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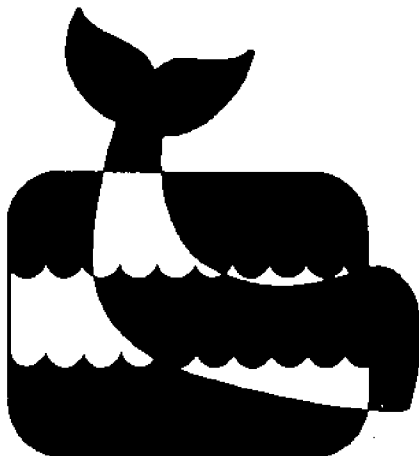
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SEA GRANT PROGRAM

THE BERING SEA TANNER CRAB RESOURCE:
U. S. PRODUCTION CAPACITY AND MARKETING

May 1977



University of Alaska

Sea Grant Report No. 77-5

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ALASKA SEA GRANT PROGRAM
UNIVERSITY OF ALASKA
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THE BERING SEA TANNER CRAB RESOURCE:
U.S. PRODUCTION CAPACITY AND MARKETING
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Alaska Commercial Fisheries Entry Commission

Alaska Crab Institute

Alaska Department of Fish and Game

Alaska Sea Grant Program

National Marine Fisheries Service, Alaska Region

National Marine Fisheries Service, Northwest and Alaska Fisheries Center, Seattle, Washington

National Marine Fisheries Service, Southwest Region

North Pacific Fisheries Management Council

Study team members are listed in Appendix G.

The study team also wishes to thank Nina Hussey for her skill and stamina during the typing and preparation of this report.

INTRODUCTION

This report contains a compilation and analysis of information on the economics of Tanner crab utilization gathered during April and May, 1977 for the use of the North Pacific Fisheries Management Council. Information was obtained by survey and from secondary sources. The analysis of the information reflects the collective judgements of the members of the short-term Tanner crab economic studies group (see Appendix G).

Some of the analyses presented must be interpreted as tentative, based on incomplete and/or inadequate information. Specific informational problems are discussed in the text of the appendices. It is hoped that this report will serve as a catalyst for arousing more general concern about the very poor state of the economic data base in fisheries industries relative to the minimum informational and analytical requirements of the Council. It is the collective opinion of the study team members that a thorough review of the adequacy of economic data should become a high priority of the Council.

ORGANIZATION

This report addresses a number of topics relevant to the management of the Tanner resource. Because each subject area was researched and written up by an individual or group working independently, the substance of this report is presented as a series

of appendices. A summary of the salient features of each of these is presented below. The only appendix which is not summarized is Appendix F, which is a paper delivered by Clint Atkinson, Fisheries Consultant, to the 1977 Kodiak Fisheries Institute.

SUMMARY OF FINDINGS

Harvesting Capacity

The physical harvesting capacity report for Tanner crab appears in Appendix A. The discussion here is limited to a summary and the implications of the information presented in the Appendix.

The crucial issue to address with regard to the harvesting capability of the Tanner crab fleet is whether the United States could effectively harvest the entire Eastern Bering Sea optimum yield for Tanner crab. The optimum yields for Tanner crab established for 1977 are: *C. bairdi*, 66,300,000 pounds and *C. opilio*, 16,300,000 pounds. At present the allowable Japanese harvest consists of 11,245,500 pounds of *C. bairdi* and the entire optimum yield for *C. opilio* of 16,300,000 pounds. This represents a total crab quota of 27,545,500 pounds of crab. From the results tabulated in Table 1, of which lines 3 and 8 are shown here for convenience, it is quite apparent that the fleet is physically capable

	<u>Eastern Bering Sea</u>	<u>Kodiak</u>	<u>Southern Peninsula</u>
(3) Annual no. lbs. landed (predicted for 1977)	44,163,381	20,781,899	9,051,101
(8) Total annual capacity in lbs.	134,400,000	76,800,000	28,800,000

of harvesting not only the bairdi optimum yield of 66,300,000 but also the additional 16,300,000 pounds of opilio represented by the Japanese quota.

If there are any barriers to expanding U.S. harvest by 38 million pounds,¹ it may turn out to be the opilio portion of the optimum yield. Opilio is a smaller, higher-cost crab to process with a market which requires the product largely in meat form. As yet, opilio is not processed to any significant degree in Alaska; domestic processor demand may therefore present a temporary bottleneck to any plans to harvest the entire optimum yield for both types of crab.

The temporary nature of the bottleneck should, however, be emphasized as there exists a strong market for canned opilio imported to the U.S. from Japan which could be rechanneled through domestic concerns. Further, as the Atkinson paper suggests, the Japanese are expanding their demand for imports as they become excluded from more and more fishing grounds.

A related aspect of processor demand involves negotiated ex-vessel price determination, a discussion of which appears in

¹27,545,500 lbs. total foreign quota plus 10,891,119 lbs. unharvested U.S. quota (assuming a catch this year of 44,163,381 lbs.)

Appendix A - Section 3. It is conceivable that a negotiated price could retard processor demand to a level below the allocated amount of crab in a given year.

Another potential bottleneck to harvesting and processing capability lies in the area of primary processing regulations. A full discussion of issues related to both state and federal postures on this issue appears in Appendix A - Section 4. Suffice it to say here that there is a need for clarification on some aspects of the primary processing issue both at the state and federal levels. Due to the capability of domestic harvesting and processing firms to handle increased catches of Tanner crab the primary processing regulations at the present time appear to present no significant constraints.

Processing Capacity

A survey of domestic Tanner crab processing capacity was conducted to determine to what extent maximum capacity is utilized at present (see Appendix B). The survey provides an indication of the amount of domestic processing capability available to handle increased amounts of catch.

The maximum and actual operating capacities calculated from the survey questionnaire are summarized by area in Table 1. From this table, the unutilized Tanner crab processing capability (maximum minus actual operating capacity) in pounds of raw crab/day is:

	<u>Sections</u>	<u>Meats</u>	<u>Total</u>
Westward Area	968,768	232,727	1,201,495
Kodiak Area	317,321	474,045	791,366

Table 1

Tanner Crab Processing Capacity--Summary Table

Westward Area

	Frozen Sections (in lbs. round wt. crab/day)	Frozen and Canned Meats (in lbs. round wt. crab/day)	Total Daily Capacity in Lbs. of Crab (round wt.)
Maximum Capacity	1,552,416	532,831	2,085,247
Actual Operation	583,648	300,104	883,752
Capacity Utilization	.37	.56	

Kodiak Area

Maximum Capacity	582,627	767,865	1,350,492
Actual Operation	265,306	293,820	599,126
Capacity Utilization	.46	.38	

Source: Tanner crab survey questionnaires--20 processing plants included

As mentioned in the capacity appendix, the production is flexible between section and meat production at some plants and the proportion may vary according to the market demand at the time. Also, it is reported that some part of section production for many Alaska plants is reprocessed into meat products in West Coast plants from Washington to California.

Additional amounts of Tanner crab to be processed by domestic plants could come from two sources. This season there will be an estimated 10,891,119 pounds (see footnote 1, page 3) of Tanner crab, part of the domestic harvest of optimum yield from the Bering Sea, which will not be harvested. In addition, the present foreign Tanner crab allocation from the Bering Sea is 27,545,500

pounds. If domestic processing plants were going to process this entire amount of 38,436,119 pounds per year, then assuming a 75-day operating season (a conservative estimate), an additional 512,481 pounds per day would have to be processed. It is clear from the above figures that the capacity to process this additional amount does exist at present.

Aside from the physical processing capability of the Tanner crab industry there remains an additional area within the processing segment where a distinct lack of documented information exists. To date there has been no significant research directed toward expanding knowledge of the structure, conduct and performance aspects of Alaska's fishing industry. Work is now underway within the University of Alaska's Sea Grant Program to examine the industrial organization of Alaska's Seafood Industry. The project is targeted for completion in 1979. A preliminary look at market concentration in the Tanner crab processing sector is undertaken below.

Market Structure

Alaska's Tanner crab processing industry is oligopolistic in structure (see Appendix C, Table 1). Producer concentration in Kodiak increased from 1975 to 1976, whereas it decreased over this period in the Westward region. These changes can be explained primarily by the exit of three producers (and three plants) from Tanner crab production in Kodiak and the entry of seven firms (and ten plants) in the Westward region. From 1975 to 1976 total

production (expressed in meat weight equivalents) increased by 55 percent in Kodiak, mostly in canned meats (393 percent), and by 402 percent in the Westward region, primarily in fresh/frozen meats (which increased from zero to over 1.5 million pounds), and frozen sections (282 percent).

Market concentration is quite high in the combined Westward and Kodiak region and in each region individually, and in individual product lines as well. The significance of the concentration statistics for market competition is difficult to interpret. On the one hand, complex domestic ownership interties and foreign investments cause the statistics in Table 1, Appendix C, to understate actual concentration. On the other hand, it would appear that the impact of high producer (and buyer) concentration on competition is mitigated to some degree by the low-to-moderate barriers to entry and the low-to-moderate degree of product differentiation.

With regard to market channels, present information is inadequate to allow their specific quantification by product form and final geographic market. It is known that most Alaska production is in the form of sections (67 percent of the combined Kodiak and Westward production in 1976 and 83 percent in 1975) and that most sections are exported to Japan. However, as mentioned above, a significant (but unknown) percent of section production is shipped from Alaska to plants from Washington to California for further processing into canned and fresh/frozen meats. Alaska production of canned and fresh/frozen meat is sold domestically, primarily in coastal areas.

Domestic Market Growth: A California Survey

The results of the snow crab market survey conducted in California (Appendix D) indicate a highly favorable marketing climate exists for snow crab at the present time in the California region. This marketing region, the survey estimated, represents 27% of the total Alaska production of snow crab.

Further results indicated that snow crab is not a substitute for king crab in the sense that markets for it definitely have an identity of their own. Substantial growth potential also exists for snow crab markets in California in 1977-78. Influencing factors will be declines in dungeness crab stocks, abundance and availability of king and snow crab stocks to American fishermen and successful product introduction to the consumer. Many of those interviewed felt snow crab was a firmly established new product and market growth would occur regardless of market activity for other crab products. Substantiating evidence for this trend is the fact that 16 out of a total of 23 firms interviewed entered the snow crab market between the years 1973 and 1975.

In the last two to three years snow crab has developed an identity and momentum of its own. Unlike some species, snow crab enjoys nationwide recognition and popularity. Its future in the domestic market place seems only to be limited by uncertainty of supply, or by a price too high to maintain its competitiveness with king crab nationwide, and with regional crab favorites in coastal areas.

Only in an indirect manner can marketing information on Tanner crab give glimpses of actual consumption patterns. For actual trends in consumption available time series data must be collected

and analyzed. The following section does this to the degree possible given severe data constraints. More detailed information on consumption appears in Appendix E.

Past Tanner Crab Consumption Patterns and Trends

Much of the data needed to estimate consumption proved to be nonexistent or unreliable. Therefore, it was decided that whenever data on two or more of the components of consumption (i.e., landings or production, imports, exports, and change in inventories) were completely lacking for a particular country or region, no estimate of consumption in that country could be made. It was possible to estimate consumption only in the United States and Japan, although data on as many of the components of consumption as could be obtained are presented for other countries and regions, namely: Canada, the Soviet Union, Europe and others.

It is the opinion of the study team that even though consumption was estimated for the U.S. and Japan, the estimates are not very reliable. This is partly because of a low level of confidence in the published production data, but primarily because of the fact that only partial measures or estimates could be obtained for some of the components of consumption.

The data and estimates are presented in their entirety in Appendix E, along with a complete explanation of the sources, estimation techniques, and problems encountered. As a summary, the annual rate of change in the estimated consumption of Tanner crabs and of king crabs in the U.S. and Japan has been computed for several recent years and is displayed in Tables 2, 3, 4 and 5. The average annual rate of change over the last several years for

which estimates could be obtained is also shown to assist in identifying trends.

The fluctuation in estimated consumption of whole Tanner crab is violent (see Table 2), and the high positive average annual rate of increase is due mainly to a sudden surge of consumption in 1972. Estimated consumption did increase steadily from 1973 to 1975 from 0.7 million pounds to 17.1 million pounds (sources familiar with industry express skepticism about the validity of the 1975 figure.)

Estimated U.S. Tanner section consumption has fluctuated no less widely. It should be noted that informed sources indicate that, in fact, there was almost no domestic section consumption until 1976. This assertion casts doubt on the validity of the estimates.

Estimated U.S. consumption of frozen Tanner crabmeat has varied somewhat less than that of whole crabs and sections. The overall trend since 1970 has been upward at an average annual rate of 13%, but the short-term trend since 1973 has been downward.

Estimated U.S. consumption of canned Tanner crabmeat shows the least variation of all, with a slight downward trend (at an average rate of -7.5% per year since 1970).

Total estimated U.S. consumption of all Tanner products has risen steadily since 1970, at an average rate of 25% per year. When product weight is converted to live weight equivalent (see Appendix E for explanation of procedure), the trend is still up-

Table 2

Annual Rates of Change in U.S. Tanner Crab Consumption

	Whole	Sections	Meat	Canned	Total (Product Wt.)	Total (Live Wt.)
1971	- 48%	- 55%	+31%	+ 8%	+ 7%	+23%
1972	+9,018	+ 467	+40	-22	+73	+28
1973	- 22	- 100	+81	- 9	+13	+ 8
1974	+ 67	+5,836	-61	+15	+ 6	+21
1975	+1,207	- 100	-27	-30	+26	-15
1976	_____	_____	_____	_____	_____	<u>+42</u>
Average	+2,044	+1,209	+13	-7.5	+25	+17.8

Source: Table 14, Appendix E

Table 3

Annual Rates of Change
in Japanese Tanner Crab Consumption

	Frozen, All Forms	Canned	Total (Live Wt.)
1971	-14%	N.A.	-32%
1972	-31%	"	+13
1973	+47	"	+20
1974	<u>N.A.</u>	<u>"</u>	<u>-21</u>
Average	+0.67	"	- 5

Sources: Table 15 and Table 2, Appendix E

ward but at a slower rate. The difference is due in part to the changing ratio of crab-in-shell products to crabmeat.

Data is available in much less detail for Japanese crab consumption (see Table 3). The 1970-1973 trend in consumption of frozen Tanner crab (including sections) is .67% growth per year average, but no data is available on canned Tanner crab consumption. Total estimated Japanese Tanner crab consumption in live weight terms has decreased slowly (-5%) on the average.

Total estimated U.S. consumption of king crab, in live weight terms, varied considerably over the period 1970-1976, but showed an overall upward trend, arising an average of 22% per year (see Table 4). Estimated consumption was down in 1976 from the previous year by 19%, however.

Total estimated Japanese consumption of king crab, in live weight terms, has fluctuated substantially, showing only a slight upward trend (see Table 5). The average annual rate of increase was 6% between 1970 and 1976, although there was a 38% drop in 1976.

Total worldwide consumption in live weight terms can be assumed to approximately equal world landings of each species. United Nations Food and Agriculture Organization statistics show that from 1970-1974, world landings of Tanner crabs averaged a 1.8% yearly rise, although there was a slight drop in 1974, and a larger drop in 1971. The average quantity landed was 143.6 million pounds.

World king crab landings declined steadily from 1970 through 1973, then rose sharply in 1974, for an average annual decrease of 1%. The average quantity landed was 146.0 million pounds.

Table 4

Annual Rates of Change in U.S. King Crab Consumption

	Whole	Sections	Meat	Canned	Total (Product Wt.)	Total (Live Wt.)
1971	- 99%	- 54%	+ 55%	+151%	+ 8%	+ 43%
1972	+3,092	+254	- 10	- 62	+24	- 13
1973	- 26	+ 71	- 82	-100	-20	- 59
1974	+ 613	- 47	+271	+112	+16	+148
1975	+ 656	-56	- 25	+859	+119	+ 34
1976	<u>N.A.</u>	<u>N.A.</u>	<u>N.A.</u>	<u>N.A.</u>	<u>N.A.</u>	<u>- 19</u>
Average	+ 848	+34	+ 42	+192	+ 29	+ 22

Sources: Table 19 and Table 6, Appendix E

Table 5

Annual Rates of Change in Japanese King Crab Consumption

	Frozen, All Forms	Canned	Total (Prod. Wt.)	Total (Live Wt.)
1971	+ 6,285	- 92%	- 76%	-66%
1972	- 99	+410	+ 70	+72
1973	+30,488	+ 35	+151	+53
1974	<u>+ 29</u>	<u>- 51</u>	<u>- 14</u>	<u>-38</u>
Average	+ 9,176	+ 76	+ 33	+ 6

Sources: Table 20 and Table 7, Appendix E



APPENDIX A
TANNER CRAB PHYSICAL HARVESTING CAPACITY

APPENDIX A

Section 1

TANNER CRAB PHYSICAL HARVESTING CAPACITY REPORT

To obtain a collective informed estimate of the true harvesting capacity of Tanner crab a questionnaire was developed based on information contained in the Norfish Study and Shellfish Monthly Reports for 1976 issued by the Alaska Department of Fish and Game. The questionnaire was administered to participants in Shellfish Study Groups organized by the Alaska Commercial Fisheries Entry Commission in Kodiak and Seattle as a preliminary harvesting capacity report designed to elicit comments as to the validity of the assumptions underlying the numbers involved. The final harvesting capacity report is a revised version based on criticisms and comments obtained in the Workshops (see Addendum #1 to this Appendix).

The basis of this report is Table 1, containing a pounds-per-landing summary and total harvesting potential by area for three major Tanner crab fishery areas. Those areas are the Eastern Bering Sea, Kodiak and the Southern Peninsula. In order to fully understand the dynamic forces at work behind each of the numbers presented in the table, the body of this report will take the reader through the table line by line explaining in each case the sources of information, underlying assumptions made and the forces which act on the numbers causing them to vary through time. An attempt is made in Table 1 to furnish the most up to date information available. Since complete 1977 data are not available, 1976 data are used as a starting point, and revised

Table 1

Pounds Per Landing Summary and
Total U.S. Harvesting Potential by Area

(Refer to Figure A for Fishing District Identification)

	<u>Eastern Bering Sea</u>	<u>Kodiak</u>	<u>Southern Peninsula</u>
(1) No. vessels	85	78	40
(2) Annual no. landings	603	800	378
(3) Annual no. lbs. landed (predicted for 1977)*	44,163,381	20,781,899	9,051,101
(4) Annual average lbs/landing (Row 3 ÷ Row 2)	73,239	25,977	23,945
(5) Avg. landing capacity in lbs/ landing (for entire fleet in each area)	5,600,000	4,800,000	1,200,000
(6) No. trips/month	4	4	4
(7) "Effective" length of season in months	6	4	6
(8) Total annual capacity in lbs.	134,400,000**	76,800,000***	28,800,000
(9) 1977 predicted landings as % of total landing capacity (Row 3 as % of Row 8)	32.9%	27.1%	31.4%

*Further support for these figures was recently obtained from cumulative catch summaries for April 1977 by area. See Table 2 for these catch summaries.

**Estimate derived from fishermen interviews in Kodiak Workshop was 112,000,000 pounds.

***Stock limitations will limit the harvest in Kodiak to the vicinity of 20,000,000 pounds. Thus there appears to be significant excess capacity in the Kodiak fleet. The question was asked at the Workshops whether fishing effort from the Kodiak area could effectively be transferred to the Bering Sea. The discussions appear below:

Kodiak Workshop

Yes. There may well be a transfer of catch capacity this year from Kodiak to the Bering Sea fishery owing to the higher price of Tanner. Between 25% and 30% of the vessels are capable and they constitute approximately 50% of the Kodiak harvest capacity.

Seattle Workshop

There are a number of reasons why such a transfer of harvesting capacity would not happen. Weather is a primary constraint. Pot limits and registration areas would also work against such a transfer. There also currently exists more than sufficient excess capacity in the Bering Sea fleet. "If every king crab vessel currently active in the Bering Sea were to fish Tanner, we would have a nightmare!" In 90 days they can take 130 million pounds of Tanner now. There simply is no need to transfer.

In addition, Kodiak characteristically pays more for Tanner than does the Bering Sea. Other constraints precluding such a move center around the limitations on processing facilities due to absence of markets. Also constraining is the access to transportation facilities to move the product out of Westward.

for 1977 where possible using the informed opinion of the Workshop participants.

Row 1: Number of Vessels

These numbers represent the number of vessels in operation during the peak months of Tanner crab harvesting for 1977. Considerable change has taken place in the size of the fleets since 1976 data was released. The Eastern Bering Sea fleet has increased in number from 43 to between 80 and 90 boats (85 was chosen as a mean). The Kodiak fleet has decreased in size from 88 boats in 1976 to 78 boats in 1977. The Southern Peninsula fleet has increased in size to around 40 boats from 32 boats in 1976.¹

It must be remembered that the number of vessels in actual operation fluctuates widely during the course of the season and oftentimes many more vessels register than actually fish.

