	17:09	0		3
		TE	61	17:11	0		2
		SE	69	17:14	Lost	Pot	0
		TE	76	17:16	0		7
		SE	82	17:21	0		37
		TE	87	17:25	0		18
		SE	92	17:30	0		24
August 12	16	SE	9	17:55	1	110	0
		TE	15	17:54	0		0
		SE	28	17:49	1	86	0
		TE	39	17:48	0		0
		SE	47	17:45	3	69,71,94	0
		TE	55	17:42	0		2
		SE	65	17:40	0		2
		TE	75	17:37	0		6
		SE	80	17:33	1	84	36
		TE	88	17:28	0		

Appendix Table 1. Detailed catch data from Experiment I: Comparison of crab and halibut catches in top-entry (TE) and side-entry (SE) crab pots.

Date	Line	Pot Type	Depth (fathoms)	Soak (hours)	Halibut Number	Halibut Lengths (cm)	Number of Tanner Crab
August 13	17	SE	40	17:44	1	117	0
		TE	37	17:48	0		0
		SE	34	17:51	1	84	0
		TE	76	17:52	0		2
		SE	77	18:11	0		11
		TE	65	18:14	0		0
		SE	79	18:16	0		9
		TE	20	18:19	0		0
		SE	18	18:21	1	53	0
		TE	30	18:25	0		0
August 13	18	TE	84	19:06	0		3
		SE	82	19:03	0		2
		TE	83	18:59	0		4
		SE	60	18:58	1	100	6
		TE	50	18:56	0		1
		SE	35	18:54	1	110	0
		TE	53	18:50	0		0
		SE	80	18:47	1	101	10
		TE	80	18:43	0		3
		SE	71	18:41	3	74, 110, 118	1
August 13	19	SE	84	19:10	2	77, 79	6
		TE	83	19:12	0		8
		SE	46	19:15	2	71, 92	0
		TE	55	19:17	0		9
		SE	61	19:20	2	80, 81	15
		TE	65	19:22	0		16
		SE	60	19:24	2	82, 95	1
		TE	72	19:28	0		18
		SE	71	19:29	3	92, 92, 134	11
		TE	72	19:31	0		11
August 13	20	TE	14	19:57	0		0
		SE	20	19:54	1	91	0
		TE	47	19:51	0		1
		SE	57	19:48	0		9
		TE	50	19:46	0		0
		SE	38	19:44	2	79, 115	0
		TE	39	19:42	1	65	0
		SE	64	19:39	2	98, 91	15
		TE	64	19:36	0		12
		SE	63	19:34	2	69, 71	10

Appendix Table 2. Detailed catch data from Experiment II: Comparison of crab and halibut catches in side-entry crab pots with (WB) and without (WOB) tanner boards.

Date	Line	Pot Type	Depth (fathoms)	Soak (hours)	Halibut Number	Halibut Lengths (cm)	Number of Tanner Crab
August 14	21	WB	63	19:39	0		5
		WOB	41	19:41	2	104, -	0
		WB	47	19:44	1	75	2
		WOB	61	19:48	1	94	0
		WB	78	19:50	0		10
		WOB	76	19:53	1	85	17
		WB	72	19:56	0		36
		WOB	41	19:59	2	78, 59	35
		WB	44	19:59	1	69	17
		WOB	45	20:01	1	81	25
August 14	22	WOB	40	20:46	2	84, 94	0
		WB	43	20:43	1	77	0
		WOB	56	20:39	4	84, 105, 123, 96	8
		WB	58	20:36	0		3
		WOB	80	20:33	1	94	5
		WB	90	20:29	1	51	15
		WOB	85	20:26	0		10
		WB	80	20:23	1	99	6
		WOB	80	20:19	2	73, 122	22
		WB	81	20:16	0		16
August 15	23	WOB	26	20:02	2	83, 79	0
		WB	30	20:04	2	84, 81	0
		WOB	65	20:11	3	96, 73, 70	9
		WB	68	20:12	1	71	22
		WOB	67	20:19	1	68	5
		WB	64	20:23	0		24
		WOB	60	20:27	1	79	4
		WB	58	20:31	0		14
		WOB	55	20:34	1	73	20
		WB	44	20:39	1	70	15
August 15	24	WB	39	21:21	2	77, 71	0
		WOB	29	21:16	2	80, 100	0
		WB	30	21:13	0		0
		WOB	61	21:11	1	77	5
		WB	63	21:08	1	106	5
		WOB	58	21:05	0		36
		WB	54	21:02	1	85	19
		WOB	49	20:51	Lost	Pot	0
		WB	45	20:49	0		3
		WOB	38	20:44	2	73, 75	0

Appendix Table 2. Detailed catch data from Experiment II: Comparison of crab and halibut catches in side-entry crab pots with (WB) and without (WOB) tanner boards.

Date	Line	Pot Type	Depth (fathoms)	Soak (hours)	Halibut Number	Halibut Lengths (cm)	Number of Tanner Cra
August 16	25	WB	68	21:33	1	81	0
		WOB	81	21:34	2	77,77	3
		WB	81	21:36	0		33
		WOB	77	21:41	0		0
		WB	68	21:45	0		18
		WOB	71	21:47	3	92,94,124	11
		WB	70	21:50	0		18
		WOB	66	21:54	1	89	28
		WB	63	21:57	2	89,71	28
		WOB	62	22:01	1	80	2
August 16	26	WOB	80	22:38	1	97	4
		WB	72	22:35	0		17
		WOB	79	22:33	1	130	9
		WB	88	22:29	1	86	9
		WOB	87	22:24	3	90,110,110	7
		WB	65	22:21	1	82	32
		WOB	76	22:14	1	97	29
		WB	71	22:08	0		46
		WOB	67	22:06	5	65,72,77,81,101	15
		WB	62	22:03	0		43

Appendix Table 3. Size composition of the Tanner Crab catch in Experiment I by sex and pot type. Carapace width is in mm.

Carapace Width	Side-Entry Male	Side-Entry Female	Top-Entry Male	Top-Entry Female	Carapace Width	Side-Entry Male	Side-Entry Female	Top-Entry Male	Top-Entry Female
65	0	0	0	0	118	4	0	1	0
66	0	0	0	0	119	5	0	4	0
67	0	3	0	0	120	4	0	4	0
68	0	2	0	0	121	5	0	5	0
69	0	0	0	0	122	2	0	6	0
70	0	4	0	0	123	7	0	2	0
71	0	2	0	0	124	5	0	8	0
72	0	5	0	0	125	7	0	5	0
73	1	5	0	0	126	9	0	8	0
74	0	4	0	0	127	11	0	8	0
75	0	6	0	0	128	7	0	6	0
76	0	2	0	2	129	14	0	18	0
77	1	6	0	0	130	5	0	13	0
78	0	7	0	0	131	10	0	16	0
79	0	4	0	0	132	11	0	7	0
80	0	7	0	1	133	14	0	12	0
81	0	3	0	1	134	10	0	15	0
82	1	1	0	0	135	13	0	10	0
83	0	4	0	1	136	9	0	12	0
84	1	2	0	0	137	3	0	5	0
85	0	2	0	0	138	4	0	6	0
86	1	2	0	0	139	7	0	8	0
87	3	0	0	1	140	5	0	7	0
88	1	5	0	2	141	5	0	6	0
89	0	4	0	0	142	7	0	5	0
90	1	2	0	0	143	10	0	6	0
91	2	2	0	0	144	3	0	7	0
92	0	0	0	0	145	7	0	5	0
93	0	1	0	1	146	6	0	2	0
94	1	0	0	0	147	4	0	2	0
95	2	0	1	0	148	1	0	4	0
96	0	1	0	0	149	4	0	1	0
97	1	1	1	0	150	2	0	4	0
98	3	0	1	0	151	1	0	3	0
99	0	0	0	0	152	3	0	6	0
100	0	0	0	1	153	4	0	2	0
101	0	0	1	0	154	2	0	2	0
102	1	1	0	0	155	0	0	1	0
103	0	0	0	0	156	3	0	0	0
104	3	0	0	0	157	4	0	1	0
105	2	0	0	0	158	1	0	2	0
106	1	0	1	0	159	0	0	2	0
107	2	0	0	0	160	0	0	0	0
108	2	0	3	0	161	1	0	0	0
109	3	0	0	1	162	0	0	0	0
110	2	0	1	0	163	0	0	0	0
111	2	0	1	0	164	0	0	0	0
112	3	0	1	0	165	0	0	0	0
113	1	0	3	0	166	0	0	0	0
114	2	0	2	0	167	1	0	0	0
115	4	0	0	0	168	0	0	0	0
116	1	0	1	0	169	0	0	0	0
117	1	0	3	0	Total	289	88	267	11

Appendix Table 4. Size composition of the Tanner Crab catch in Experiment II by sex and pot type. Carapace width is in mm.