Row 2: Annual Number of Landings

The annual number of landings for each port has been revised from Monthly Shellfish Reports for 1976 to reflect 1977

¹Workshop participants suggested the fleet size had increased from 32 boats but did not estimate that increase. The figure of 40 boats is therefore a very crude guess. Recent reports from the Alaska Department of Fish and Game indicate that fewer boats than 32 have actually participated in the 1977 harvest, but the predicted harvest is still in the vicinity of 9,000,000 pounds, which parallels the findings in this report.

fleet sizes.¹ These figures will vary inversely with weather adversity, poor catch rates and longer than normal processor turnaround time.

Row 3: Annual Number of Pounds Landed

The annual number of pounds landed are, as is Row 2, taken from 1976 Monthly Shellfish Reports and revised to take into account the changes in fleet sizes. The Kodiak estimate for 1977 is down from the 1976 landings of 27,000,000 pounds. This appears to be largely due to the fact that there are fewer large boats in operation this year, there was a shorter period of intense fishing effort and the size limitation is now 5½ inches.² The Bering Sea catch for 1976 was 22,000,000 pounds. That catch is expected to approximately double this year due to the large increase in the size of the fleet. As indicated above there have been conflicting fleet size reports concerning the South Peninsula. The estimated season-final estimate is still, however, in the vicinity of 9,000,000 pounds, a decrease of 1,000,000 pounds over last year's catch.

1			
Fleet Size			
Area	1976	1977	1977 as % of 1976
Eastern Bering Sea	43	85	198%
Kodiak	88	78	89%
South Peninsula	32	40	125%

²These observations by Alaska Department of Fish and Game biologists appeared in the April 18 edition of the Kodiak Daily Mirror.

Row 4: Annual Average Pounds per Landing

These figures are derived by dividing Row 3 by Row 2.

Row 5: Average Landing Capacity in Pounds per Landing for
the Entire Fleet in Each Area

These numbers were arrived at by a concensus of participants in the Kodiak Shellfish Study Group. The only published information found on hold capacity was contained in the Norfish Study for a sample of vessels from the Kodiak fleet. There were not only inherent problems involved in applying this information to areas other than Kodiak, but fishermen in the Workshop appeared to be highly dissatisfied with the vessel classification system in the Norfish Study;¹ thus, their educated guesses appeared to be the most reliable source for purposes of this study.

Row 6: Number of Trips per Month

The running time between processor and fishing grounds is approximately the same for each of the respective areas. Four trips per month is a reasonable average which, of course, can vary substantially with the constraints of weather, catch rates and unloading time.

Row 7: "Effective" Length of Season in Months

The "effective" season in each case can, it is recognized,

¹The Workshop participants in Kodiak have offered an alternative classification which appears on page . The need to develop an accurate vessel classification system and associated hold capacity estimates was recognized by both groups. The Seattle group suggested hold capacity information could be collected in next year's license forms.

be substantially modified by quota restrictions. This is particularly true in Kodiak.

The Bering Sea and Southern Peninsula Tanner crab harvesting seasons are strongest in the 6-month period January through June. There are several factors contributing to this. First of all, the Tanner crab begins its molting season in mid June (April-May in the Kodiak area). Prior to this, pre-molt symptoms begin to appear which make harvesting undesirable. These are "red joings,"¹ which is a thickening and redening of the shell in the area of the joints, increased dead loss in transit, and a decrease in catch per unit effort due to the fact that the crabs undergo a decrease in appetite prior to the molting phase. After the molting season is completed, roughly around October, harvesting continues to be undesirable because dead-loss rates are still high.

The high dead-loss rates occur because Tanner crab require a water temperature of 32-34°F. for normal metabolism. Their rate of metabolism will approximately triple for every 18°F. rise in temperature (Hartsock). Metabolism increases require increased oxygen intake. These higher oxygen requirements in a holding tank situation on a boat result in high rates of dead loss. Thus as winter approaches, ocean temperatures tend to lag behind air temperatures so it is well into winter season before water

¹Biologists have indicated that "red joints" appear occasionally in catches at other times of year so that this may not be a valid indication that the molting process has begun.

temperatures are considered in the safe range for the harvest of Tanner crab.

Consideration during the harvesting season must also be given to crab density. The average minimum economic commercial yield for Bering Sea bairdi crab is 60 crabs/pot for a given haul. This number will vary inversely with the price of crab. Since crab appear to concentrate in specific areas of the Bering Sea, it is to the fisherman's economic benefit to maximize his knowledge of those areas at the start of every fishing season. The extent to which regulatory agencies are willing and able to help maximize that flow of information is an issue for consideration.

There is an additional economic factor involved in determining Tanner crab harvesting capacity. This is a work-leisure type phenomenon which may result in a backward bending supply curve of labor in the crab fishing industry in Alaska.

In general terms, the situation can be depicted as follows: Much of the Tanner crab is harvested in Alaska by vessels which also engage in the king crab fishery. Since king crab is a high-value product, fishermen who harvest it can make a substantial income during the 3-month king crab season. In some cases fishermen are reluctant to then fish for Tanner crab during the winter season when the bad weather increases risk and the harvest (Tanner crab) is a lower-value product. In other words, in some cases the additional income accrued from harvesting Tanner crab is not worth as much to the fisherman as his leisure time.

To the extent Tanner crab remains an inferior product in value to king crab, this phenomenon must be kept in mind while reviewing harvesting capacity estimates as compared to actual landings.

Row 8: Total Annual Capacity in Pounds

These figures are obtained by multiplying Row 5 times Row 6 times Row 7 for the respective areas.

Row 9: 1977 Predicted Landings as % of Total Landing Capacity

The numbers indicate a large margin of physical excess harvesting capacity present in the Tanner crab fishery. Even allowing for the restraining factors implicit in the economic issues previously discussed, there appears to be every indication that the Tanner crab fleet could easily harvest far greater amounts of crab than are presently being landed.

Table 2

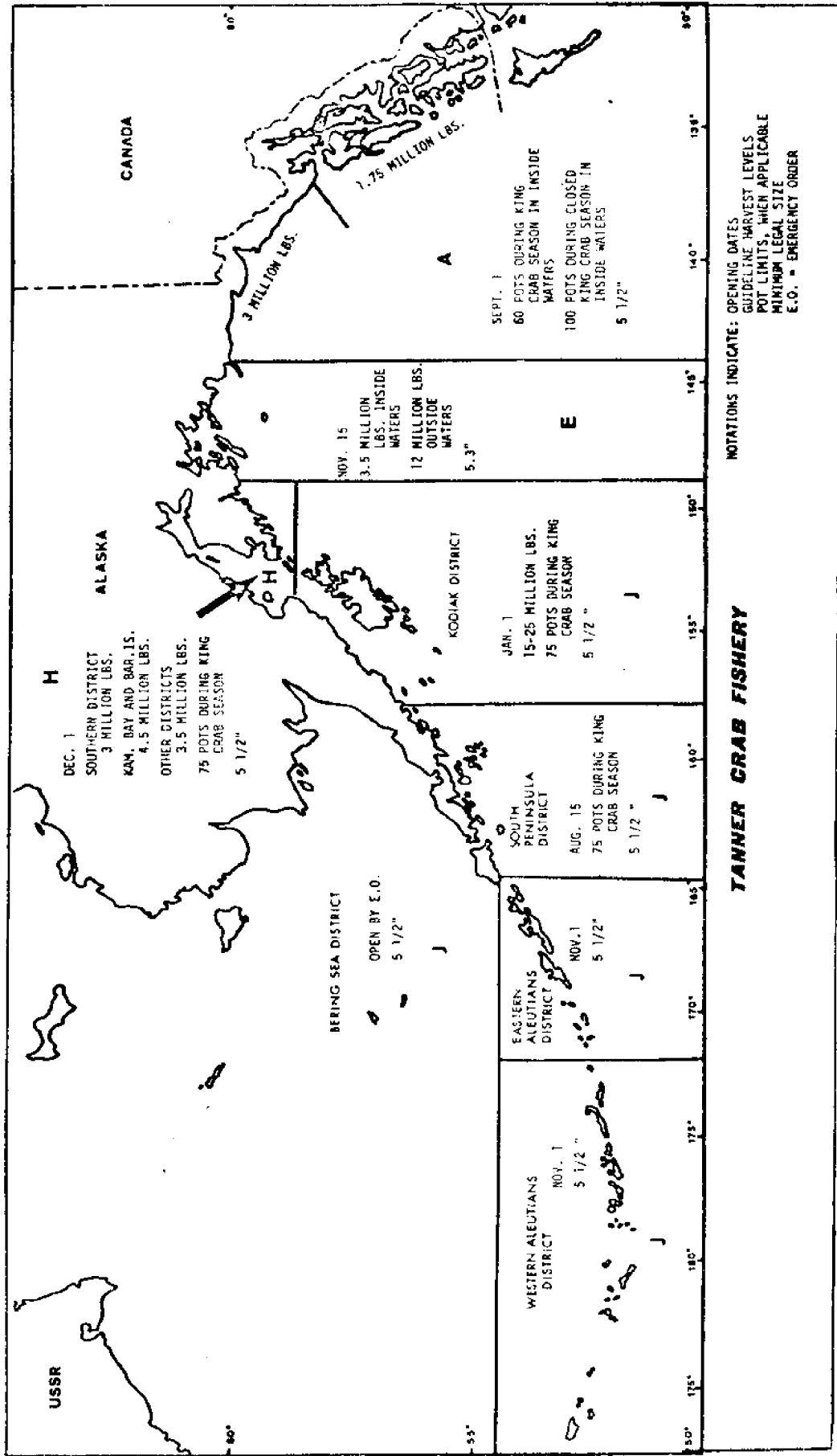
End of April 1977 Cumulative Catch Summary

REPORTED FROM:

Paul Tate, Alaska Dept. of Fish & Game, Dutch Harbor
 Marty Eaton, Alaska Dept. of Fish & Game, Kodiak

<u>Fishing Area</u>		<u>Pounds</u>
Kodiak (season closure April 30)	(season final- estimate)	20,000,000
Bering Sea (season closure June 15)	(As of April 30) (As of May 8) (season final- estimate)	15,932,543 20,000,000 40-50,000,000
South Peninsula (season closure May 15)	(As of April 30) (season final- estimate)	5,665,020 9,000,000
<u>Other Areas</u>		
Chignik	(As of April 30)	4,977,516
Unalaska	(As of April 30)	1,129,866

FIGURE 1



Reprinted from 1976 Alaska Shellfish Commercial Fishing Regulations, Alaska Department of Fish and Game.

Section 2

TANNER CRAB PHYSICAL HARVESTING CAPACITY
QUESTIONNAIRE

This questionnaire is part of a larger study being conducted by the Sea Grant Program at the University of Alaska for the North Pacific Fisheries Management Council. Its aim is to provide the Council with pertinent information on the harvesting capabilities of the Tanner crab industry. The information obtained in this study will provide a partial basis for management decisions to be made by the Council. Thus it is very important that data obtained in this questionnaire be as accurate and well conceived as possible. Your cooperation with this effort is greatly appreciated.

Physical Harvesting Capacity, Tanner Crab

Information on the physical harvesting capacity of Tanner crab in the Kodiak, Eastern Bering Sea and South Peninsula districts is a result of combined information from two sources:

- a. Alaska Department of Fish and Game Monthly Shellfish Reports, 1975 and 1976
- b. Norfish, NR26, Technical Report 61, University of Washington Sea Grant, August 5, 1976. Classification Enumeration, and Vessel Characteristics of Alaskan Shellfish Vessels

The assumptions involved in compiling the capacity figures shown in Table 1 are listed below for your review. Data limitations necessitated some of these and others are made on the suggestions of informed sources. If from your knowledge of the fishery you feel any are inaccurate please so indicate and include the recommended changes. Space is provided after every item. If additional space for answering is required, refer to the extra page provided at the end of the questionnaire.

1. Hold capacity estimates were estimated for all areas on the basis of a 93-boat sample taken from the Kodiak fleet (Norfish, NR 26). Detailed information on the hold capacity size distribution of the fleets in the Eastern Bering Sea and South Peninsula areas are as yet unavailable.

Kodiak response: (Refer to revised Table 3)

Seattle response: While there does not seem to be a reliable source for current hold capacity information, it is strongly suggested that such a data source be developed. This could be done at minimal cost and effort by requesting hold capacity on next year's license forms.

Prior to doing this, however, one must clearly and precisely define hold capacity. Are we talking about cubic feet of storage space below deck, net tonnage of a vessel, or live tanking capacity expressed in raw pounds, number of crab, or cubic feet? None of these are the same.

2. The figure for the number of vessels indicated for each area (see Table 1, Row 1) is the number of vessels in operation during the peak months of Tanner crab harvesting for 1976.

Kodiak response: The figures presented in Table 1, Row 1, seem to be reasonable for 1976. No precise information was contributed, but the general feeling was that these figures were approximately correct. However, considerable change has taken place in 1977. Kodiak declined to approximately 78 vessels, while the Peninsula fleet was thought to have increased in number over the 1976 level, but the magnitude of the change was unknown.

Seattle response: Perhaps at the peak of the season 43 is reasonable. But there were wide fluctuations over the course of the season and many more vessels registered than 43.

3. Tanner crab vessels fishing out of the Eastern Bering Sea and South Peninsula areas have the physical capability of making 3 trips per month maximum (see Table 1, Row 8).

Kodiak response: This number seems reasonable, but this can vary dramatically in response to weather conditions, catch rate, and unloading time.

Seattle response: There are several very significant factors which would serve to modify this number. Among the most important are weather, catch rate, and processor turnaround time. It is felt that with these in mind the Bering Sea figure (Table 1, Row 8) should be higher. Perhaps 4 or 5 would be more reasonable. At the peak of the season the weather generally permits more trips. It should also be noted, the running time between processor and grounds is approximately the same for all three areas.

4. Tanner crab vessels fishing out of the Eastern Bering Sea and South Peninsula areas have the physical capability of making 3 trips per month maximum (see Table 1, Row 8).

Kodiak response: In point of fact, the running time from processor to the fishing grounds and back to the processor is approximately the same whether you are talking about the Eastern Bering Sea, Kodiak, or Southern Peninsula fleets. Given the constraints of weather, catch rate, and delivery turnaround time, as noted in the previous question, each fleet might expect to make four trips per month.

Seattle response: There are several very significant factors which would serve to modify this number. Among the most important are weather, catch rate, and processor turnaround time. It is felt that with these in mind the Bering Sea figure (Table 1, Row 8) should be higher. Perhaps 4 or 5 would be more reasonable. At the peak of the season the weather generally permits more trips. It should also be noted, the running time between processor and grounds is approximately the same for all three areas.

5. The "potential" Tanner crab harvesting season in the absence of Japanese harvesting operations in the Eastern Bering Sea and South Peninsula areas is 9 months (see Table 1, Row 9).

Kodiak response: Assuming the Japanese were excluded from the Tanner crab fishery, the first obstacle preventing a dramatic expansion of the domestic harvest is the dual barrier of limited processing and transportation facilities. Close behind, in terms of limiting factors, is the current state of the market for snow crab.

If the Japanese were excluded from the fishery, assuming processing/transportation facilities and markets, the result would be an increase in the CPUE. This would solicit an increase of from four to six weeks on top of the regular season. (The regular season was four months long in 1976.) The price is up this year, as is the effort in the early season. This will result in a shorter season. The MSY is moving downward and the future will require harvesting additional quantities of opilio.

With the exclusion of the Japanese, domestic CPUE would rise about 25%. The effective seasons would be:

Eastern Bering Sea	- 5 months
Kodiak	- 4 months
Southern Peninsula	- 6 months

Seattle response: By law or regulation the season may be extended to 9 months as a result of the exclusion of the Japanese. However, the effective season for Tanner would never exceed 4½ to 6½ months because of the openings on the

higher valued king crab fishery. What will occur as a result of Japanese exclusion will be an intensification of effort or an increase in capacity on the grounds in a short time.

In practice, Tanner crab harvest begins January 1, and there is no simultaneous harvest of Tanner and king. A fisherman will not fill his tanks with Tanner when he could be using that space for the higher valued king.

A particularly significant constraining factor in the harvesting of Tanner is availability of processing facilities. Only half as many Tanner crab as king crab can be processed per day.

In terms of "effective season" Eastern Bering Sea is expected to be 6 to 6½ months in length, Kodiak perhaps 3 months, and Southern Peninsula 7 to 7½ months. Note that all of the above is modified by quota limits.

Additional Questions

6. Given that the Kodiak area Tanner crab fishery is approaching MSY, is it possible to transfer some of its excess harvesting capacity to the Bering Sea fishery? Please indicate why or why not. How much could be transferred in your estimation?

Kodiak response: Yes. There may well be a transfer of catch capacity this year from Kodiak to the Bering Sea fishery owing to the higher price of Tanner. Between 25% and 30% of the vessels are capable and they constitute approximately 50% of the Kodiak harvest capacity.

Seattle response: There are a number of reasons such a transfer of harvesting capacity would not happen. Weather is a primary constraint. Pot limits and registration areas would also work against such a transfer. There also currently exists more than sufficient excess capacity in the Bering Sea fleet. "If every king crab vessel currently active in the Bering Sea were to fish Tanner, we would have a nightmare!" In 90 days they can take 130 million pounds of Tanner now. There simply is no need to transfer.

In addition, Kodiak characteristically pays more for Tanner than does the Bering Sea. Other constraints precluding such a move center around the limitations on processing facilities due to absence of markets. Also constraining is the access to transportation facilities to move the product out of Westward.

7. Are vessels from all areas (i.e., Kodiak, Southern Peninsula, Chignik, Adak, Unalaska, Western Aleutians) generally capable of fishing in the Bering Sea? If not, is the limitation vessel size, landing area or both? Please indicate additional reasons if they exist.

Kodiak response: No. The limitation is a result of vessel size. Beyond the obvious constraint of seaworthiness, smaller vessels do not possess suitable facilities to sustain a crew while fishing the Bering Sea. Further, smaller vessels cannot carry a sufficient number of pots to be economically viable. It is this gear moving capability which makes any vessel under 82 feet simply noncompetitive in the Bering Sea. Perhaps 50% of the vessels, on an average, from all areas are potentially capable of fishing in the Eastern Bering Sea. This number is smaller for the Kodiak fleet owing to the large number of relatively small vessels in the Kodiak fleet.

Seattle response: No. First of all, vessels in Western Aleutians are there. Vessels under 73 feet probably would not go into the Bering Sea during this time of the year. Actually 85 footers are probably the smallest vessels that can expect to function successfully out there. Smaller vessels, beyond being constrained by weather and sea conditions, aren't economically viable. There is a lack of harbors and small boats simply do not have sufficient pot carrying capacity.

8. If you feel after examination of Table 1 the lbs./landing capacity figure or the total annual harvesting capacity figure for any of the three areas is in error for reasons not covered in the five assumptions listed above, please indicate why and what the figure or figures should more reasonably be.

Kodiak response: No comment.

Seattle response: No response.

To be Completed if You are a Vessel Owner

1. Please look at Table 2 and indicate which class of vessels most closely describes your boat.

Kodiak response: No response.

Seattle response: These categories are not terribly useful in categorizing vessels. Categories 1.0 and 2.0 lump too many discrete types together. 3.0 and 4.0 are not all inclusive since the "limit" component is only an Alaskan limit.

Classes 8.1-8.5 are not necessarily combination boats. This determination would require a horsepower component.

Classes 9.1-9.3 for the most part have small engine capacity and therefore no trawl potential.

A crabber/processor class is required, of which there are currently 5 either active or capable of entry at this time. This class could also accommodate trawler/processor vessels for groundfish.

2. Please look at Table 3 and indicate if the hold capacity shown corresponds to that of your boat. If your answer is no, please indicate the approximate hold capacity of your boat.

Kodiak response: (see Table A-2)

Seattle response: Because vessel classes are so inconsistent, the hold capacity figures are questionable.

3. Do you feel 20 lbs. of live crab per cubic foot of hold capacity is an accurate conversion factor? If your answer is no, please indicate a more accurate measurement in lbs.

Kodiak response: Twenty pounds of live Tanner per cubic foot of "live tank" is not unreasonable. However, depending on weather, sea conditions, temperature, and the condition of the crab, the usual conversion used locally is 27 lbs. live weight/cu. ft. Tanner, and 24 lbs. live weight/cu. ft. for king crab.

Seattle response: 27 lbs. of Tanner/cu. ft.
24 lbs. of king/cu. ft.

4. On the average is your hold filled to capacity on every trip? If your answer is no, what percentage of your hold capacity is filled on the average on a per trip basis?

Kodiak response: It makes no sense in most cases to use such an estimate on a per-trip basis. But if pressed for a figure, perhaps one might expect to average 60-75% of live tank capacity per trip, subject to all of the constraints cited in question 3, above.