Carapace Width	With Boards		Without Boards		Carapace Width	With Boards		Without Boards	
	Male	Female	Male	Female		Male	Female	Male	Female
65	0	0	0	0	118	5	0	8	0
66	0	0	0	0	119	7	0	3	0
67	0	0	0	0	120	4	0	3	0
68	0	0	0	0	121	6	0	5	0
69	0	0	0	0	122	8	0	6	0
70	0	0	0	0	123	7	0	8	0
71	0	0	0	0	124	15	0	4	0
72	0	0	0	0	125	6	0	2	0
73	0	0	0	0	126	12	0	7	0
74	0	0	0	1	127	16	0	3	0
75	0	0	0	0	128	9	0	6	0
76	0	1	0	0	129	20	0	11	0
77	0	0	0	0	130	12	0	8	0
78	0	1	1	1	131	14	0	14	0
79	0	2	0	0	132	11	0	9	0
80	0	0	0	0	133	14	0	4	0
81	0	2	0	0	134	22	0	9	0
82	0	1	0	0	135	11	0	9	0
83	0	2	0	1	136	12	0	10	0
84	0	9	0	5	137	13	0	10	0
85	0	3	0	2	138	10	0	5	0
86	0	1	0	2	139	3	0	6	0
87	0	4	0	3	140	3	0	3	0
88	0	4	0	2	141	5	0	5	0
89	1	3	0	1	142	4	0	3	0
90	0	5	0	5	143	5	0	3	0
91	1	7	0	5	144	0	0	3	0
92	1	4	0	6	145	6	0	5	0
93	1	3	0	4	146	2	0	5	0
94	1	8	0	4	147	7	0	3	0
95	1	4	0	3	148	1	0	4	0
96	0	3	0	6	149	4	0	9	0
97	4	7	0	6	150	4	0	1	0
98	1	4	0	4	151	4	0	1	0
99	0	3	0	3	152	4	0	1	0
100	0	3	0	1	153	3	0	4	0
101	2	5	1	0	154	4	0	3	0
102	2	7	0	0	155	2	0	2	0
103	4	2	0	2	156	3	0	2	0
104	3	0	1	1	157	2	0	0	0
105	5	1	0	0	158	0	0	0	0
106	0	0	0	0	159	1	0	2	0
107	1	0	0	0	160	0	0	1	0
108	3	2	2	1	161	0	0	2	0
109	2	0	0	0	162	2	0	2	0
110	4	0	0	1	163	2	0	1	0
111	1	0	1	0	164	1	0	0	0
112	4	2	2	0	165	0	0	0	0
113	2	0	2	0	166	0	0	0	0
114	2	0	2	0	167	0	0	0	0
115	5	0	0	0	168	0	0	0	0
116	3	0	1	0	169	0	0	0	0
117	3	0	2	0	Total	363	103	230	70

Appendix Table 5. Catch of species other than halibut and crab by experiment and pot type.

Species	Experiment I		Experiment II	
	Side-entry	Top-entry	W/Boards	W/O Boards
Cottids (*Hemilepidotus* spp.)	1	-	-	-
Lingcod (*Ophiodon elongatus*)	15	-	-	-
Pacific cod (*Gadus macrocephalus*)	27	2	1	2
Sablefish (*Anoplopoma fimbria*)	2	-	-	-
Skate (*Raja* spp.)	1	-	-	-
Spiny dogfish (*Squalus acanthias*)	1	-	-	1
Turbot (*Atheresthes stomias*)	3	-	-	-
Walleye pollock (*Therogra chalcogramma*)	-	-	2	-
Yelloweye rockfish (*Sebastes ruberrimus*)	1	-	-	-

Appendix Table 6. Fishing locations during Experiments I and II.