Note: There was some general confusion as to the length increments. Were they taken to be keel length or overall vessel length?

Seattle response: This question makes no sense in real world terms. It depends on too many variables, chief among which are weather, water temperature, rate of catch, condition of crabs, and processor rotation schedules. Also it makes no sense to talk about "hold," unless you define hold to equal

live tank. Dead loss is a component which figures significantly in the decision to either continue fishing or move to the processor.

Incidentally, while fishermen (boat owners) are independent businessmen, characteristically each fisherman tends to fish for a particular processor or plant on the basis of a "gentlemen's agreement." That is, there are rarely any written contracts binding a fisherman to a processor. But most fishermen do informally agree to deliver their catch to a particular processor. Some of these agreements may be linked to gear storage arrangements, fuel and/or stores allowances, and even low cost loans arranged between the processor and fisherman to purchase gear, etc.

TABLE A-1*

Pounds Per Landing Summary and
Total Harvesting Potential by Area

(Based on Total Hold Capacity
of 93-Vessel Sample in Kodiak of
4,521,406 lbs. of Live Crab)

	<u>Eastern Bering Sea</u>	<u>Kodiak</u>	<u>Southern Peninsula</u>
(1) No. Vessels	43	88	32
(2) Row 1 as % of Vessels in Kodiak Sample (=93)	46.2%	94.6%	34.4%
(3) Annual No. Landings	305	902	302
(4) Annual No. Lbs. Landed	22,341,475	23,446,245	7,240,881
(5) Annual Avg. Lbs./Landing	73,250	25,993	23,976
(6) Lbs. of Landing Capacity per Landing ¹	2,088,889	4,277,250	1,555,363
(7) No. Trips/Month	3 (assumption)	4 (assumption)	3 (assumption)
(8) Length of Season in Months	9 (assumption)	4 (assumption)	9 (assumption)
(9) Total Annual Capacity in lbs.	56,400,003	68,436,000	41,994,801
(10) Row 4 as % of Row 10	39.6%	34.2%	17.2%

*Note: This Table does not contain final capacity estimates.
For the latter see Table 1, Appendix A - Section 1

¹Based on total hold capacity of 93-vessel sample in Kodiak of
4,521,406 lbs. of live crab. Derived by Row (1) times 4,521,406
lbs.

TABLE A-2

The Range and Mean of Hold Capacity of Vessel Classes

<u>Class</u>	<u>Hold Capacity (cu. ft.)</u>	
	<u>Range</u>	<u>Average</u>
1.0	100 - 750	406.9
2.0	300 - 1000	590.0
3.0	500 - 1250	1035.7
4.0	1250 - 2500	1625.0
5.0	N.A.	1000.0
6.1	N.A.	1000.0
6.2	2500 - 10000	4375.0
7.0	1000 - 1500	1250.0
8.1	1500 - 4000	2800.0
8.2	2500 - 4500	3000.0
8.3	2500 - 5000	3500.0
8.4	2500 - 6500	5500.0
8.5	6500 - 9800	7500.0
9.1	1000 - 4000	1836.4
9.2	1500 - 4500	2704.5
9.3	3000 - 6500	4750.0
10.1	1000 - 3000	1040.3
10.2	6500 - 11500	8250.0

APPENDIX A

Section 3

Negotiated Ex-Vessel Prices

Prices for Tanner crab on the ex-vessel level are determined in negotiation at the start of the season. In Kodiak these price negotiations are carried out between the Fisherman's Association, the United Fishermen's Marketing Association and the large processors, usually four or five in number. Historically a leading firm establishes the first contract price and the others then follow suit. Statements in price negotiation are often broken by the arrival of the season's first boat load of crab. The price established for Tanner crab at these meetings acts as floor for subsequent pricing of crab as the season progresses. Prices in the Westward area are determined in the same manner, either at the fishing port or in Seattle. The negotiation for the fishermen in these areas is the North Pacific Fishing Vessel Owner's Association.

When a fisherman arrives in port with a hold of crab, he has two alternatives. He can sell his catch to the processor at a mutually agreed upon price, or he can undertake what is known as a "direct sale." In this unusual instance the fisherman will pay the processor to process his crab and he will then in turn sell his processed catch directly to a wholesaler or broker. Usually the motivation for undertaking a direct sale is the circumstance where a fisherman is landing a very large catch of crab and the processor is unwilling to give him a price which the fisherman feels is adequate.

APPENDIX A

Section 4

Primary Processing Requirements for Tanner Crab

The primary processing issue for Tanner crab divides itself into two categories, state statutory regulation and interpretation of the Fishery Conservation and Management Act of 1976.

Primary Processing in the State of Alaska has historically been more a policy than a statutory issue. Only in the case of king, dungeness and Tanner crab is there a written law covering instate processing requirements. This came about as a result of circumstances in Wrangell, Alaska where dungeness crab were being shipped live to Seattle to take advantage of higher prices there. The statute restricting shipments of live crab from Alaska was enacted in 1962 and amended in the years 1966 and 1969. The present law preceded by Legislative Finding number 6 on the "spirit" of crab conservation regulations appears below:

Alaska Statutes

Sec. 16.10.180 Legislative Findings

(6) Conservation regulations should not be promulgated to impose economic sanctions.

(§ 1 CR 121 SLA 1960)

Article 5 Transportation of Fish and Shellfish

Sec. 16.10.240 Transportation of King, Dungeness or Tanner Crab

No person may take out of, ship, transport, or send from the State any live king crab, species *Paralithodes camtschatica*, live dungeness crab, species *Cancer magister*, or live Tanner crab, species *Chionoecetes bairdi*, except that all

these species may be shipped live via air freight after pre-packaging.

The first point at issue here is that it is not entirely clear that if legislators found item 6 under Legislative Findings to be a valid and in fact necessary stance on the issue of shellfish conservation, why in fact they allowed Section 16.10.240 to come into being at all. The second issue, relating to the statute itself, involves the interpretation of the word "state." Is state defined in the sense of fishing port or other dry land base of operation or does it refer to state in the sense of surrounding waters of the state? Here again surrounding waters for the purposes of shellfish conservation were not defined in the strict 3-mile limit sense but in terms of the entire geographic ocean area king, dungeness and Tanner crab were to be found in. This aspect was contested in 1974 in the Hjelle vs. Brooks case where the U.S. District Court ruled in favor of the State of Alaska's right to extend regulation of shellfish beyond the 3-mile limit to include the entire geographical niche occupied by the species involved.

At present the shellfish law is enforced strictly in the transportation context, i.e., if you harvest king, Tanner or dungeness crab within the regulatory area you cannot land them live anywhere other than in an Alaskan port. The law clearly does not address, nor was it originally meant to address, the question of at-sea processing. The stance of the state has been to hope this issue didn't arise since they have no legal means to deal with it outside the 3-mile limit. Now that the 200-mile limit legislation is in effect, these questions will be dealt with through federal channels.

The controversy involved in the interpretation of the FCMA revolves around the definition of the term "fishing" and in particular the meaning of the phrase which appears under item D [Sec. 3(10)] in the definition of the term "fishing."

(d) any operations at sea in support of, or in preparation for any activity described in paragraphs (a) through (c).

Item (d) does not specify the vessel categories involved in the phrase "any operations at sea in support of."

This becomes of crucial importance in Sec. 204(a) where the general discussion of permits for foreign fishing appears. Sec. 204(a) states:

(a) In General.--After February 28, 1977, no foreign fishing vessel shall engage in fishing within the fishery conservation zone, or for anadromous species or Continental Shelf fishery resources beyond such zone, unless such vessel has on board a valid permit issued under this section for such vessel.

If it is unclear what vessel categories are involved in sea support operations, then it is also unclear which vessel categories need to be licensed other than those actually engaged in the harvesting of fish or Continental Shelf resources. Furthermore, if the act is interpreted as meaning all vessel categories need permits, then the question of quotas becomes a cloudy issue.

For example, if U.S. vessels harvest fish and unload their catch on a foreign floating processor which has a permit categorizing it as a fishing vessel engaged in fishing, then whose quota (U.S. or foreign) does that catch belong to?

It is not the intent of this report to take a stance on an interpretive issue such as is involved here, particularly since any particular interpretation may unintentionally coincide with vested interests, but merely to identify possible sources of conflict in an informative manner. It is, however, highly advisable to have legal clarification of this matter and a uniform policy which all eight regional councils could agree on and adhere to.

APPENDIX B
TANNER CRAB PROCESSING CAPACITY SURVEY

Tanner Crab Processing Capacity Survey

A comprehensive survey was conducted by the study team in order to estimate the processing capacity for Tanner crab from the Bering Sea. All plants having capacity to process Tanner crab, from Kodiak west, were included in the survey. The processing capacity was divided into two geographical areas: The Westward area, which includes processing facilities at Dutch Harbor, Unalaska, Akutan, Sand Point, King Cove and Chignik; and the Kodiak area which includes all of the plants in Kodiak with capability to process Tanner crab (see Figure 1). While it is recognized that most Tanner crab from the Bering Sea are presently being processed in the Westward area, Kodiak plants were included in the survey also. There is a five or six cent differential in price paid to the fishermen between Kodiak and Westward areas. Vessels attracted by this differential or on their way to home port do deliver crabs to Kodiak plants. With the possibility of an increased domestic crab catch, this amount may become more significant in the future.

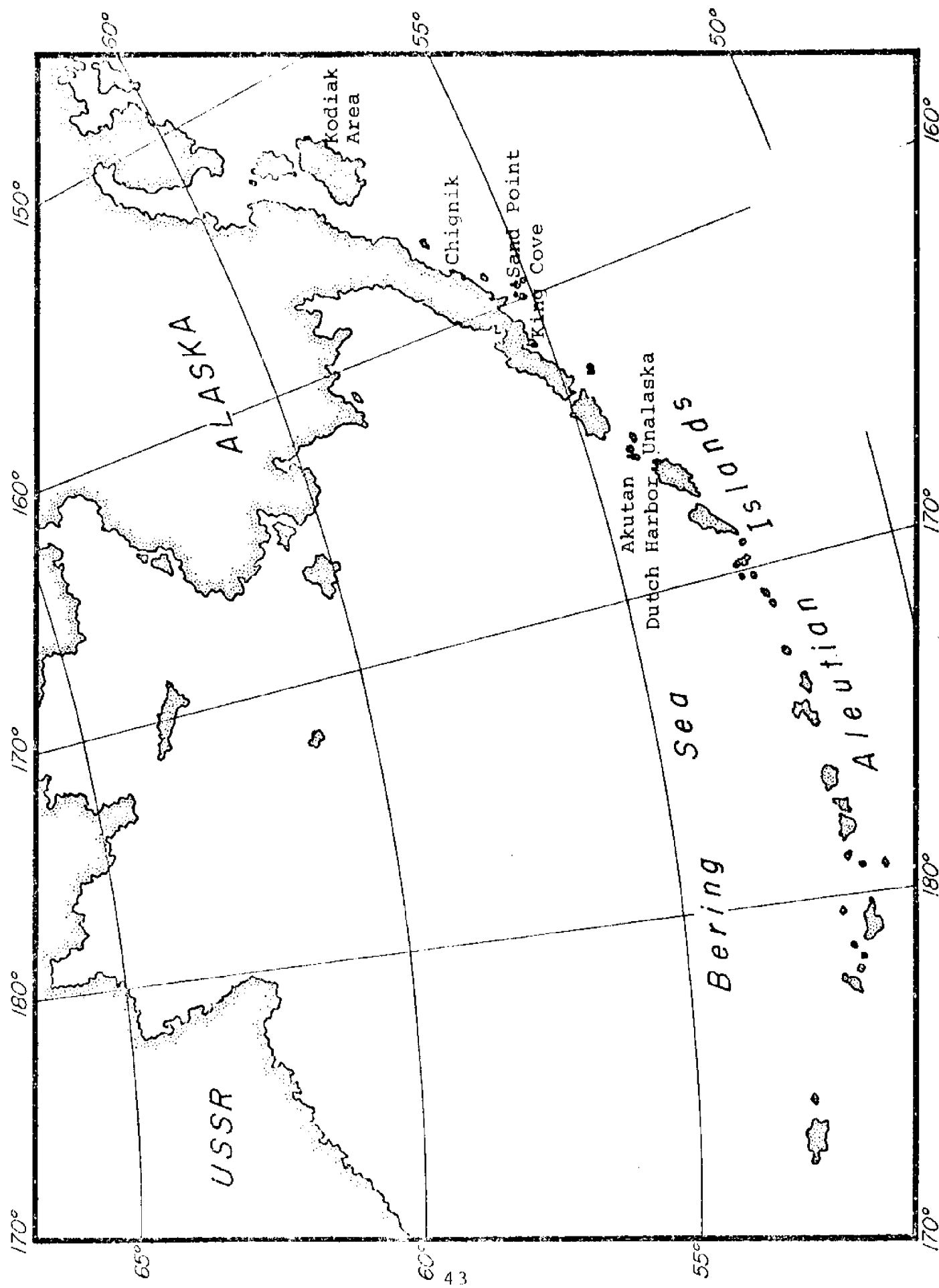
The companies and plants included in the survey are listed below.

Westward Area

Alaska Shell
M/V Alaska Shell
M/V Northern Shell

Alaskan Packers Association
Chignik plant

FIGURE 1



All Alaskan Seafoods Inc.
M/V All Alaska

Deep Sea Inc.
M/V Deep Sea

Dutch Harbor Seafoods
M/V Galaxy

New England Fish Co.
M/V Theresa Lee

New Northern Process
M/V Aleutian Fjord

Pacific Pearl
M/V Akutan
Unalaska plant, Captains Bay
Sand Point plant

Pan Alaska
Magellan Barge
M/V Royal Alaskan
Unalaska plant

Pelican Cold Storage
M/V Pricilla Ann

Peter Pan Seafoods Inc.
King Cove plant

Queen Fisheries
M/V East Point

Sea Alaska Products
M/V Sea Producer
M/V Sea Alaska

Trident Seafood Corp.
M/V Billican

Universal Seafoods Ltd.
M/V Unisea

Vita Food Products
M/V Vita
M/V Viceroy

Whitney Fidalgo Seafoods Inc.
M/V Mokahana
M/V Whitney

Total 25

Kodiak Area

Alaska Pacific Seafoods Inc. plant
Alaska Packers Association plant
B & B Fisheries Inc. plant
Columbia Ward Fisheries--Icy Cape
East Point Seafood plant
King Crab plant
New England Fish Co.
 Gibson Cove plant
New Northern Process
 M/V Skookum Chief
North Pacific Processors Inc. plant
Northern Lights Native Group--Port Lyons
Pacific Pearl
 Main plant
 Roxanne Division
Swiftsure Alaska Inc. plant
Whitney Fidalgo plant

Total 14

Processing Capacity Estimates

The maximum Tanner crab processing capacity for each plant was calculated from data collected by questionnaire (see attachment #1 to this appendix). Due to the importance of maintaining the confidentiality of data released to the study team, results are aggregated by area so that information from individual plants cannot be identified.

I. Westward Area

The capacity figures for this area were derived from the

data received from twenty of the twenty-five plants with capability for processing Tanner crab. Of the five plants not included, four were not included because they did not return the questionnaire in time to be included in this report. Also, the M/V Aleutian Fjord was not included although it did process Tanner crab in 1976, because it is not clear at this time that it will continue in the Tanner crab fishery. Although it would have been desirable to have the processing capacity of all of the plants included in the report, the four omissions are not critical. They would only change the magnitude of the results, not the conclusion.

The maximum capacity, actual capacity and percent capacity utilization is shown in Table 1 below, broken into product form.

Table 1
Tanner Crab Processing Capacity--Summary Table
Westward Area

	Frozen Sections (in lbs. round wt. crab/day)	Frozen and Canned Meats (in lbs. round wt. crab/day)	Total Daily Capacity in lbs. of Crab (round wt.)
Maximum Capacity	1,552,416	532,831	2,085,247
Actual Operation	583,648	300,104	883,752
Capacity Utilization	.37	.56	.42*

*Weighted average.

Source: Tanner crab survey questionnaires--20 processing plants included.

From the table, it can be seen that the maximum total daily capacity to process Tanner crab in the Westward area is 2,085,247

pounds raw crab per day, broken down into 1,552,416 pounds raw crab per day for sections and 532,813 pounds raw crab per day for frozen and canned meats. It is important to note that this is the maximum reasonable daily production capacity with existing facilities, based on data and estimates from the twenty plants participating in the survey. For many plants, the maximum capacity includes double shifting, which is not presently being done because of product supply constraints or other limiting factors. This was, however, in each case indicated to be an attainable figure, assuming conditions merited the effort.

It also should be noted that the breakdown of maximum capacity between sections and meats is not rigid and will react to market conditions. For example, several plants indicated that they do not have the facilities to produce both products at the same time, and run either sections or meats. In order to prevent double counting, their maximum capacity was included under the section total. In the event that they would produce all meat, the maximum daily capacity shown in Table 1 would be increased by approximately 200,000 pounds per day, and the section total would decrease by an equivalent amount.

Several companies indicated that some part of their production from Westward plants is shipped south in section form to west coast plants from Washington to California. The sections are further processed into meat products at these plants. The total amount of Tanner crab re-processed in this manner is not

known, however, this does provide a further indication of product mix flexibility.

The figures for actual operating production were calculated in an attempt to determine what percent of maximum possible capacity is being utilized. This average actual production proved a difficult figure to obtain. Many plants operate an irregular shift length for many days and then shut down waiting for product. External factors such as bad weather, shipping problems, fishing effort and success, etc. cause production to vary. Also there were several companies which did not provide sufficient data to calculate actual operating production. In these cases, production data from the 1976-77 season or estimates were used. However, the total actual production shown in Table 1 should be indicative of the proportion of total possible capacity utilized, which can be seen to be 37% and 56% for sections and meats respectively.

Participation in Tanner crab processing is increasing in the Westward area as shown below.

Numbers of Westward Plants Processing Tanner Crab

1975/76 Season	17
1976/77	18
1977/78 (projected)	23

There were seventeen plants which produced Tanner products in the 1975/76 season. This was increased to eighteen this (1976/77) season. The figure of twenty-three plants which will be processing Tanner in the 1977/78 season consists of:

- (a) the plants processing this year

- (b) three new vessels which have only had pilot operations this year and will go into full operation next year
- (c) one vessel which has not previously processed Tanner and indicated it will next season, and
- (d) one new vessel scheduled to be completed and in operation next season, the M/V Royal Sea, which was not included in the capacity survey.

There are also three plants included in the capacity survey which indicated they would not process Tanner crab in the 1977/78 season due to market conditions or other factors.

Expansion of Present Facilities

As part of the survey questionnaire, each processing company surveyed was asked if they had plans for expanding their production facilities for processing Tanner crab, and if so what the determinants of the decision to expand would be. Of the twenty Westward plants participating in the survey, ten indicated that they had plans for expanding their facilities, either presently underway, or to be started in the near future. The plans for expansion consist of additions to production lines, freezing capability and additions to cold storage capacity.

The determinants which will influence the decision on expansion vary. Some typical replies were:

- Japanese market conditions
- length of season/quotas
- an increase in demand for domestic Tanner crab products

- availability of raw crab
- prospects for a more realistic market price

The plants not planning expansion of facilities obviously felt that investment was not warranted at this time. This attitude was indicated by a quote from the president of one company surveyed, "With the present allowable catch, justification (for expansion) is limited because the current processing capabilities in the Dutch Harbor area can handle the production."

II. Kodiak Area

The capacity figures for the Kodiak area were determined in the same manner as for the Westward area. Of the fourteen plants in Kodiak having capacity to process Tanner crab, twelve participated in the survey. Again, the two plants which were not included did not respond to the questionnaire in time to be included in this report.

The maximum capacity, actual capacity and percent capacity utilization is shown in Table 2 below, broken into product form.

Table 2
Tanner Crab Processing Capacity--Summary Table

	Kodiak Area		
	Frozen Sections (in lbs. round wt. crab/day)	Frozen and Canned Meats (in lbs. round wt. crab/day)	Total Daily Capacity in Lbs. of Crab (round wt)
Maximum Capacity	582,627	767,865	1,350,492
Actual Operation	265,306	293,820	559,126
Capacity Utilization	.46	.38	.41*

Source: Tanner crab survey questionnaires--12 processing plants included
* Weighted Average.

From the table, it can be seen that the maximum total daily capacity to process Tanner crab in the Kodiak area is 1,350,492 pounds raw crab, broken down into 582,627 pounds raw crab per day for sections and 767,865 pounds per day for frozen and canned meats. These figures are calculated from data and estimates provided by the twelve participating plants. In the majority of cases, the maximum capacity figures involve a double shift which is not now being utilized, due to product supply constraints or other limiting factors. As was the case for the maximum capacity for the Westward area, the maximum capacities for plants in the Kodiak area were indicated to be an attainable figure, assuming product was available and other conditions favorable.

The figures for actual operating production were calculated in an attempt to show what percent of each plant's maximum capacity is being utilized. Data used to calculate this figure was based on average plant production estimates, which as previously mentioned were difficult to arrive at due to the influence of external factors. The capacity utilization calculated for section and meats production are shown in Table 2 to be .46 and .38 respectively.

Another estimate of the amount of crab actually processed per day in the Westward and Kodiak areas can be calculated from harvest estimates for this year.

Bering Sea	40 - 50 million pounds
Southern Peninsula	9 million pounds
Chignik	11 million pounds
Kodiak	20 million pounds

Assuming that one-half of the Chignik-Southern Peninsula catch is processed in each of the Westward and Kodiak areas, the total amounts of crab processed will be:

Westward Area	60 million pounds
Kodiak Area	30 million pounds

The range of days of plant operation of plants surveyed varied from 60 days to 120 days. For purposes of estimation, 75 days was used as an average operating season. From this, an approximation of the amount of crab actually processed per day in each area is:

Westward Area	800,000 pounds raw crab/day
Kodiak Area	400,000 pounds raw crab/day

These figures are lower than the amount of crab processed in daily operation calculated from survey information. The difference can probably be attributed to the difficulty in estimating average daily production at the individual plant level. The effect a lower daily actual production will have on the percent capacity utilization will be to lower it slightly, which only reinforces the conclusion stated in the summary that adequate capacity presently exists for increased catches of Tanner crab.

Expansion of Present Facilities

The basic number of plants processing Tanner crab in Kodiak remained the same this year as in the 1975/76 season. However, there were two new plants starting production this year, which increase overall total capacity. Of the twelve Kodiak plants participating in the survey, seven indicated that they had plans for expanding their facilities, either presently underway, or to

be started in the near future. The plans for expansion include additions to production line capacity, canning capacity, freezing capability and cold storage capacity. Of the companies surveyed in the Kodiak area, the determinants which will influence their decision or expansion were consistent. Every company replying to this question stated that the availability of raw crab was the factor which would determine their investment in expansion of processing facilities.

Factors Limiting Tanner Crab Production

Several common factors which are limits to achieving maximum production of Tanner crab were listed by the companies surveyed. Some of the limiting factors identified are:

- availability of raw crab to processors
- continuity of supply of crab from fishermen
- availability of section quality crab
- problems with transporting finished product
- shortage of labor and housing for labor
- limitations of frozen storage capacity
- limitations of production-freezing facilities
- different species competing for processing facilities

For the Westward plants, perhaps the most important of these factors is the problem of transportation. Most of the plants are floaters rather than shore-based plants and have limited cold storage facilities. Usually, product is loaded immediately into refrigerated vans, barges or freight ships and shipped when full. The cold storage space can become a constraint, however, when bad weather or a strike slows down the shipping of product.

In response to this problem, many companies have planned expansion of cold storage space, or started operation of their own barge or freighter for transport.

Of the plants surveyed in Kodiak, the most frequent limiting factor expressed was lack of supply of raw crab. The survey was conducted in April after the Tanner quota for the Kodiak area had been filled. Most plants at that time were only running part shifts a couple of days a week.

ATTACHMENT 1--APPENDIX B

Company Code _____

Plant Code _____

Contact Code _____

Short-Term Economic Study: Tanner Crab

A Survey of Processing Capacity and Capacity Utilization

1. Crab products processed in 1975 and 1976 (net pounds)

<u>Product</u>	<u>King</u>		<u>Tanner</u>		<u>Dungeness</u>	
	<u>'75</u>	<u>'76</u>	<u>'75</u>	<u>'76</u>	<u>'75</u>	<u>'76</u>
Canned Meats						
Fresh/Frozen Meats						
Fresh/Frozen Sections						

2. Time distribution of raw crabs processed in 1976 by month (in thousands of lbs.)

<u>Month</u>	<u>King Crab</u>			<u>Tanner Crab</u>			<u>Dungeness Crab</u>			<u>Other Product List Major Species</u>
	<u>Fresh/Frozen</u>			<u>Fresh/Frozen</u>			<u>Fresh/Frozen</u>			
	<u>Canned</u>	<u>Meats</u>	<u>Sects</u>	<u>Canned</u>	<u>Meats</u>	<u>Sects</u>	<u>Canned</u>	<u>Meats</u>	<u>Sects</u>	
Jan.										
Feb.										
Mar.										
Apr.										
May										
Jun.										
Jul.										
Aug.										
Sep.										
Oct.										
Nov.										
Dec.										

3. Average number of days per year plant is in operation producing tanner crab products.

4. Average recovery factors (in % of round weight) by month

Month	King Crab			Tanner Crab			Dungeness Crab		
	Fresh/Frozen			Fresh/Frozen			Fresh/Frozen		
	Canned	Meats	Sects	Canned	Meats	Sects	Canned	Meats	Sects
Jan									
Feb									
Mar									
Apr									
May									
Jun									
Jul									
Aug									
Sep									
Oct									
Nov									
Dec									

5. General flow chart describes processing method for tanner crab. If your processing operation is different than as shown, please outline differences.

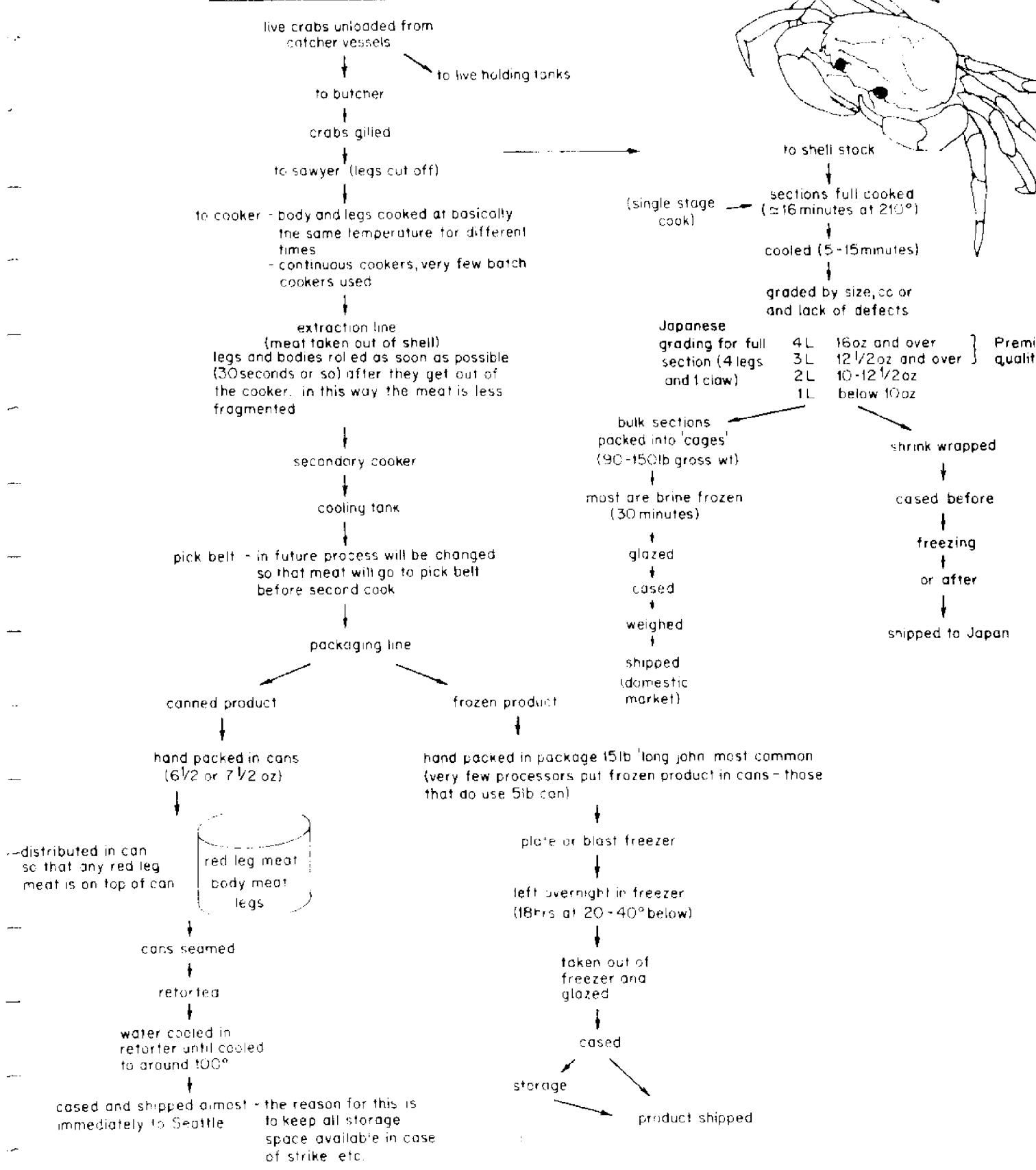
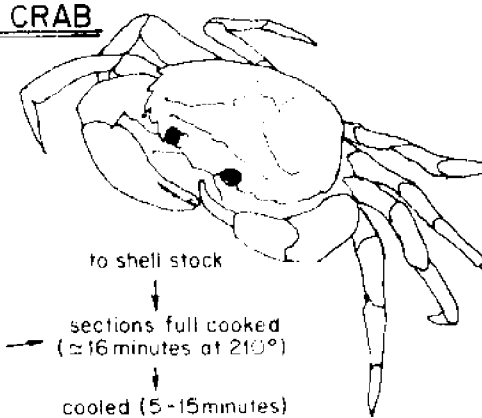
6. Capacity estimates

Canned Meats

(a) Number and size of canning lines

(b) Type and make of lines

FLOW CHART - STEPS IN PROCESSING TANNER CRAB



distributed in can so that any red leg meat is on top of can



cased and shipped almost immediately to Seattle - the reason for this is to keep all storage space available in case of strike etc.

- (c) Maximum sustainable rate of production (cases per hour) on each line

- (d) Actual average production, cases per shift (accounting for shutdowns and maintenance)

- (e) Maximum hours per shift and maximum number of shifts possible per 24 hour period

- (f) Actual average number of shifts in 24 hour period and normal length of shifts during crab season

- (g) Limiting factors
 - E.g. - Continuity of supply of crabs from fishermen (which months)
 - Quality of raw crabs
 - Competing product/species uses for processing equipment (which species and months)
 - Supply of labor
 - Limited capacity on part of line
 - Equipment and maintenance

Frozen Meats

- (a) Maximum freezing capacity in pounds per freezing cycle
- (b) Number of freezing cycles possible per shift
- (c) Number of freezing cycles possible per 24 hour period
- (d) In actual operation is each freezing cycle filled to capacity? If not, what % of the total lbs. capacity is used per cycle?
- (e) Freezing cycles actually run per shift
- (f) How many shifts operate on the average during a 24 hour period?
- (g) Maximum storage capacity (may include off plant storage, public storage, etc.)
- (h) Percent of maximum storage capacity used during average operation
- (i) Limiting factors:

Frozen Sections

- (a) Maximum freezing capacity in pounds per freezing cycle
- (b) Number of freezing cycles possible per shift

- (c) Number of freezing cycles possible per 24 hour period
- (d) In actual operation is each freezing cycle filled to capacity? If not, what % of the total lbs. capacity is used per cycle?
- (e) Freezing cycles actually run per shift
- (f) How many shifts operate on the average during a 24 hour period?
- (g) Maximum storage capacity (may include off plant storage, public storage, etc.)
- (h) Percent of maximum storage capacity used during average operation
- (i) Limiting factors:

7. Plans for future expansion

Does your company have any plans to expand this plant's facilities for processing tanner crab in the future? If so, what additions are planned?

- _____ addition to canning capacity
- _____ addition to freezing capacity
- _____ addition to frozen storage capacity

Does your company operate or have future interest in operating factoryships on the Bering Sea?

What are the determinants that will influence your decision on expansion?

APPENDIX C
MARKET STRUCTURE

Table 1

Tanner Crab Production: Companies, Plants, and Concentration

No. of Companies	Products			Canned Meats			Frozen Meats			Frozen Sections		
	1975	1976	Change	1975	1976	Change	1975	1976	Change	1975	1976	Change
Total ¹	15	17	+2	4	5	+1	2	7	+5	15	16	+1
Westward	4	11	+7	0	1	+1	0	6	+6	4	11	+7
Kodiak	13	10	-3	4	4	0	2	2	0	13	9	-4
Number of Plants												
Total	19	26	+7	4	5	+1	2	11	+9	18	24	+6
Westward	5	15	+10	0	1	+1	0	9	+9	5	15	+10
Kodiak	14	11	-3	4	4	0	2	2	0	13	9	-4
Firm Production Concentration Ratios ²												
Total (Kodiak & Westward)	.53	.52	↑	1.00	.94	↑	a	.90	↑	.61	.49	↑
Largest 4 Firms	.86	.78	↑	b	b	-	b	b	-	.86	.77	↑
Westward												
Largest 4 Firms	1.00	.73	↑	a	a	-	a	.97	↑	1.00	.67	↑
Largest 8 Firms	b	.95	↑	b	b	-	b	b	-	b	.90	↑
Kodiak												
Largest 4 Firms	.79	.68	↑	1.00	1.00	-	a	a	-	.75	.88	↑
Largest 8 Firms	.92	.97	↑	b	b	-	b	b	-	.91	.99	↑
Production (in equivalent lbs. of meat)												
Total	1975	1976		1975	1976		1975	1976		1975	1976	
Westward	4,152,227	9,872,014		c	c		c	c		3,440,761	6,631,264	
Kodiak	1,388,565	5,580,515		0	c		0	c		1,388,565	3,913,990	
Production (in percent)												
Total	100.0	100.0		100.0	100.0		100.0	100.0		100.0	100.0	
Westward	33.4	56.5		0	c		0	c		40.4	59.1	
Kodiak	66.6	43.5		100.0	c		100.0	c		59.6	40.9	

1 Exclusive of duplication
 2 The concentration ratio measures the production of the largest four (eight) firms as a percent of the total production in each market.

Key: a - fewer than 4 firms; see top of table for number
 b - fewer than 3 firms; see top of table for number
 c - cannot be released to protect confidential individual-firm information

APPENDIX D
SNOW CRAB MARKET SURVEY
CALIFORNIA REGION
MAY 16, 1977

APPENDIX D

Section 1

Snow Crab Market Survey--California Region

Purpose of Study: To describe the market channel distribution, volume and trends of snow crab¹ sales in California since 1975. The central objective of the survey was to make a reliable forecast statement on the growth potential of snow crab markets in California in 1977-78 by identifying contributing market factors.

Study Objectives:

1. Description of market structure and geographic distribution of markets; size and specific marketing activity.
2. Document annual change in volume of snow crab sales ince 1975.
3. Explain reasons behind snow crab marketing activity. The explanatory variables most responsible; quality, availability of products, consumer shift from king crab and dungeness to the snow crab or development of new markets.

The following information was needed to estimate the growth potential for snow crab in California:

1. Annual sales volume from 1975 to present.
2. Product origin.
3. How much more product could be marketed if all factors were held constant.
4. Number of sale outlets, geographic area of sales distribution, and type of sale outlets (restaurants, institutions, etc.).
5. Quality of snow crab products compared to other crab seafood products.
6. Length of time the product has been marketed by the firm and why.
7. Size of firm.

¹Terminology: In Alaska, the area of production, the common name Tanner crab is prevalent, however in the California marketing area the trade name snow crab is widely accepted and will be used in this report.

Snow Crab Market Survey Form Development¹

A survey form was designed to obtain information from individual firms, the following criteria were used in the survey form design: (1) a brief format to minimize the interviewing time period. This is especially necessary when interviewing buyers and other seafood firm employees who are extremely busy during the work day. (2) Continuity of replies. Certain biases on the part of both interviewer and respondent are impossible to eliminate entirely; however, if the number of interviewers are kept to a minimum and they are coached as a team bias can be reduced.

Survey questions one and two were designed to compensate for interviewer bias. Question two was designed to determine the substitute effect on snow crab for other shell fish (specifically crab products) and the explanatory variables of price quality, supply availability and consumer taste and preference would be explained in answers to this question.

Sample Size:

Population

There are an estimated 676 food wholesalers and 177 brokers in the state of California who market seafood products. Most of the wholesalers that are involved in seafood marketing are small firms or they specialize in meat or produce and offer seafood as a convenience item for their customers. In addition, there are a number of Japanese traders who import and export seafood.

¹A copy of the survey form is included in the Appendix.

Firms that Market Seafood Products in the State of California

	Los Angeles Southern California	Bay Area	Remainder of California	Total
Brokers	71	81	25	177
Wholesalers	305	120	251	676
Area Total	376	201	276	853

National Marine Fisheries Service, Market News and Statistics personnel in the Southwest Regional Office estimate that approximately 100 California wholesalers and 33 brokers buy and sell the bulk of domestic and imported snow crab products on a regular basis. These 133 firms represent the sampling frame. A 23 percent sample (30 firms) was drawn from the sampler frame.

Sixty-five of the wholesalers in the sample are located in the Southern California marketing area. Thirty-five percent of these firms were interviewed. Fourteen brokers were also interviewed in the Los Angeles-Southern California marketing area. These brokers are thought to represent all of the major brokerage marketers of snow crab in the Southern California region. Four brokers were interviewed in the San Francisco Bay Area for a total of 17 brokers representing over a 50 percent sample of brokerage firms in California.

Why the Survey Was Conducted in California

It is realized that the greatest part of the volume of domestic snow crab marketed in the United States is sold through firms located in Seattle, Washington. There are seven major processor-distributors located in Seattle that are integrated with Alaska

packers that process and distribute snow crab, both domestically to the Midwest and East Coast markets. They also export to Japan.

However, the California survey was undertaken to try to portray a broader profile of the marketing activity for this product. Because of California's large population (over 20 million individuals) and because it is a coastal state, this area is a good indicator of seafood demand trends. California probably represents the greatest concentration of marketing activity for snow crab in the United States.

The cadre of marketing firms that perform the service of distributing seafood products in the state represent several levels within the marketing chain and their reaction to questions on consumer demand can add to the knowledge of the underlying demand factors for this product.

Results of Survey: An estimated 20 to 27 percent of Alaska's snow crab production is distributed in California. The survey results indicated that the restaurant trade purchased 36 percent of the snow crab meats marketed in California in 1976 and only two percent of the legs, claws and sections.

Retail supermarkets and grocery stores purchased 67 percent of the in-shell products and only eight percent¹ of the meats.

An estimated ten million pounds of snow crab in-shell products were marketed in California in 1976, almost one million pounds of frozen snow crab meat was sold in the state of California that same year.

¹A significant amount of snow crabmeat is usually packaged under trade labels and is sold directly from Alaskan or Seattle based processors, therefore undoubtedly some of this product circumvents intermediate markets in the chain and much of this volume was probably accounted for in this survey.

Exclusive of recruitment 15 firms reported a 67 percent increase in total sales of frozen in-shell crab. A 20 percent increase of snow crab meat sales occurred during the same period.

The results of the survey indicate that snow crab sales accounted for 45 percent of the crab sales for those firms indicating they sold snow crab in Southern California. This was followed by king crab at 40 percent and dungeness at 15 percent.

Snow crab was surprisingly competitive with dungeness crab in the San Francisco Bay Area. This is particularly surprising because West Coast dungeness crab production was extremely high last year and the San Francisco Bay area is a traditionally dungeness crab marketing region.

Most respondents to the survey stated that snow crab is not a substitute for king crab or dungeness crab in California. The fact that snow crab markets have an identity of their own was strongly supported by the survey respondents. Although some substitution effects must exist, particularly for king crab sales, this is not a major contributing factor to snow crab market development.

Based on the results of the survey, the conclusion was reached that there is a substantial growth potential for snow crab markets in California in 1977-78. Supply factors that will influence the development of snow crab markets in California will undoubtedly be the cyclic decline of dungeness crab stocks. Also, the abundance and availability of king crab and snow crab stocks to American fishermen will play a large role in market development. Probably the single most important factor in the increase in the demand for snow crab products will be the introduction of the product to consumers. Since snow crab is apparently not a major substitute food commodity there are undoubtedly many consumers who have not yet had an opportunity to purchase this product.

DESCRIPTION OF MARKETING ACTIVITY IN THE CALIFORNIA REGION

There are two distinct seafood marketing areas in California, Northern and Southern. The Southern area is bordered by San Diego and northward to Santa Barbara. Los Angeles brokers, wholesalers, and processors serve primarily the Southern California area. The Los Angeles seafood marketing industry distributes to states in the Southwest including Nevada, Arizona, New Mexico, Colorado, and as far east as West Texas. San Francisco is the major distribution point for Northern California.