		Start		End	
Date	Line	Latitude	Longitude	Latitude	Longitude
August 9	1	59:15:11N	139:16:07W	59:11:52N	139:24:52W
	2	59:13:71N	139:12:60W	59:10:39N	139:21:30W
	3	59:12:59N	139:08:72W	59:09:24N	139:17:45W
	4	59:11:44N	139:04:91W	59:08:07N	139:13:67W
August 10	5	59:06:94N	138:49:60W	59:04:68N	138:41:98W
	6	59:05:20N	138:53:98W	59:02:91N	138:46:43W
	7	59:03:48N	138:58:48W	59:01:19N	138:50:94W
	8	59:01:74N	139:02:85W	59:59:43N	138:55:32W
August 11	9	59:00:91N	139:05:07W	58:57:57N	138:57:57W
	10	59:02:60N	139:00:68W	59:00:29N	138:53:16W
	11	59:04:31N	138:56:30W	59:02:05N	138:48:73W
	12	59:06:05N	138:51:80W	59:03:79N	138:44:19W
August 12	13	59:19:45N	139:24:96W	59:16:66N	139:32:35W
	14	59:22:18N	139:31:53W	59:18:97N	139:40:15W
	15	59:25:27N	139:37:22W	59:22:07N	139:45:76W
	16	59:28:33N	139:42:92W	59:25:17N	139:51:51W
August 13	17	59:35:59N	139:58:67W	59:38:68N	139:49:97W
	18	59:36:72N	140:02:57W	59:39:81N	139:54:00W
	19	59:37:86N	140:06:68W	59:40:92N	139:58:12W
	20	59:39:00N	140:10:62W	59:42:03N	140:02:11W
August 14	21	59:38:44N	140:08:74W	59:41:49N	140:00:20W
	22	59:37:31N	140:04:66W	59:40:40N	139:56:11W
August 15	23	59:41:20N	139:53:98W	59:43:39N	140:02:04W
	24	59:41:95N	139:51:89W	59:44:15N	139:59:97W
August 16	25	59:39:81N	139:53:95W	59:42:05N	140:02:09W
	26	59:39:02N	139:56:09W	59:41:27N	140:04:31W

Appendix Table 7. Results from analysis of variance on Experiment I.

Source	Degrees of freedom	Catch of Halibut														
		Day 1			Day 2			Day 3			Day 4			Day 5		
		Sum of squares	Mean square	F	Sum of squares	Mean square	F	Sum of squares	Mean square	F	Sum of squares	Mean square	F	Sum of squares	Mean square	F
Total	40	91.00			193.80			71.00			30.00			54.00		
Mean	1	30.62			68.00			27.23			4.90			19.60		
Row	3	2.87			30.20			0.27			0.90			3.40		
Column	9	4.13			32.00			2.03			6.10			3.40		
Pot type	1	27.23	27.23	26.96*	54.50	54.50	155.71*	24.03	24.03	35.87*	4.90	4.90	9.61*	16.90	16.90	41.22*
Residual	26	26.15	1.01		9.10	0.35		17.44	0.67		13.20	0.51		10.70	0.41	
		Catch of Tanner Crab														
Total	40	830.00			7.00			29.00			8595.00			2162.00		
Mean	1	72.90			0.63			3.03			3822.02			940.90		
Row	3	151.70			1.08			7.07			427.07			320.90		
Column	9	209.10			1.13			5.73			3150.23			303.10		
Pot type	1	0.40	0.40	0.03	1.25	1.25	11.36*	0.03	0.03	0.06	164.03	164.03	4.14*	8.10	8.10	0.36
Residual	26	395.90	15.23		2.93	0.11		13.14	0.51		1031.25	39.66		589.00	22.65	

*significant at p = 0.01

Appendix Table 8. Results from analysis of variance on Experiment II.

Source	Degrees of freedom	Catch of Halibut								
		Day 1			Day 2			Day 3		
		Sum of squares	Mean square	F	Sum of squares	Mean square	F	Sum of squares	Mean square	F
Total	20	42.00			37.00			59.00		
Mean	1	24.20			24.50			26.50		
Row	1	0.80			0.50			0.50		
Column	9	8.80			7.00			17.00		
Pot type	1	5.00	5.00	12.50*	1.40	1.40	2.75	8.50	8.50	10.49*
Residual	8	3.20	0.40		3.60	0.51		6.50	0.81	
		Catch of Tanner Crab								
Total	20	5170.00			8198.00			10,010.00		
Mean	1	2737.80			2738. 0			6,195.20		
Row	1	192.20			410.90			245.00		
Column	9	1539.20			2496.00			1,951.80		
Pot type	1	7.20	7.20	0.08	227.60	227.60	0.68	924.80	924.80	10.67*
Residual	8	693.60	86.70		2325.50	332.21		693.20	86.65	

*significant at p = 0.01.