It is estimated that, excluding Eureka, 80 percent of all the California's fresh fish production is marketed within a 50 square mile radius of the port of landings. From this statistic it becomes obvious that California is not a major primary producer of United States fresh and frozen seafood products, in fact, most of the seafood processed and consumed in California comes from other states and foreign ports. It is estimated that 30 percent of the producer-wholesalers account for 90 percent of the total sales, and four of these firms account for slightly more than 59 percent. Brokers play a large role in the seafood distribution chain and most of them buy and sell on their own account. It has traditionally been considered poor business ethics for a broker to circumvent a wholesaler and sell direct to a retailer, but this custom is changing and more brokerage houses are directing sales toward final markets. Fabrication is continuing to gain a significant portion of the seafood market in the form of pre-cooked, ready-to-cook, and frozen fish dinners, portions and sticks. In recent years, Fish & Chip and fish sandwich carry-out restaurants have increased dramatically in California, and a recent study showed an estimated 250 of these establishments

statewide, accounting for one to six and one-half million pounds of fish fillets and portions per year.

The Los Angeles Southern California marketing area is called the "Salad Market." Because of the warm year-round climate, a significant amount of shellfish is sold to restaurants for salad ingredients. Although king crab legs and claws are a favorite restaurant item, restaurants account for less than three percent of the estimated total in-shell frozen snow crab sales volume of seven million pounds (Table 1). Retail chain store outlets account for approximately 70 percent. Snow crab frozen meat market sales are concentrated in the restaurant trade and it was estimated that over 30 percent of the snow crab meat marketed in Southern California in 1976 was concentrated in that market segment.

DISTRIBUTION OF SNOW CRAB PRODUCT FORMS TO VARIOUS OUTLETS

It is evident that the retail trade gets the "lion's share" of snow crab frozen section and claw products. Restaurants are evidently purchasing a small amount of that product form. Only two percent in 1976 compared to 88 percent of the total in-shell frozen crab sales volume in 1976.

Frozen snow crabmeat sales are more difficult to trace because the majority of the sales volume went to "intermediate" buyers in 1975-76 and the final distribution is difficult to determine.

Restaurant sales of snow crabmeat significantly increased during this period jumping from 11.6 percent in 1975 to over 36 percent in 1976.

Table 1

Percent of Distribution of Frozen Snow Crab
Categorized by Type of Market and Product Form
1975 and 1976

(Southern California)

	1975	1976	
<u>In Shell</u>	Restaurants	0.3	2.0
	Retail outlets	88.4	67.6
	Intermediate distributors	11.3	30.4
	Total	100.0	100.0
<u>Frozen Meat</u>	Restaurants	11.6	36.2
	Retail outlets	9.5	8.1
	Intermediate distributors	78.9	55.7
	Total	100.0	100.0

Region of Marketing Outlets

All of the 30 firms in the survey reported sales in the California area, 8 of these firms directed their sales exclusively in the state. Most of these consisted of the smaller local distributors, wholesalers and restaurants, the product form being about equally divided between in-shell and meat products. Twelve firms market snow crab products in the 11 western states exclusively. Five firms (2 of these in San Francisco) direct sales in the Midwest and the East Coast. These consisted of the larger wholesalers and processors representatives. In general, it appears that crab sections sold by California firms are being marketed on the East Coast and the extracted meat is sold in the Midwest and West Coast.

Rate of Entry into the Snow Crab Markets - Question 1

The estimated growth of the number of firms entering the snow crab market in the Southern California region was fairly constant from 1961 to 1973, averaging less than two per year (Tables 2 and 3). The years 1973 through 1975 saw the greatest increase in growth when 16 out of 23 firms responding to this question indicated they entered the snow crab market.

Reason for Entry into the Snow Crab Market - Question 2

Twenty-three interviewees responded to this question (Table 4). Seven, 30 percent, stated consumer demand, another group of seven replied with the closely related variable of competitive pricing. Four respondents, 17 percent, reported availability or continuity of supply as a reason for market entry and only two respondents, nine percent, stated that snow crab was a substitute for other crab pro-

Table 2

CUMULATIVE TOTAL OF FIRMS RECRUITED INTO THE SNOW CRAB MARKET SINCE 1961 IN THE LOS ANGELES AREA

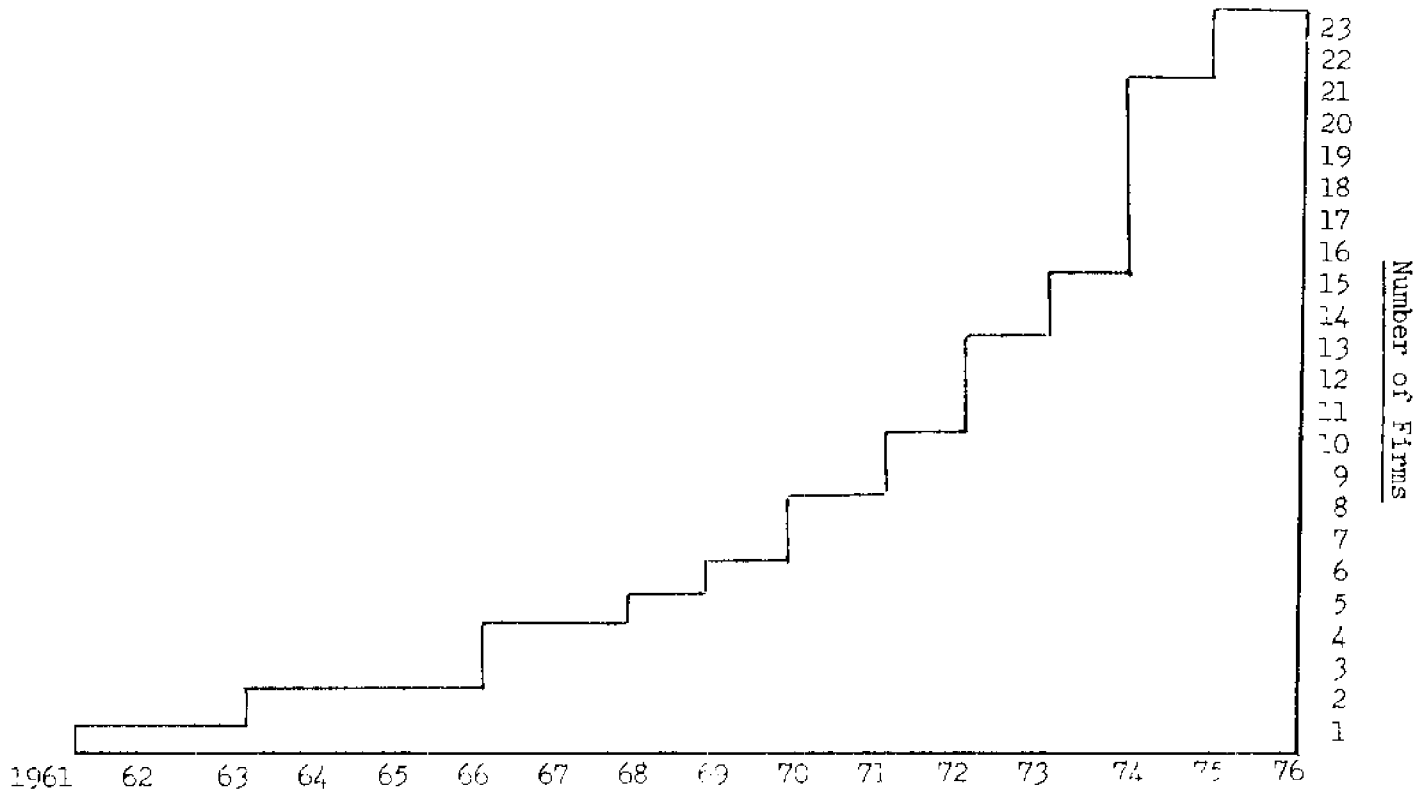


Table 3

NUMBER OF FIRMS RECRUITED INTO THE SNOW CRAB MARKET FOR EACH YEAR FROM 1961 TO 1976 IN LOS ANGELES AREA

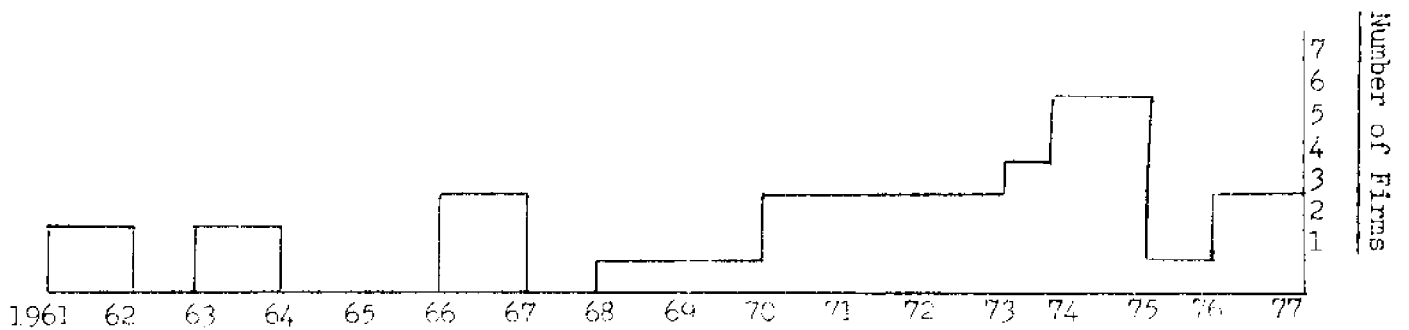


Table 4

Response to the Question of Why Entry was
Initiated in the Snow Crab Market

Reason	Number of Respondents	Percentages of Total
Availability-continuity of supply	4	17.4
Customer demand	7	30.4
Parent company decision	3	13.0
Price	7	30.4
Substitute	2	8.8
Total	23	100.0

ducts. The remaining three replied that a parent company decision was responsible for market entry.

Determination for the Growth Potential in Snow Crab Markets Assuming All Market Conditions Remain Constant - Question 3

Seventeen out of 21 respondents (81 percent) replied positively to this question (Table 5). All of the 21 firms represented buyers of domestic products. Of this group, seven stated demand increases over the last two years will justify supply increases. Seven other respondents stated that snow crab is a firmly established new product and growth in this market will occur regardless of the market activity for other crab products. Four respondents indicated that Japanese export opportunity will increase.

Only two respondents had negative feelings on the subject; they believe that higher production costs will be accompanied by sales price hikes if domestic production is increased. Two other exporters replying to this question believed that domestic production is of superior quality and the product's image would improve with increased domestic production.

THE ESTIMATED TOTAL VOLUME OF SNOW CRAB SALES
IN THE CALIFORNIA MARKETING REGION

The total volume was difficult to determine from the survey. A double counting problem exists because brokers and wholesalers were interviewed, although most of the brokerage sales of frozen crabmeats are directed towards retail and restaurant outlets. We can say with a high degree of confidence that five to six million pounds

TABLE 5

RESPONSES TO POSSIBLE INCREASES IN DOMESTIC
SNOW CRAB QUOTA

Type of Response	Buyers of Domestic Products			Buyers of Imported Products		
	Responding Firms		Reason Cited	Responding Firms		Reason Cited
	Number	Percent		Number	Percent	
Favorable	7	33.2	Increase in demand* inexpensive substitute new acceptance	2	40.0	Good Quality
	3	14.2				
Subtotal (rounded)	7	33.3				
	17	81.0				
Unfavorable	2	9.5	Raises prices	1	40.0	Poor quality; Raises prices
Subtotal	2	9.5		1		
				2		
Mixed Reaction	2	9.5		1	10.0	
TOTALS**	21	100.0		5	100.0	

Note: *Five firms suggested that imported Snow Crab was inferior in quality.
Four firms thought that exporting opportunities would increase.

**Did not add due to rounding.

of in-the-shell crab was marketed in Southern California in 1976 (Table 6). Over 666,000 pounds of frozen snow crabmeat was sold to Southern California market outlets in 1976. The total frozen crabmeat volume in 1976 in Southern California will probably total seven million pounds in 1976. If the snow crabmeat production is calculated back to the whole animal weight at 14 percent yield, 666,000 pounds of snow crabmeat would equal 4.8 million pounds live weight. If the in-shell sales volume was calculated back to pounds in live weight, it would equal 9.1 million pounds. Estimated at a 60 percent recovery rate. An estimated 14 million pounds live weight of Alaska's snow crab was marketed in Southern California in 1976. This represents over 17 percent of Alaska's 82 million pound production for that year.

The Northern California marketing area totals are treated separately because some of the firms represented in that area are integrated with processing activity and their output could be double counted. Seven firms were contacted in the bay area. Most of these firms have direct sales to the Midwest and East Coast making it difficult to estimate total sales volume within the Northern California Marketing region. It was estimated at least a quarter of a million pounds of snow crabmeat and two million pounds of in-shell snow crab products were sold in Northern California in 1976.¹

In summary, 10 million pounds of snow crab legs, claws and sections were marketed in California in 1976. Also there were an estimated 900,000 to one million pounds of snow crabmeat sold in the same time period. The total estimated snow crab sales volume represents 27 percent of Alaska's 1976 production.²

¹See the Northern California perspective by Robert Pata appended to this report.

²200 thousand pounds of meat was imported from Japan, it is not known how much of this product was caught in waters off Alaska.

TABLE 6

TOTAL FROZEN SNOW CRAB SALES VOLUME FOR REPORTING FIRMS
BY MARKET DESTINATION AND YEAR
SOUTHERN CALIFORNIA

Product Form	Type of Markets Serviced	Thousand Pounds ^{1/}	
		1975	1976
In-Shell	Restaurants	4.7 (1)	99.7 (3)
	Retail	1523 (3)	3312 (6)
	Intermediate Buyer	<u>195 (4)</u>	<u>1490 (4)</u>
	TOTAL	1722.7 (8)	4901.7 (13)
	Percent Change		+184.5%
Frozen Meat	Restaurants	50 (2)	241.5 (5)
	Retail	41 (2)	54.2 (2)
	Intermediate Buyer	<u>341 (7)</u>	<u>371 (7)</u>
	TOTAL	432 (11)	666.7 (14)
	Percent Change		+54%

^{1/} Number in parenthesis represents the number of firms represented.

Table 7 shows snow crab volume for 1975 and 1976. Some of the increase in volume shown in the table was due to the entry of firms in the market in 1976. Exclusive of recruitment, a 67 percent increase in sales of frozen in-shell snow crab was indicated (Table 7) , and a 20 percent increase in snow crab frozen meat sales occurred in the same time period.

Species Composition of Crab Sales - Question 5

Our summaries indicated that snow crab sales accounted for 45 percent of total crab sales in southern California for those firms included in the survey. This was followed by king crab at 40 percent and dungeness at 15 percent. The Bay Area survey showed a higher percentage of dungeness sales , but snow crab was surprisingly competitive in that area where an estimated 35 percent of all crab sales were Alaska snow crab in 1976. This does not represent a true marketing perspective in that area however , because most of the region suppliers of dungeness crab were not called upon in the survey .

Imported Snow Crab

Only one firm in the survey reported canned snow crab imports. Japanese traders undoubtedly account for more canned imports in California, however, this information was not available to us at this time. One hundred eighty-nine thousand pounds of snow crabmeat were reported imported from Japan in 1976. This represents approximately 27 percent of the total snow crab frozen meat market in Southern California. None of the firms interviewed reported section purchases from overseas in 1976. Almost all of the importers stated that the Japanese imported snow crab frozen meat

TABLE 7

COMPARISON OF SNOW CRAB VOLUME BY PRODUCT FORM FOR
FIRMS REPORTING IN BOTH 1975 AND 1976

Firm Code	Thousand Pounds					
	Frozen in-shell Meat		Canned Meat		Frozen Meat Out Of Shell	
	1975	1976	1975	1976	1975	1976
1	25	30	0	0	95	95
2	4.7	4.7	4.8	4.8	0	0
3	10	1000	0	0	0	0
4	40	40	0	0	40	40
5	0	0	0	0	45	85
6	0	0	0	0	20	20
7	1400	1200	0	0	0	0
8	2.2	0	0	0	0	0
9	73	72	0	0	38.5	38
10	0	0	0	0	5	8
11	0	0	0	0	2.5	2.5
12	0	500	0	0	45	100.5
13	20	20	0	0	50	50
14	30	20	0	0	50	40
15	120	0	7.6	9	41	41
Total Percentage	1724.9	2886.7 67.3%	12.4	13.8 11.3	432	520 20.4
Average per Firm	115	192	0.83	0.92	29	35

Note: Of the 15 firms reporting figures for both 1975 and 1976, 4 firms indicated slight declines in volume, 5 reported no change, and six showed an increase in sales.

products were inferior in quality and the main reason for marketing this product was the 33 to 40 percent price spread between domestic and imported frozen crab meat.

SNOW CRAB PROJECT

COMPANY: _____

DOMESTIC _____ IMPORTED _____

PRODUCT FORM	VOLUME (lbs.)		MARKETS						
			Number		Type		Location		
	1975	1976	1975	1976	1975	1976	1975	1976	
Frozen Meat									
Canned									
Frozen (in shell)									

1. How long have you been involved in the Snow Crab market: _____

2. How and why did you enter the market? _____

3. If the North Pacific Fisheries Management Council were to increase the quota of Snow Crab for the American fishermen, what potential exists for marketing in the United States? _____

4. Total volume of seafood sales in pounds: _____

5. What percentage of your total Crab sales are:

Snow Crab _____	<u>1975</u>	<u>1976</u>
Dungeness Crab _____		
King Crab _____		

APPENDIX D

Section 2

SAN FRANCISCO BAY AREA PERSPECTIVE

A San Francisco Bay area survey of seafood trade members was conducted. When asked "why they got into the Snow Crab market" a uniform reply was given. All responses were a variation on the theme of profit potential.

In this area, the local favorite--dungeness crab--is subject to great seasonal fluctuations in landings. Another problem is the short shelf life of dungeness crab--fresh or frozen. King crab is an ideal substitute, but has since priced itself out of all but the "carriage trade" establishments. Snow crab has finally been established by fulfilling the need for a less expensive product and continuity of supply.

Snow crab, like king crab, has managed to establish itself nationwide, whereas dungeness crab, blue crab, stone crab, etc., must be considered regional items. This nationwide acceptability is one of the key factors in projecting a large growth potential for snow crab. The long fishing season and good storage life allows snow crab to be processed and picked in California and eastern plants during the off season.

Two problems have slowed market development of snow crab in this area. One has been a lack of domestic supplies. Most firms originally got into snow crab marketing to fill a Japanese demand for top quality frozen, shrink wrapped, sections. The domestic market started with the selling of the remaining sections and meat to the United States buyers.

The second problem is selling price. At first the appeal of snow crab was its newness and a low price which made it an attractive supermarket item. In the last

two to three years the domestic market for snow crab seems to be taking hold. Both prices and demand have been moving up and snow crab has established itself as a desirable item with its own identity.

Our survey revealed some concern that when the domestic fishermen gain control of the entire fishery prices will rise and price snow crab out of the domestic market. A significant amount of the resource taken today is exported and most respondents see little change in that situation as the Americans take a larger share of the quota. Consumers in the world market are willing to pay a higher price for product.

APPENDIX E
TANNER CRAB CONSUMPTION ESTIMATES

In the tables presented in this appendix all quantities are measured in thousands of pounds. Prices are expressed in various currencies, but in all cases are for one-pound units. Prices are averages derived by dividing total value by total quantity. Three symbols are used in the tables:

— means zero or negligible quantities.

NA means not available, or probably not available.

A blank space means that data probably are available but could not be obtained with the limited time and effort allowed for this report. A blank space in a recent year means that data has not yet been published. A blank space in an average price column means that average price computations were not deemed meaningful.

APPENDIX E

Tanner Crab Consumption Estimates

The purposes of this section are: (1) to present yearly estimates of worldwide consumption of Tanner crab and two substitutes--king crab and dungeness crab; (2) to explain the process which generated the estimates; and (3) to identify known and potential errors in the estimates, and point out gaps in data on which they are based.

The data are displayed in the accompanying tables. The tables are arranged in two groups, one showing data and estimates in live weight terms and the other showing the same information in product weight terms. The live weight tables allow comparisons between aggregate consumption and landings in each nation and region considered. The product weight tables permit comparison between consumption and production, by product form.

In order to estimate consumption, it was necessary to obtain measurements or estimates of four components of consumption: catch (or production), imports, exports, and increase or decrease in inventories by year for each country and region. To compute consumption, begin with the catch (or production), add imports, subtract exports, and add (subtract) any decrease (increase) in inventories over the year. What follows is a category-by-category discussion of data sources, estimation techniques, and problems encountered in the process of estimating consumption in each country.

Live Weight Tables (All quantities in thousand lbs. live weight.)

Throughout the live weight tables, the following conversion ratios were used to obtain live weight from product weight:

<u>Tanner Crabs</u>	<u>King Crabs</u>
Sections/live = .55	Sections/live = .50
Meat/live = .15	Meat/live = .20

The Tanner crab factors are those used in Aspects of the Structure and Market Behavior of the Tanner Crab Industries of the United States and Japan, a report prepared by National Marine Fisheries Service in 1976, while the king crab factors were suggested in personal communication with Tak Miyahara, who spent many years in the industry before joining National Marine Fisheries Service in Seattle. These ratios were assumed to be constant, even though it is likely that they vary depending on the average age of the crabs landed, the species mix (e.g., bairdi : opilio), the areas and times fished, and perhaps other factors.

Table 1. United States Tanner Crab Consumption: (1) Catch-- Since all U.S. Tanner crabs are harvested in Alaskan waters, the source of this data is Alaska Department of Fish and Game's annual statistical leaflet, Alaska Catch and Production, Commercial Fisheries Statistics. These data are regarded as relatively accurate measures of the quantity of crabs sold to commercial processors by fishermen. However, they don't include the

Live Weight Tables

Table 1. Estimated U.S. Tanner Crab Consumption

All quantities in thousand lbs. live weight.
 Tanner crab conversion factors: section/live = .55; meat/live = .15

	Catch ¹	Ex-vessel Price ¹	Imports ²	Exports to Japan ³	Change in Frozen Holdings ⁴	Consumption
68	3,248	.10			NA	
69	11,207	.10			"	
1970	14,473	.10	16,269		"	30,742
71	12,880	.11	25,089	124	"	37,845
72	30,135	.12	18,467	92	"	48,510
73	61,719	.17	15,658	25,149	"	52,228
74	63,906	.20	13,492	14,128	"	63,270
75	46,857	.15	14,286	7,621	"	53,522
76	80,712	.20	10,555	18,065	-3,000	76,202

¹Source: Alaska Catch & Production, Commercial Fisheries Status, Statistical Leaflets Nos. 27 & 28, ADF&G. Ex-vessel prices are averages obtained by dividing total value by catch.

²Imports from Canada and canned imports from Japan. Derived from Crab Review, Canadian Dept. Ind., Trade and Comm.; and Japan Tariff Commission.

³Source: The Fisheries and Markets for Tanner Crabs in the Northeast Asian Countries, by Clinton Atkinson (1977), with assumption that all exports to Japan are sections.

⁴Derived from Seattle Fishery Market News Reports. See text for explanation.

catch sold from the boat directly to consumers. It has been suggested that the volume of this trade may be significant.

The procedure outlined above wherein imports, exports, and inventory changes are added and subtracted from landings to obtain consumption assumes, on the other hand, that all crabs reported in the landing statistics are eventually consumed. This ignores the problem of dead loss on the docks and inventory spoilage. To some extent this problem offsets the problem of direct sales by fishermen to consumers.

The magnitude of the problems may be suggested by the following observation. The existence of the above sources of error, in addition to the variability of conversion factors over time, may help to explain why Alaskan production statistics, when converted to live weight equivalents, do not match the catch statistics. In 1970 and 1973, the live weight equivalent of production was greater than the catch (by 27% in 1973), while the 1971, 1974, and 1975 production was less than catch (by 46% in 1975, by 27% in 1976). In 1972, production equalled catch.

Another possible explanation for the discrepancy between catch and production is errors in the production data. Support for this hypothesis comes from the skepticism of two persons familiar with the industry about the accuracy of the 1975 whole Tanner crab production figure reported by Alaska Department of Fish and Game. They feel this number (17.3 million pounds) is far too high to be realistic, and, indeed, the highest level of whole crab production in previous years was only 1.3 million pounds. Further support

for the erroneous production data hypothesis is seen in the fact that the preliminary 1975 canned Tanner crab meat figure issued by Alaska Department of Fish and Game had to be revised from 8.1 million pounds to 0.7 million pounds. Still another explanation may lie in the possibility of producing crabmeat from frozen sections or whole crabs processed in the previous calendar year.

(2) Ex-vessel price--is an average obtained by dividing the total value of landings each year by total volume of landings reported in Alaska Catch and Production, Commercial Fisheries Statistics. These figures do not include end of season bonuses paid to fishermen by processors, nor can they be interpreted as the weighted average price. Rather they are obtained from the area management biologist's estimate which he bases on season-long observations.

(3) Imports--Import data for the United States are published by the Bureau of the Census, but are not differentiated by species. However, estimates of Tanner crab imports were made possible by the existence of partial data on imports from Japan and Canada in other sources. The National Marine Fisheries Service Office of International Fisheries provided excerpts from Japan Tariff Commission publications showing Japanese exports to the United States and other countries of canned Tanner crab products. Canadian data on exports of all crabs by country of destination are published by Statistics Canada and were reproduced in "Crab Review," issued by the Canadian Department of Industry, Trade and Commerce, in 1976. Even though the Canadian export figures are not differ-

entiated by species, "Crab Review" states that virtually all the exports are snow (Tanner) crab. Moreover, it asserts that over 97 percent of Canadian production is shucked meat, canned, or frozen. This fact permits an approximate conversion from product weight to live weight, though the result will be an overestimate.

(4) Exports--There are no published statistics on U.S. exports of Tanner crab since the Bureau of the Census collects data on king crab exports only. For the years 1973-1975, estimates of Japanese imports of Tanner sections from the United States are presented in April 20, 1975 Followup Report on the 1975 Japanese Market Outlook on Alaskan Tanner Crab Sections prepared by Yutaka J. Okamoto for National Marine Fisheries Service. His original source is not cited. It is interesting to note that his 1975 figure differs by 18% from the one given in Aspects of the Structure and Market Behavior of the Tanner Crab Industries of the United States and Japan, whose original source is also undisclosed.

Japanese Customs Reports show imports of frozen crabs by country of origin, which are reproduced in The Fisheries and Markets for Tanner Crabs in the Northeast Asian Countries by Clinton Atkinson (1977). Atkinson asserts that almost all imports from the U.S. are Tanner crab.

For comparison, estimates were generated using the following technique: Since U.S. Tanner crabs are caught only in Alaska,

it was assumed that all Tanner crabmeat produced in the lower 48 was processed from Alaska sections. The volume of this production was obtained by subtracting Alaska canned and frozen Tanner crabmeat production from total U.S. Tanner crabmeat production. The result was then divided by $.27 (= \frac{.15}{.55})$ to obtain the section weight equivalent. This number can be regarded as the quantity of Alaska Tanner sections shipped to the lower 48 states for further processing during each year. Then on the basis of a statement in Aspects of the Structure and Market Behavior of the Tanner Crab Industries of the United States and Japan to the effect that all Alaska Tanner sections which were not shipped to the lower 48 for further processing were exported to Japan, the section weight equivalent of lower 48 production was subtracted from Alaska section production to derive the quantity of sections exported. This estimation procedure was not used for 1975 because of the enormous increase in whole crab production reported in that year by Alaska Department of Fish and Game. If the Alaska Department of Fish and Game report is correct, much of the lower 48 production could have come from whole Alaska crabs instead of sections. The estimation procedure probably will be unusable in the future because of the recent emergence of a domestic market for Tanner sections.

It is disconcerting to note that the estimates do not agree with either the Atkinson or the Okamoto statistics. The estimates are consistently greater than or equal to the Atkinson figures, which are greater than the Okamoto figures. The Atkinson data are used in the tables because they are based on official sources

and cover a longer time period. On the assumption that all U.S. Tanner exports to Japan are in the form of sections, the data were divided by .55 to convert them to live weight.

No data was available on U.S. exports of Tanners to other countries, if any.

(5) Change in frozen holdings--There is almost no data available in this area that is useful for the purposes of this report. National Marine Fisheries Service does collect frozen holdings data, but until 1975 Tanner crabs were included in the "unclassified" category, and until 1976 the product form (i.e., in shell or shucked), was not specified. It would be possible to obtain estimates of Tanner crab holdings in previous years by assuming that the proportion of unclassified crabs which are Tanner crab is the same in every year, say the average of the 1975 and 1976 proportions (42% + 48% respectively). The product form mix could be estimated by assuming that sections and meats were held in the same ratio as in 1976. Because these required assumptions have no known basis in fact, it was decided that no estimates should be made. An additional deficiency in such estimates is that there is no information available on cold storage holdings in private warehouses, such as those owned by retail grocery chains, and there is no information available on holdings of canned crab.

Table 2. Japanese Tanner Crab Consumption:

(1) Catch--the source used here is Fishery Statistics of Japan (English

Table 2. Estimated Japanese Tanner Crab Consumption

	Catch ¹	Ex-vessel Price	Imports from U.S. ²	Canned Exports ³	Inventory Change	Consumption	Catch of "Other" Crabs ⁴
68	135,978	48			N.A.		56,676
69	115,325	79			"		40,642
1970	117,428	89		11,613	"	105,815	41,998
71	93,369	117	124	21,373	"	72,120	67,672
72	91,998	115	92	10,700	"	81,390	59,705
73	73,592	179	25,149	933	"	97,808	84,762
74	66,284	184	14,128	3,367	"	77,045	121,392
75			7,621	2,947	"		
76			18,065		"		

¹Source: Fisheries Statistics of Japan (English summary), for years 1967, '73 & '74, Ministry of Agriculture and Forestry.

²U.S. Exports to Japan. See Table 1, note 3 for source.

³Source: Japan Tariff Commission publications.

⁴May include *C. japonicus*, *C. tanneri* and *C. bairdi*.

summary), published annually by the Japanese Ministry of Agriculture and Forestry. A serious difficulty is the uncertainty about whether Chionoecetes species other than C. opilio are included in the "queen crab" harvest statistics or in the "others" category. Notes in Fishery Statistics of Japan imply that only C. opilio is included. However, it is known that in some years a significant part of Japanese mothership high seas catch from the Eastern Bering Sea are C. bairdi. On the other hand, the F.A.O. Yearbook gives the same figures with notes that imply the inclusion of both C. japonicus and C. tanneri, in addition to C. opilio.

(2) Ex-vessel price--same source as catch statistics. These are average prices derived by dividing total quantity landed into total value.

(3) Imports--These figures are simply U.S. exports to Japan, taken directly from column (4) in the U.S. Tanner Crab table. Their source and shortcomings are described above. No other data on imports could be found. It appears that Canada and South Korea both send small amounts of Tanner products to Japan.

(4) Canned Exports--The National Marine Fisheries Service Office of International Fisheries has copies of Japan Tariff Commission publications, containing separate country by country data on Japanese exports of canned king crab and Tanner crab. Information on Japanese exports of frozen Tanner products, if any, could not be found.

(5) Inventory Change--No data available.

Table 3. Canadian Tanner Crab Consumption: (1) Catch--obtained from Annual Review of Canadian Fisheries, published by Environment Canada, Fisheries and Marine Service.

(2) Ex-vessel Price--Same source.

(3) Imports--Data available only for all crabs combined.

(4) Exports--Data available for all crabs combined in Statistics Canada publications, reproduced in "Crab Review." However, according to "Crab Review, virtually all Canadian crab exports are Tanner, so these totals are used in this report.

(5) Inventory Change--Data available only for all crabs combined.

It was decided that Canadian consumption could not be estimated because of the lack of import and inventory information.

Table 4. European Consumption of Tanner Crabs: (1), (2), and (3) Since both Canadian and Japanese fishery agency statistics show exports of Tanner crab products by country of destination, (canned products only, for Japan), it is an easy matter to compile figures for European imports from those two countries. No information was available on imports from the U.S. or U.S.S.R. (South Korea also harvests Tanner crabs but is not an important exporter), or on inventories. O.E.C.D.'s annual review does not provide sufficient detail. Therefore, total European consumption is not estimated.

Table 3. Canadian Catch & Exports of Atlantic Snow (Tanner) Crab.
1970-1975

	Catch ¹	Ex-Vessel Price ¹	Imports	Exports ²	Inventory Change
1970	16,905	.09	N.A.	18,507	N.A.
71	14,949	.08	"	27,445	"
72	15,475	.13	"	19,625	"
73	21,728	.18	"	27,063	"
74	23,060	.17	"	19,448	"
75	15,523	.16	"	25,313	"
76			"	28,068	"

¹Source: Annual Statistical Review of Canadian Fisheries, for 1970 through 1975, Environment Canada, Fisheries and Marine Service. (Prices in Canadian \$ per lb.)

²Derived from data in Crab Review, Canadian Dept. of Indus., Trade & Commerce, 1976, on the assumption that all Canadian crab exports are snow crab and that all exports were shucked meats.

Table 4. European Imports of Tanner Crab, 1970-1976

	From Canada ¹	From Japan ²	Total ³
1970	7,130	3,733	10,864
71	8,820	7,853	16,673
72	4,998	4,500	9,498
73	11,143		
74	6,027	1,273	7,300
75	11,201	2,220	13,421
76	17,211		

¹Derived from Crab Review, Canadian Dept. of Industry, Trade and Commerce, 1976.

²Source: Japan Tariff Commission publications. Canned crab only.

³Does not include imports from U.S., U.S.S.R., or Republic of Korea, if any.

Table 5. Consumption of Tanner Crabs by Other Countries and Canadian Exports by Country - Canadian Exports to Other Countries are Insignificant: The only information available here is Japan Tariff Commission's data on Japanese canned crab exports to all countries by destination.

Consumption of Tanner Crabs in the Soviet Union and Republic of Korea: No data available on any of the components of consumption.

Table 6. United States King Crab Consumption: Virtually all general comments made about Tanner crab data above apply to king crab data, as do the source citations, with the following exceptions:

(3) Imports--Imports from Japan are the only ones shown since Canada does not harvest or export king crabs.

(4) Exports--The Bureau of the Census collects export data on king crabs, by country of destination. The data does not separate crab in the shell from fresh and frozen crabmeat, so it was necessary to assume that no in-shell products were exported, in order to convert to live weight. The approximate validity of this assumption was confirmed by Tak Miyahara.

(5) Change in Frozen Holdings--Data specific to king crabs is available in National Marine Fishery Service's Seattle Fishery Market News Report. Until 1976, however, this data did not specify product form, so it was assumed that the ratio of sections to crabmeat was the same in each year as it was in 1976.

Table 5. Japanese Exports of Canned Tanner Crab
to Countries other than U.S., Canada
& Europe

1970	2,920
71	6,513
72	1,987
73	
74	360
75	287
76	

Source: Japan Tariff Commission Publications.

Table 6. Estimated U.S. King Crab Consumption

	Catch ¹	Ex-Vessel Price	Imports from Japan ²	Exports ³	Change In Frozen Holdings ⁴	Consumption
66	159,202	.10		N.A.	N.A.	
67	127,723	.12		N.A.	"	
68	81,805	.27	6,615	5,095	"	83,325
69	57,730	.27	7,715	2,735	"	62,710
1970	52,061	.25	5,070	3,400	"	53,731
71	70,703	.27	8,990	2,815	"	76,878
72	74,427	.28	1,795	6,730	+ 2,717	66,775
73	76,824	.58	500	31,270	+18,705	27,349
74	95,214	.41	45	16,195	+11,422	67,642
75	97,629	.39	15	15,790	- 8,680	90,534
76	105,825	.66		22,345	+10,331	73,149

¹Source: Alaska Catch & Production, Commercial Fisheries Statistics, ADF&G.

²Source: FAO Yearbook of Fishery Statistics and Japan Tariff Commission publications. Canned imports only.

³Derived from U.S. Bureau of the Census data on assumption that all U.S. King Crab exports are in the form of shucked meat.

⁴Derived from "Seattle Fishery Market News Reports", NMES, on the assumption that frozen holdings in each year were 73% sections and 27% meats, as was the case in 1976. Does not include private warehouse or canned inventories.

Table 7. Japanese King Crab Consumption: All comments and sources mentioned in the Tanner crab section apply to king crab data, except that it is not necessary to estimate imports from the U.S. because U.S. export data is available by country of destination.

Tables 8, 9, and 10 Consumption of King Crab in Other Countries: The United Nations Food and Agriculture Organization publishes king crab catch data for the other four nations which harvest king crab: the Soviet Union, the Republic of Korea, Argentina and Chile. According to "Crab Review, exports of southern king crab from Argentina and Chile is beginning to compete in Europe with Tanner crab products. However, the only export statistics available for any of the four nations are the Russian exports of all canned crab reported in the F.A.O. Yearbook of Fishery Statistics.

Since king crab export data, by country of destination, is available for the U.S. and Japan, it is possible to extract the quantity imported by Europe from each of these nations.

Table 11. Consumption of King Crab by Countries Other than U.S., Japan, Canada, and Europe: The only available information is Japanese and U.S. exports to other countries. Nothing could be found on U.S.S.R., Korea, Chile or Argentina exports.

Tables 12 and 13. World Consumption of Dungeness Crabs: Dungeness crabs are harvested and consumed almost entirely domestically by the U.S. and Canada. Imports and exports to and from

Table 7. Estimated Japanese King Crab Consumption

	Catch ¹	Ex-Vessel ¹ Price	Imports ² From U.S.	Canned ³ Exports	Inventory Change	Consumption
68	66,910		110	19,840	N.A.	47,180
69	49,652		110	16,535	"	33,327
1970	38,713	123		9,885	"	28,828
71	23,238	150		13,550	"	9,688
72	21,278	178	40	4,650	"	16,668
73	13,625	188	12,645	510	"	25,760
74	12,042	354	3,975	160	"	15,857
75			4,330	60	"	

¹Source: Fisheries Statistics of Japan, (English summary), Ministry of Agriculture & Forestry.

²Source: U.S. exports to Japan from U.S. Bureau of the Census on assumption that all exports are in the form of shucked meat.

³FAO Yearbook of Fishery Statistics, and Japan Tariff Commission publications.

Table 8. Soviet Catch of King Crab¹

	Catch
68	89,100
69	81,800
1970	69,200
71	56,700
72	40,100
73	41,200
74	39,500
75	
76	

¹Source: FAO Yearbook of Fishery Statistics.

Table 9. Catch of King Crab by Other Nations¹

	South Korea	Argentine (Southern King Crab)	Chile
1970	440	440	880
71	1,100	660	880
72	220	660	880
73	880	440	880
74	750	880	1,110

¹Source: FAO Yearbook.

Table 10. European Imports of King Crab

	From ¹ U.S.	From ² Japan	From U.S.S.R.	Total
1970	1,700	2,835	N.A.	4,585
71	1,295	2,490	"	3,785
72	3,925	2,050	"	5,975
73	15,785		"	15,785
74	7,275	30	"	7,305
75	6,380	25	"	6,405

¹Source: U.S. Bureau of the Census.

²Source: Japan Tariff Commission publications.

Table 11. Japanese & U.S. Exports to
Countries other than U.S.,
Japan, Canada & Europe

	Japan ¹	U.S. ²	Total
1970	1,925	870	2,795
71	2,070	1,140	3,210
72	800	1,805	2,605
73		1,845	1,845
74	85	3,480	3,565
75	20	1,790	1,810
76			

¹Source: Japan Tariff Commission publications.

²Source: U.S. Bureau of the Census. It is assumed that all U.S. King Crab exports are shucked meat.

Table 12. Estimated U.S. Dungeness Crab Consumption

	Catch	Ex-Vessel Price	Imports	Exports	Change in Inventory	Consumption
1968	44,000	.19	negligible	negligible	N.A.	44,000
69	49,100	.21	"	"	"	49,100
1970	58,509	.21	"	"	"	58,509
71	42,679	.24	"	"	"	42,679
72	26,917	.44	"	"	"	26,917
73	12,124	.58	"	"	"	12,124
74	16,067	.61	"	"	"	16,067
75	16,004	.64	"	"	"	16,004
76	35,804	.63	"	"	"	35,804

Source: Fisheries of the United States, (Annual), NMFS.

Table 13. Estimated Canadian Dungeness Crab Consumption

	Catch	Ex-Vessel Price	Imports	Exports	Change in Inventory	Consumption
1968	4,371		negligible	negligible	N.A.	4,371
69	3,710	.18	"	"	"	3,710
1970	2,548		"	"	"	2,548
71	1,963	.22	"	"	"	1,963
72	1,976	.38	"	"	"	1,976
73	2,580	.45	"	"	"	2,580
74	2,503	.53	"	"	"	2,503
75	2,513	.57	"	"	"	2,513

Source: Fisheries Statistics of British Columbia, Environment Canada, Fisheries & Marine Service.

either country are reported by "Crab Review" to be insignificant. Inventory data in the U.S. does not specify product form, so conversion to live weight equivalent is impossible, while inventory data in Canada does not specify species.

The source of data on U.S. catch of dungeness crabs, which are harvested off the coasts of Alaska, Washington, Oregon, and California, is Fisheries of the United States, published annually by National Marine Fisheries Service. Canadian dungeness catch data is taken from Fisheries Statistics of British Columbia, published annually by Environment Canada, Fisheries and Marine Service.