Note: On Day 2, the degrees of freedom for the total, main effects and residual are 18, 1, 1, 8, 1 and 7, respectively.

AGENDA F-3(a)
December 1980

M E M O R A N D U M

TO: Finance Committee

FROM: Jim H. Branson
Executive Director

DATE: November 21, 1980

SUBJECT: Status of Contract 80-5, "A Study of the Offshore Chinook and Coho Salmon Fishery Off Alaska" with Natural Resources Consultants; final billing and approval of report.

ACTION REQUIRED

1. *Approve transfer of travel funds to general expenses, and approve payment of final billing.*

2. *Consider additional funds for contract over-run.*

BACKGROUND

NRC has billed $46,712.25 as of October 30, 1980, leaving $11,287.75 in the budget. Of this, $7,212.75 is appropriated to travel and $4,075 to general expenses. The final NRC billing is $124.24 for travel and $14,081 for general expenses. By transferring $7,088.51 from travel funds, all but $2,917.41 is covered.

The Finance Committee should approve this transfer and pay all but 10% of the contract amount, and consider appropriating an additional $2,917.41 to cover all NRC expenses.

Budget as of 10/31/80

Travel	$7,212.75	General expenses	$4,075.00
Final Billing	124.24	From travel	+7,088.51
Remaining travel funds	$7,088.51		11,163.51
		Final billing	14,080.76
		Over-run	$ 2,917.25

Payment of $5,487.75 should be approved at present. Last payment would be $8,593.01 (including $2,917.25 over-run).

JG

NATURAL RESOURCES CONSULTANTS
4055 21st Avenue West • Seattle, Washington 98199, U.S.A. • (206) 285-3480

ACTION | INITIAL
Admin. Off.
Exec. Sec.
Staff Asst. 1
Staff Asst. 2
Staff Asst. 3
Sec./Dir.
Sec./Typist
NOV 17 1980

November 12, 1980

Mr. Jim Branson, Executive Director
North Pacific Fisheries Management Council
P.O. Box 3136DT
Anchorage, Alaska 99510

Reference: Contract #80-5
NRC Project/Salmon-NPFMC #19

Dear Jim:

Enclosed is our final billing (Statement #162) covering the period October 1-31, 1980, and a Statement of Accomplishments for the same period. You will note that we have billed some minor travel on November 6-7 for expenses incurred by Frank Fukuhara who drove to Portland to discuss the Plan with Dr. Ted Perry of the Pacific Fisheries Management Council.

This final billing was developed as follows:

Budget as of 10/31/80:

Labor	$4,075.00
Travel	7,212,75
Balance	11,287.75

Final Statement (#162 enclosed)

Labor	$11,163.51
Travel	124.24
Total	$11,287.75

The FMP is now in the hands of the word-processor and we expect that task to cost in excess of $1,000.00. The overhead on this project has been considerable: the manuscript is long and went through several draft versions,

necessitating the hiring of temporary office help; Xeroxing expenses have been high, as have mailing costs. Jim, it should be noted that NRC's normal charges would have been:

Professional services (Mike and Frank)	$ 7,075
Overhead	5,306
Miscellaneous (work-processing and graphics)	1,500
NRC supervision	200
Travel	124
Total	$14,205

Therefore, we will eat $2,918 of this amount. The $11,287.75 balance due will keep us within the budget contract but will require the transfer of $7,088.51 from the travel category. Since additional work was done by Mike and Frank during the month of October at the request of the Council, we believe the charges reflected by our invoice are appropriate. It might also be appropriate to point out that Mike and Frank continue to work on this project, in spite of the fact that they will not be compensated for their time.

We anticipate that the FMP will be completed by the word-processor late this week or early next week. We will get it into the mail at the earliest possible time.

Yours sincerely,

NATURAL RESOURCES CONSULTANTS

Dayton L. Alverson
Managing Partner

Enclosures