Product Weight Tables

The tables in this section represent a different approach to estimating consumption in each country. In the live weight tables, landings were adjusted by adding and subtracting the various other components of consumption (i.e., imports, exports, and where available, change in inventories), all of which had been converted to live weight terms. Production statistics are then adjusted, using the data in product weight form to permit estimates of the consumption of each product form separately and to permit the inclusion of average price information as well as quantities.

This approach eliminates some of the problems of the live weight approach, such as the necessity to use constant product weight-to-live weight conversion factors, but brings with it a set of new problems. A category by category discussion of these problems follows.

Table 14. United States Consumption of Tanner Crab: Production--Alaska production is shown separately from production in the rest of the United States, which is insignificant in most years. Two major problems occur here, having to do with the respective data sources. The Alaska production data are taken from Alaska Department of Fish and Game's annual Alaska Catch and Production, Commercial Fisheries Statistics, which may be accurate during most years; but some doubt has been raised by the appearance in 1975 of an exceptionally large figure for whole Tanner crab production (17.1 million pounds). Two persons familiar with the industry expressed disbelief in the figure, along with surprise at the very low figure for Tanner section production (1 million pounds). Confidence in the statistics was further eroded when the figure initially published for canned Tanner crabmeat in 1975 had to be revised from 8.1 million pounds to 0.7 million pounds.

The source of the data on Tanner crab production in the rest of the United States is National Marine Fishery Service's Processed Fishery Products Annual Summary. The data in it are arranged to show production by state and for the U.S. as a whole. An example of some of the inconsistencies found in this publication is the fact that the 1972 issue shows that there was some Tanner crabmeat production in Washington and Oregon (it is included with unclassified shellfish), but the U.S. total production of Tanner crabmeat shown is the same as Alaska's production, implying no non-Alaska production. Another example: the 1973

Table 14. U. S. Tanner Crab Production, Trade & Consumption

All quantities 1,000 lbs. product weight
Prices in appropriate national currency per lb. See footnotes

	1970		1971		1972		1973		1974		1975		1976	
	Quant.	Ave. Price	Quant.	Ave. Price	Quant.	Ave. Price	Quant.	Ave. Price	Quant.	Ave. Price	Quant.	Ave. Price	Quant.	Ave. Price
Alaska Production														
Whole	21	.52	11	.27	1,003	.39	782	.59	3,308	.69	17,100	.87		
Sections	1,099	.39	691	.50	2,831	.43	14,937	.96	14,010	.54	1,047	1.58		
Meat	1,166	1.39	1,029	1.30	2,974	1.85	6,485	2.32	1,907	2.14	243	2.56		
Canned	829	1.93	529	2.13	695	2.60	1,098	3.57	1,048	2.96	705	3.24		
TOTAL	3,115		2,323		7,503		23,302		18,273		19,095			
U.S. Production ²														
Outside Alaska														
Meat	-	-	36	1.22	-	-	405	2.53	109	2.81	591	2.47		
Canned	-	-	-	-	-	-	-	-	-	-	-	-		
Imports from Canada ³														
Meat	1,541		2,430	1.09	2,004	1.86	2,110	1.85	1,535	1.84	1,766	1.70	1,438	
Canned	157		282	1.69	157	2.04	218	3.60	229	2.96	311	2.52	145	
Imports from Japan ⁴														
Canned	743	523.	1,051	454.	609	444.	20	1016.	260	1085.	66	924.		
TOTAL	2,441		3,763		2,770		2,342		2,024		2,143		1,583	
Exports to Japan ⁵														
Sections			68	387.	51	348.	13,832	599.	7,770	645.	4,192	669.	9,936	842.
Change in Cold Storage Holdings ⁶														
Sections	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Meat	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Estimated Consumption ⁶														
Whole	21	NA	11	NA	1,003	NA	782	NA	1,308	NA	17,100	NA		
Sections	1,099	NA	490	NA	2,780	NA	-395	NA	5,836	NA	-5,334	NA		
Meat	2,707	NA	3,558	NA	4,978	NA	9,000	NA	3,551	NA	2,600	NA		
Canned	1,729	NA	1,862	NA	1,461	NA	1,336	NA	1,537	NA	1,082	NA		
Est. Consump. TOTAL	5,556		5,921		10,222		11,510		12,222		15,448			

¹Source: Alaska Catch & Production, Commercial Fisheries Statistics, ADF&G. (Annual). Prices paid to processor in \$ per lb.

²Source: Processed Fishery Products Annual Summary, NMFS, (Annual). Prices paid to processor in \$ per lb.

³Source: Crab Review, Canadian Dept. of Indus., Trade & Commerce, (1976). Prices in Canadian \$ per lb.

⁴Source: Japan Tariff Commission publications. Prices in yen per lb.

⁵Source: The Fisheries & Markets for Tanner Crab in the Northeast Asian Countries, by Clinton Atkinson (1977).

⁶See text for derivation.

⁷Probable error in production data. See text.

issue shows some Tanner crab section production in Oregon and California, yet the total U.S. Tanner section production figure is the same as the one given for Alaska production. The 1975 issue claims that 39,000 pounds of Tanner sections were produced outside of Alaska, which seems unlikely, since Tanners are not harvested outside of Alaskan waters. It is not only difficult to land live Tanner crabs in the lower 48, it is a violation of Alaska's primary processing law. It would be possible to ship cooked whole crabs to the lower 48 for further processing into sections, but the transport costs are reported to be prohibitively high.

It should be noted that the statistics for Alaska production appearing in Processed Fishery Products Annual Summary are obtained by National Marine Fishery Service from Alaska Department of Fish and Game, and are identical to those appearing in Alaska Catch and Production, Commercial Fisheries Statistics.

In this report it is assumed that no U.S. Tanner crab sections are produced outside of Alaska and that any Tanner crabmeat produced in the lower 48 states is manufactured from Alaska sections. This means that the total U.S. production figures reported in Processed Fishery Products Annual Summary overstate true production because of a double counting problem: some of the reported section production is counted again when it is further processed into crabmeat in another state.

One can attempt to correct for this problem by converting reported crabmeat production outside of Alaska into its section

weight equivalent, and then subtracting the result from reported Alaska section production. This procedure will yield accurate estimates if: (1) the production figures are correct, (2) the meat-to-section conversion factor is realistic, and (3) the quantity of lower 48 meat production which is manufactured from sections produced in the previous calendar year is insignificant.

The use of this technique on the 1975 data yields the result that the quantity of sections which were further processed into crabmeat in Washington, Oregon, and California was about four times larger than the quantity of sections produced in Alaska! It seems likely that an error has been made somewhere.

Imports, Exports and Changes in Inventories--All comments made and sources cited in the live weight table narrative regarding these categories apply here, since the data used are the same.

Estimated U.S. Consumption--is derived for each product form by starting with total U.S. production and then adding imports, subtracting exports and subtracting the increase in inventories (which may be negative). When data or estimates are completely lacking for one of these components, the estimation is made without it. If two or more of the components are missing, no estimation is made.

Note that in 1973 and 1975 the estimates of section consumption are negative. This could result from any of the problems outlined above, or it could, in fact, reflect the truth. If the estimates are correct, they imply that inventories of sections were depleted by at least the amount of the estimates in order to

supply sections for export and/or further processing. This cannot be verified because of the lack of inventory data.

Tables 15, 16, 17 and 18. Consumption of Tanner crabs in Japan, Canada, Europe and Other Countries: Most problems here stem from the lack of data. No data are available for Japanese canned production, imports from South Korea, exports of frozen products, if any, or inventories. No data are available on Canadian imports or inventories. None are available on European imports from the U.S., U.S.S.R. or Korea, or on European inventories. No data is available on Soviet production or consumption, and nothing is known about consumption of Tanner crab in other countries except the dwindling Japanese export supply to those countries.

Table 19. U.S. Consumption of King Crabs: All general comments made about the Tanner crab production statistics apply. All comments made in the live weight table narrative regarding U.S. king crab exports, imports and inventories also apply.

In addition a specific comment should be made. Note that the estimated canned consumption in 1973 is negative. This is clearly impossible and demonstrates the problem in estimating consumption with incomplete data. A possible explanation for the negative consumption figure could lie in depletion of inventories for which we have no data.

Table 15. Japanese Tanned Crab Production, Trade & Consumption

	1970		1971		1972		1973		1974		1975		1976	
	Quant.	Ave. Price	Quant.	Ave. Price	Quant.	Ave. Price	Quant.	Ave. Price	Quant.	Ave. Price	Quant.	Ave. Price	Quant.	Ave. Price
Production														
Frozen, All forms ¹	31,790	NA	27,480	NA	19,021	NA	14,204	NA	NA	NA	NA	NA	NA	NA
Canned	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Imports from U.S. Sections ²			68	176	51	157	13,832	272	7,779	203	4,102	302	9,036	302
Exports to All Countries Canned ³	1,977	927	2,710	880	930	790	102	875	32	1,961	12	1,601		
Estimated Consumption														
Frozen, All forms	NA	NA	27,598	NA	19,072	NA	28,036	NA	NA	NA	NA	NA	NA	NA
Canned	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

¹Source: Fishery Statistics of Japan, (English summary), Dept. of Agriculture & Forestry, (annual). Prices in yen per lb.

²Source: The Fisheries & Markets for Tanned Crab in the Northeast Asian Countries, by Clinton Atkinson (1977). It is assumed that all imports from U.S. are sections. Prices in yen per lb.

³Source: Japan Tariff Commission publications. Prices in yen per lb.

Table 16. Canadian Tanner Crab Production and Exports

	1970		1971		1972		1973		1974		1975		1976	
	Quant.	Ave. Price	Quant.	Ave. Price	Quant.	Ave. Price	Quant.	Ave. Price	Quant.	Ave. Price	Quant.	Ave. Price	Quant.	Ave. Price
Production ¹														
Frozen Meat	1,671	1.35	2,803	1.44	3,244	2.26	4,110	2.49	4,686	2.77	2,370	2.72		
Canned	1,310	1.72	794	2.10	754	2.63	1,429	5.40	1,298	3.73	933	3.84		
Production TOTAL	2,981		3,596		3,998		5,539		5,984		3,303			
Imports	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Exports ¹														
Canned	657		986	.61	573	.59	1,111	.29	741	.33	1,023	.38	1,515	
Frozen Meat	2,119		3,131	.91	2,370	.54	2,948	.49	2,176	.51	2,774	.56	2,696	
Exports TOTAL	2,776		4,117		2,943		4,059		2,917		3,797		4,211	
Change in Inventories	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

¹Source: Crab Review, Canadian Dept. of Industry, Trade and Commerce, (1976). Prices in Canadian \$ per lb.

Table 17. European Imports of Tanned Crab Products

	1970		1971		1972		1973		1974		1975		1976	
	Quant.	Ave. Price	Quant.	Ave. Price	Quant.	Ave. Price	Quant.	Ave. Price	Quant.	Ave. Price	Quant.	Ave. Price	Quant.	Ave. Price
From Canada ¹														
Frozen Meat	573	1.08	347	1.85	749	2.56	476	2.67	994	1.95				
Canned	496	1.62	406	1.58	882	3.47	428	3.24	686	2.64				
TOTAL	1,069		1,323		1,571		904		1,680				2,582	
From Japan ²														
Canned	560		1,178		675		191		333					
TOTAL ³	1,629		2,501		1,425		1,095		2,013					

¹Source: Crab Review. Prices in Canadian \$ per lb.

²Source: Japan Tariff Commission publications.

³Does not include imports from U.S., U.S.S.R., or Republic of Korea, if any.

Table 18. Japanese Exports of Canned Tanner
Crab Products to Countries Other
than U.S., Canada & Europe.

1970	1971	1972	1973	1974	1975	1976
438	977	298		54	43	

Source: Japan Tariff Commission publications.

Table 19. U.S. King Crab Production, Trade & Consumption.

	1970		1971		1972		1973		1974		1975		1976	
	Quant.	Ave. Price	Quant.	Ave. Price	Quant.	Ave. Price	Quant.	Ave. Price	Quant.	Ave. Price	Quant.	Ave. Price	Quant.	Ave. Price
Alaska Production														
Whole	1,645	1.05	24	0.96	766	1.50	566	0.93	4,035	1.23	30,488	1.99		
Sections	5,057	1.17	6,266	1.26	8,199	1.66	18,782	1.73	10,438	1.11	4,201	1.74		
Frozen Meat	7,041	2.01	9,884	2.22	9,803	2.58	8,277	4.08	10,224	2.65	4,587	2.51		
Canned	1,089	2.7	975	2.95	1,026	3.86	946	6.44	810	6.00	1,074	3.97		
TOTAL	14,832		17,149		19,794		28,571		25,507		40,350			
U.S. Production²														
Outside Alaska														
Frozen Meat	-	-	1,581	2.26	-	-	-	-	-	-	353	3.53		
Canned	-	-	-	-	-	-	-	-	-	-	-	-		
TOTAL	-	-	1,581	-	-	-	-	-	-	-	353	3.53		
Imports from Japan³														
Canned	1,014	938.	1,798	901.	359	948.			9	2206.	3	1932.		
Exports to all Countries														
Frozen Meat	480	1.64	523	2.07	1,325	2.05	4,730	1.72	2,532	2.48	2,712	2.34	4,099	
Canned	200	1.94	40	2.55	21	1.90	1,524	2.19	707	3.44	446	3.81	370	
TOTAL	680		563		1,346		6,254		3,329		3,158		4,469	
Change in Cold Storage⁴														
Holdings														
Sections	NA		NA		+731		+4,791		+2,966		-2,255		+2,805	
Frozen Meat	NA		NA		+251		+1,772		+1,098		-834		+1,024	
TOTAL	NA		NA		+982		+6,563		+4,064		-3,089		+3,829	
Estimated Consumption⁵														
Whole	1,645		24		766		566		4,035		30,488			
Sections	5,057		2,314		8,199		13,991		7,472		3,319			
Frozen Meat	6,561		10,942		9,803		1,775		6,594		4,940			
Canned	1,903		2,733		1,026		-578		112		1,074			
TOTAL	15,166		16,013		19,794		15,754		18,213		39,821			

¹Source: Alaska Catch & Production, ADF&G (Annual). Prices in \$ per lb.

²Source: Derived from Processed Fishery Products, Annual Summary, NMFS, (Annual) by subtracting Alaska production from total U.S. production of each product form. Prices in \$ per lb.

³Source: Japan Tariff Commission publications. Prices in yen per lb.

⁴Derived from Seattle Fishery Market News Reports, NMFS by assuming ratio of sections to meat held was the same in every year as it was in 1976. Does not include privately owned cold storage warehouses, or canned inventories.

⁵See text for derivation.

⁶See appendix discussion for Table 19.

Tables 20, 21, 22 and 23. King Crab Consumption Data for Japan, the Soviet Union, Europe and Other Countries: The problems again stem from lack of data. The tables are self-explanatory.

Table 24. Wholesale Prices for King and Snow Crab in Chicago and New York.

Table 20. Japanese King Crab Production, Trade & Consumption.

	1970		1971		1972		1973		1974		1975		1976	
	Quant.	Ave. Price	Quant.	Ave. Price	Quant.	Ave. Price	Quant.	Ave. Price	Quant.	Ave. Price	Quant.	Ave. Price	Quant.	Ave. Price
Production¹														
Frozen, all forms	13	NA	830	NA	-	NA	476	NA	2,758	NA				
Canned	7,361	NA	3,122	NA	3,033	NA	2,388	NA	1,841	NA				
Imports From U.S.²														
Frozen Meat	-	-	-	-	8	2.75	1,971	1.61	492	1.96	765	1.25		
Canned	-	-	-	-	-	-	558	1.93	393	2.97	191	4.15		
Total	-	-	-	-	8	-	2,529	-	705	-	956	-		
Exports to All Countries³														
Canned	1,977	927.	2,710	300.	930	790.	102	975.	32	1862.	12	1501.		
Change in Inventories	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Estimated Consumption														
Frozen, all forms	13		83		8		2,447		3,160					
Canned	5,384		412		2,103		2,844		1,402					
TOTAL	5,397		495		2,111		5,291		4,562					

¹Source: Fisheries Statistics of Japan, Ministry of Agriculture & Forestry (Annual). Prices in yen per lb.

²Source: U.S. Bureau of the Census. Prices in \$ per lb. Sweden, Belgium & Netherlands only.

³Source: Japan Tariff Commission publications. Prices in yen per lb. All EEC members.

Table 21. Soviet Production of Canned King Crab

	1970	1971	1972	1973	1974
Production Canned	3,600	7,500	5,500	5,500	5,300

Source: FAO Yearbook of Fishery Statistics (annual).

Table 22. European Imports of King Crab Products

	1970		1971		1972		1973		1974		1975	
	Quant.	Ave. Price	Quant.	Ave. Price	Quant.	Ave. Price	Quant.	Ave. Price	Quant.	Ave. Price	Quant.	Ave. Price
From the U.S. ¹												
Frozen	202	1.96	232	2.07	785	2.22	2,267	1.87	1,257	3.17	1,002	3.01
Canned	138	2.00	27	2.78	-	-	890	2.06	203	4.27	274	3.80
Total	340		259		785		3,157		1,455		1,276	
From Japan ²												
Canned	577	900.	498	799.	410	648.			6	1947.	5	1342.
From the U.S.S.R.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	917		757		1,195		3,157		1,461		1,281	

¹Source: U.S. Bureau of the Census. Prices in \$ per lb.

²Source: Japan Tariff Commission publications. Prices in yen per lb. All EEC members.

Table 23. Japanese & U.S. Exports of King Crab to Countries other than U.S., Japan, Canada and Europe.

	1970	1971	1972	1973	1974	1975	1976
Japanese Exports ¹							
Canned	385	414	160		17	4	
U.S. Exports ²							
Frozen	112	215	340	307	601	287	
Canned	62	13	21	62	95	71	
Total	174	228	361	369	696	358	
TOTAL	559	642	521		713	362	

¹Source: Japan Tariff Commission publications.

²Source: U.S. Bureau of the Census.

Table 24. Wholesale prices for king and snow crab meat, monthly, 1973-1976.

Item	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
<u>Dollars per pound</u>												
<u>King Crab</u>												
<u>Chicago</u>												
1973	2.98	3.17	3.25	3.25	3.78	3.78	3.78	-	4.85	5.45	5.37	5.29
1974	5.20	5.15	5.15	5.12	4.99	4.89	4.80	4.58	4.18	3.79	3.34	3.20
1975	3.04	2.88	2.99	3.18	3.45	3.45	3.45	3.41	3.50	3.65	3.82	3.92
1976	4.12	4.14	4.29	4.44	4.65	4.72	-	-	-	5.88	5.93	-
<u>New York</u>												
1973	3.34	3.37	3.45	3.60	-	-	-	-	5.00	5.56	5.37	5.22
1974	5.21	5.15	5.15	5.18	5.00	4.84	4.70	4.52	4.12	3.68	3.28	3.18
1975	2.94	2.87	3.05	3.20	3.40	3.45	3.35	3.24	3.52	3.64	3.70	3.96
1976	4.12	4.28	4.36	4.48	4.69	5.01	5.32	5.58	5.60	-	5.98	-
<u>Snow Crab</u>												
<u>Chicago</u>												
1973	-	2.89	-	3.15	3.16	3.06	3.07	3.10	3.26	3.38	3.34	3.35
1974	-	-	3.30	3.31	3.18	2.97	2.94	2.70	2.40	2.30	2.32	2.23
1975	2.28	1.98	2.16	2.22	2.52	2.52	2.52	2.49	2.45	2.60	2.48	2.48
1976	2.62	2.62	-	-	3.45	3.45	-	-	3.72	3.72	3.72	-
<u>New York</u>												
1973	2.90	-	-	-	3.12	3.18	3.25	3.24	3.28	3.36	3.38	3.35
1974	3.25	3.26	3.35	3.41	3.33	3.11	2.88	2.80	2.55	2.46	2.28	2.27
1975	2.18	2.06	2.09	2.22	2.35	2.43	2.44	2.43	2.48	2.51	2.48	2.50
1976	2.61	2.78	3.22	3.70	3.80	3.96	3.90	3.61	3.53	3.51	3.45	-

Source: "Shellfish Market Review", (NMFS), Dec. 1976.

APPENDIX F

THE FISHERIES AND MARKETS FOR TANNER CRAB
IN THE NORTHEAST ASIAN COUNTRIES

The Fisheries and Markets for Tanner Crab
in the Northeast Asian Countries¹

Although the large crabs (i.e., king crab, Tanner crab, etc.) have been traditionally taken and used in local communities along the coasts of Hokkaido and northern Honshu, the establishment of a commercial fishery is linked with the development of the canned crab industry, beginning in 1893 with the export of a small trial pack of king crab to a Fishery Exhibition in England but not really attaining stable production until 1908 when a number of crab canneries were established along the coasts of Hokkaido and southern Sakhalin. In 1916, the first floating cannery operated in the Kamchatka area of the Okhotsk Sea. By 1923, there was a total of 15 factoryships operating in the Okotsk (8 sailing vessels and 7 steamers) and by 1930, the number had increased to 19 (all steamers). To avoid the growing competition and conflict between the various operators, all crab factoryships were consolidated into a single company in 1932, the Nippon Godo Kaisha, and the number of vessels reduced to from 5 to 8 until the beginning of World War II.

During the course of exploration for new king crab fishing grounds in the Japan Sea, along the coasts of Aomori and Yamagata Prefectures and further south and along the east coast of the Korean Peninsula from Peter the Great Bay south to the vicinity of Po'hang, a few king crab were found, but the catches were mainly Tanner crab. The total catch of Tanner crab for the first reported year of fishing (1925) was 800-1500 mt -- the largest catches coming from Ishikara Prefecture (200-1000 mt) (Ogata, 1974).

¹A report presented by Clinton E. Atkinson at the Fisheries Institute, Kodiak Community College, University of Alaska, April 21, 1977.

Up to World War II and for perhaps 15 years afterward, Tanner crab were not utilized by the crab fisheries in the North Pacific and, in fact, were considered to be a nuisance when taken incidentally in the king crab nets. Tanner crab meat was difficult to extract from the shell, it produced an inferior canned product, and the frozen product, as we know it today, had not yet been developed. In any case, it was only after the king crab catch in both the eastern and western North Pacific were restricted by international agreements that the Japanese fishing industry began to seriously develop a Tanner crab fishery and market.

The situation, however, was quite different along the Japan Sea coast (especially in Shimane and Tottori Prefectures) where king crab are rare, if present at all. Here Tanner crab has grown in popularity as a local food, and in order to satisfy the demand of both the local and "big-city" markets over the past ten years, the fishery has become so intense that the stocks are now seriously over-fished and the catch decreasing year-by-year.

Historically, the Soviet Union began to fish king crab in the early 1930's in the Okhotsk and Bering Seas, and after World War II their catch regularly exceeded the Japanese catch. The product is canned, of good quality and usually used for export. Under provisions of the Japanese-Soviet Fisheries Convention, the Continental Shelf Convention and the recently declared USSR 200-mile Fishing Zone, the Soviet Union has been gradually phasing out the long-established Japanese crab fisheries in the western Bering and the Okhotsk Seas. The position of the Soviet Union, then, is exactly opposite to that of Japan: Where Japan has had to turn to Tanner crab, snails, etc. to keep her

industry alive, the USSR has been able to increase her production of king crab with little incentive to begin production of the less desirable Tanner crab and other species.

We might predict, however, that the position of the Soviet Union will soon change. The series of recent 200-mile declarations will severely curtail the fishing area for Soviet vessels, and in order to keep her vessels busy and maintain her production schedule, the USSR will be re-examining the exploitable resources within her own 200-mile zone. If true, then we can expect the Soviet Union to also be looking for a market for Tanner crab and she could be a serious competitor for Alaska.

Since Korea was a colony of Japan between 1912 and 1945, the early histories of the king crab/Tanner crab fisheries for the two countries are quite similar. At one time there was a very significant fishery for "large" crabs along the east coast of Korea, especially off the Prefecture of Gyeongsang Buk Do, but in one year the catch fell dramatically from 2,179 mt (1964) to 271 mt (1965). The reason for the decline is not known.

It is debatable whether or not we should include China in this review since there are no stocks of Tanner crab (Chionoecetes sp.) in Chinese waters. Within the past ten years, however, Taiwan has begun to utilize a related species of crab (Portunus sp.) for canning and export as "snow" crab. Accordingly, this information has been included, although the supply is limited and the quality of the canned product generally inferior to that of the true Tanner crab.

Distribution

Five species of Tanner crab have been reported from the North Pacific and Arctic Oceans and the Bering, Okhotsk, Japan and East China Seas:

(1) *Opilio* (i.e., *Chionoecetes opilio*) has the broadest range of the five species, extending from British Columbia in the east to the Arctic Ocean in the north and to the northern East China Sea (along the southern coast of Korea) in the west. They also occur off the coast of Greenland. The adults are found in the Japan Sea at depths of 200 to 450 meters and in water with temperatures of 0.4 - 4.4°C. The majority of the males are found in a band from 225 to 275 meters in depth while the females are more dispersed, depending upon the stage of maturity and molting.¹ *Opilio* is found in shallower waters to the north (e.g., at depths of 30 to 60 meters in Aniva Bay off the east coast of Sakhalin).

Opilio is the smallest of the five species of crab. In the Japan Sea it reaches a maximum size of 142 mm carapace width at an estimated age of 20 years. The average size of crabs in the commercial catch from the Japan Sea (1964 to 1970, Fukui Prefecture) ranges from 98 to 118 mm carapace width and from 399 to 603 gr in weight.

(2) *Bairdi* is found in the eastern Bering Sea, the Aleutian Islands and as far south as British Columbia, and the majority are found at depths less than 200 meters in depth.

Bairdi, being a larger species and living in shallower waters, domi-

¹ In the Japan Sea, female *Opilio*, as they become mature, generally are found at depths of 225 to 240 meters and later, when they pass through the reproductive stages, are found at depths of 250 to 260 meters.

nates the U.S. commercial catch of Tanner crab in Alaskan waters. The male crab reaches a maximum size of about 168 mm in 13 or 14 years. The average size group in the eastern Bering Sea fishery is between 85 and 129 mm carapace width, and an average weight of about 1 kg.

(3) Japonicus, or benizuwai-gani, is found in the deeper water of the Japan and Okhotsk Seas, usually in water from 500 to 2500 meters in depth. There is some overlapping in vertical distribution with the more common Opilio. It is a deeper red color than opilio, but little is known of its life history and movements.

(4) Tanneri is a deep water species found only in the eastern North Pacific Ocean (Washington to Lower California) occurring at depths of 450 to 1500 meters or more. It is not fished commercially but they are relatively abundant in some areas. For example, Pereyeva (1966) reports catches up to 400 lbs./hour (average 25 lbs./hour) by trawl off the Columbia River. Growth and movements are similar to Opilio.

Tanneri is a large crab: Males attain a maximum size of 181 mm carapace width (average weight of 1.09 kg), females 130 mm (average weight 1.35 kg).

(5) Angulatus resembles Tanneri and is found over a broad area of the North Pacific, from the east coast of Kamchatka (Avacha Bay), in the Bering Sea and Gulf of Alaska, and south to off the coast of Oregon. Although Angulatus has been reported from waters 90 meters in depth, it is considered to be a deep water species and generally found at depths of 1,000 meters or

more. *Angulatus* is not fished commercially and little is known of its life history and movements.

This crab is slightly smaller than *Tanneri*, with a maximum carapace width for males of 151 mm.

Hybridization among the species appears to be common. The hybrid *C. bairdi* x *C. opilio* forms a significant part of the catch in the eastern Bering Sea and hybrids of *C. japonicus* x *C. opilio* occur in the Japan Sea.

Resource

At the present time, only three of the five species of Tanner crab are fished commercially:

(1) *Bairdi* is larger than *opilio* or *japonicus*, is abundant in southeastern Bering Sea, the Aleutians and the Gulf of Alaska, and forms the backbone of the American Tanner crab fishery. Initially, the eastern Bering Sea stocks were fished exclusively by Japanese and Soviet mothership fleets. Beginning in 1965 the catches reached a peak in 1969-1970 (24,000 mt). Subsequent negotiations have gradually forced the Japanese and Soviet fisheries out of the major fishing grounds for *bairdi*. Since that time negotiations with Japan and the USSR have sharply curtailed foreign catches until this year, these fisheries for *bairdi* have been virtually eliminated.

The U.S. fisheries began in 1967, rose to a level of 5,000 to 6,000 mt in 1969-1971, and to a 27,000 mt level in 1973. The stocks are now under the complete protection of the Fishery Conservation and Management Act of 1976. According to the Preliminary Management Plan prepared by the National Marine

Table 1. Distribution of Tanner Crab (Chionoectes sp.) in the North Pacific

Distribution	Species				
	<u>C. Tanneri</u>	<u>C. bairdi</u>	<u>C. angulatus</u>	<u>C. opilio</u> ¹	<u>C. japonicus</u>
Depth (in meters):	450-1500 +	-500	90-1000 +	30-500	500-2500
Ocean/Sea:					
North Pacific (east)	X	X	X	X	
Bering (east)		X	X	X	
Arctic (circumpolar)				X ²	
Bering (west)			X	X	
Okhotsk				X	X
Japan				X	X
East China (north)				X	?

¹Chionoectes opilio in the Japan and Okhotsk Seas differ somewhat in body measurement e.g., longer legs) and are frequently termed Chionoectes opilio elongatus.

²Chionoectes opilio is found along the arctic coast of Siberia and off Greenland in the Atlantic Ocean.

Fisheries Service for 1977, the maximum sustainable yield for Bering Sea bairdi stocks has been calculated to be about 49,000 mt with an optimum yield of 30,000 mt.

Although the maximum sustainable yield is not known for stocks of bairdi other than the Bering Sea stocks, it is reasonable to assume that the total maximum sustainable yield for all of Alaska would lie between 75,000 to 100,000 mt.

(2) *Opilio* is the smallest of the five species of Tanner crab and abundant in the Japan, Okhotsk and Bering Seas. After World War II the catches from the Japan Sea reached a peak of 15,000 to 16,000 mt in 1963-1964, maintained a yield of 10,000 to 13,000 mt through 1972, and then declined over the past 4 or 5 years.

The population parameters for the Japan stocks of *opilio* have been quite well established (Ogata, 1974), with evidence that the stocks have been heavily exploited and require greater protection in order to restore them to their former level of yield. This is especially true for female crabs.

Tanner crab is a delicacy in Korea, and while most of the Blue Crab are exported to Japan, most Tanner crab are consumed domestically.

The Korean fishery for *opilio* is not large, however, with a maximum catch of about 3,500 mt in 1962, the first year that statistics are available. Most significant was the sudden drop in catch from 2,179 mt in 1964 to only 271 mt in 1965. The stocks have never recovered.

Although the literature available does not specifically give the maximum sustainable yield for Japan Sea *opilio*, it is assumed that it would be about 10,000-12,000 mt a year.

It is impossible to draw any conclusion about the size of the resource in the Okhotsk and the western Bering Sea. A peak Japanese catch of 15,000 mt occurred in the first year of serious fishing for Tanner crab (1967) in the Okhotsk Sea, and a year later (1968) a peak of 13,000 mt was reached in the Olyutorski and Navarin areas. The USSR has also effectively reduced Japanese fishing effort and area through action of the Japan Soviet Fisheries Commission or through bilateral negotiations as a continental shelf resource.

A further complication is the complete lack of data from the Soviet Union on domestic catches of Tanner crab. It is assumed that Tanner crab are being taken by a number of local Kholkhoz along the coasts of the Okhotsk and Bering Seas, and it is anticipated that the larger Soviet vessels, forced out of the 200-mile zones of other countries, will be directed into these fisheries to help maintain production. There is already evidence of this in the current Japan-Soviet negotiations: The Soviet's position is to eliminate all Japanese crab fishing from the USSR 200-mile zone. From all of this we can only assume that the stocks of opilio in the soviet Far East are very large, and if fully developed for export purposes, could easily saturate the Japanese market (i.e., if Japan allowed them to do so).

The eastern Bering Sea stocks, of course, are extremely large, almost beyond imagination. The maximum sustainable yield has been calculated to be about 150,000 mt -- half of which occur north of 58° N latitude. Although only a guess, if all fisheries for opilio were fully developed (both North American and Asian), we could easily be talking about a total annual supply of perhaps 300,000 metric tons or more.

Table 2. Catch of "Opilio" Tanner Crab by Various Countries (in metric tons)

Year	United States Total (mt)	Japan				Japan Sea Actual (mt)	Soviet Union Total (mt)	South Korea Total (mt)
		East Bering Sea Quota (no)	East Bering Sea Actual (mt)	West Bering Sea Quota (no)	West Bering Sea Actual (mt)			
1952					5,869			
1953					7,519			
1954					8,974			
1955					8,839			
1956					8,111			
1957					9,608			
1958					10,994			
1959					10,860			
1960					13,281			
1961					13,021			
1962					14,853			3,544
1963					15,604			2,348
1964					15,534		20,382	2,179
1965					11,060		16,380	271
1966					10,459		19,487	403
1967				1,942	10,100	14,822	31,864	756
1968				13,146	11,275	12,346	61,679	435
1969		13.0m	9,669	19.0m	11,065	11,360	52,311	253
1970		11.4m	8,442	17.0m	12,783	10,152	53,265	247
1971		8.1m	6,417	13.0m	11,821	7,804	42,352	494
1972		8.0m	7,867	13.0m	12,869	7,651	41,730	132
1973		6.3m	4,900	11.0m	9,022	6,090	33,381	355
1974		5.7m	4,356	9.7m	8,097	5,480	30,066	340
1975		6.0m	4,637	10.3m	5,905	5,905	24,000	

(3) The fishery for benizuwai-guni (C. japonicus) in the Japan Sea is still in the exploratory stage of development. However, as a result of the recently declared 200-mile zones, the Government of Japan and the Japanese fishing industry are actually developing a fishery at the present time, and although there is no information on the actual size of the stock, the newly formed Japan Sea Crab Pot Fisheries Association believes that the resource is substantial, possibly as large as opilio in the Japan Sea, or about 10,000 mt.

Fishing Method

Traditionally, the Japanese and Russians developed their crab fisheries by using large mesh tangle nets set along the bottom of the fishing area. There were two main objections to the use of these nets: (1) the destruction of large numbers of females and undersized male crab when removed from the nets, and (2) the conflict with the use of trawls or other types of mobile gear. Accordingly, the United States through bilateral negotiations began in 1967 to shift the Japanese fishery from tangle net to a pot fishery. The conversion was complete in 1973.

Similarly, in 1973 the Japan-Soviet Commission began the experimental use of pots in the western Bering and Okhotsk Seas in 1973, with partial conversion in 1974 and complete conversion by 1975.

At the present time, about 75% of the total catch of Tanner crab is taken by pots with the remaining 25% taken as a mixed catch by the small and off-shore trawlers operating in the Japan Sea and in the Okhotsk/Bering Seas and

the North Pacific Ocean off Hokkaido.¹ Further, the proposed fishery for benizuwai-gani in the Japan Sea (a deep-water fishery) will also be a pot fishery.

The production statistics, which are readily available in the Government publications, leave much to be desired. The information on fresh crab is a sample from the major fish landing ports -- data for 1964 to 1966 come from some 284 ports and are probably quite complete, but more recent years are based on a sample of 67 ports, and there is no reasonable way to equate the two series of data. The information for frozen crab is taken from tables of mothership production and accounts for the bulk of the domestic production. Although there is a long series of consistent and complete statistics on the annual pack of king crab and other crab in standard cases, the pack of Tanner crab is not published and not usually available to the public. However, even with these inconsistencies, we can make some general conclusions about production trends.

There is no question but that the production of both domestic produced fresh and frozen Tanner crab have declined over the past 5 or 6 years -- fresh crab from some 9,107 mt in 1971 to 3,932 mt in 1974 and frozen crab from 14,420 mt in 1970 to 6,443 mt in 1973. This is due to the reduction of crab quotas, both in the U.S. Eastern Bering Sea area and the Soviet western Bering Sea and the Okhotsk Sea. In contrast, the production of fresh and frozen king and other crab (mainly hair crab) has increased at the expense of canned crab.

¹ Tanner crab consist of about 1% of the total catch by small and offshore trawls.

Table 3. Production of Crab in Japan¹

Year	Tanner		King		Other		Total				
	Fresh	Frozen	Fresh	Frozen	Fresh	Frozen	Fresh	Frozen			
1962		18069					57431		333301		
1963		30573					48215		333124		
1964	11497	2	48095	6	237287	16976	5	30856	13	323624	
1965	15551	38	43397	-	207080	22478	4	41108	42	285244	
1966	21577	-	98489	-	181773	64440	35	91160	85	318311	
1967		5	128269	1	170183		17	70762	23	369214	
1968		13021	123002	35	222238		718	17204	13774	362444	
1969		3690		-	182388		79	132019	3769	314407	
1970		14420		6	154643		332	163912	14758	318555	
1971	9107	12465	264	375	65584	13350	224	70704	22721	136288	
1972		8628		-	63726			95299		159025	
1973	5160	6443	291	216	50167	23745	223	173895	29196	6883	224092
1974	3932	844	1251	21867	25199	9913	136471	29972		158338

¹ Although the above statistics are based upon a standard, government sampling system, they do not, when converted to raw crab and added together, equal the total landings: Tables used are found in Suisan Butsu Ryutsu Tokei Nenpo for various years (1964 - (1) (i) -2 and (7) -3, 1965 - Landings (1), Explanatory Tables (7) -4, 1966 - Same, 1971 - I - (5) (i), Annual Combined Landings (7) -3, (7) -4, 1973 - I - (5) -2, Annual Combined Tables (7) -3, (7) -4, 1974 - I - (5) -2, Annual Combined Tables (7) -3, (7) -4). Note that detail for canned Tanner is lacking for 1968 to present and is included in Other.

Lacking more detailed data, we must rely upon general impressions of representatives of the Japanese Fishing Companies in Seattle. It is believed by most that the production of canned hair crab has declined to about 10% of other, and if true, this would mean that canned Tanner crab would remain at 100,000 to 150,000 cases. Quite frankly, this is a guess and needs to be confirmed.

In Korea, a small amount of "large" crab are canned (10 mt in 1972, 21 mt in 1973 and 5 mt in 1974), and the remainder is sold fresh/chilled.

In Taiwan, the production of Portunus sp. is about 10,000 mt per year, mostly for export as "snow crab." There is no information on the total production of this crab.

The Soviet Union presumably canned most, if not all, of the Tanner crab taken by their motherships fishing in the eastern Bering Sea for domestic consumption but information is lacking on the kind and amount of Tanner crab processed at shore plants.

Imports and Exports

Although the Japanese Customs Reports do not provide a breakdown of Tanner crab imports alone, almost all of the frozen crab imports from the United States are Tanner crab and no other country exports Tanner crab to Japan at the present time except South Korea (about 100 mt per year). As shown in Table 4, Japanese imports of frozen Tanner crab began in 1971-1972, rose suddenly to 6,273 mt in 1973, declined in 1974-1975 as a result of the "oil shock" and unstable economic conditions in Japan, and recovered in 1976 to total 4,506 mt.

Table 4. Japanese Imports and Exports of Tanner Crab

Year	Imports (U.S. frozen)			Exports (canned)		
	Quantity (mt)	Value (mil. yen)	Price (yen/kg)	Quantity (mt)	Value (mil. yen)	Price (yen/kg)
1966						
1967						
1968						
1969						
1970						
1971	31	12	387	1,457	1,369	940
1972	23	8	348	730	749	1,026
1973	6,273	3,761	599	64	162	2,531
1974	3,524	2,274	645	230	526	2,287
1975	1,901	1,271	669			
1976	4,506	3,793	842			

There is no relation between the total amount of all crab imported into Japan and the total of Tanner crab alone: The total amount of crab imported (i.e., 9,338 to 12,492 mt) has remained about the same with the proportion of Tanner crab varying between 18 and 58% with no apparent pattern.

Japan processes and exports canned Tanner crab to about 20 countries, half going to the United States in 1974, about 25% to France and about 10% to Holland.

As noted above, Taiwan is exporting canned crabmeat, called snow crab, to a number of countries including the United States. One company has been processing and exporting about 20,000 cases (48 - 6 oz. tins per case) of snow crab per year to some 14 countries. This company is also interested in importing frozen crab from Alaska for processing in Taiwan for export.

Unfortunately, no information is available on the exports and imports of Tanner crab from the USSR. It is known, however, that the USSR has canned king crab for a number of years for export, mainly for the European markets.

Supply

The total landings, imports and exports have been converted to whole crab equivalents and combined in Table 5 in order to obtain some idea of the trend in per capita supply of Tanner crab in Japan. Although some adjustments will have to be made in the data, the general picture shown in Figure 1 is most interesting. There was a rapid rise in the supply of Tanner crab from 1968 to 1970, and then a decline in the years 1970 and 1971 because of international curtailment and before U.S. production of frozen Tanner crab for export was fully established, a peak in 1973, a decline in 1974 due to unstable

Table 5. Per Capita Supply of Whole Tanner Crab

Year	Landings (mt)	Imports ¹ (mt)	Total (mt)	Exports ² (mt)	Total (mt)	Populations (millions)	Per Capita Supply (kg per person per year)
1964	20,382	-	20,382		20,382	97.190	0.210
1965	16,380	-	16,380		16,380	98.270	0.176
1966	19,487	-	19,487		19,487	99.060	0.197
1967	31,864	-	31,864		31,864	100.190	0.318
1968	61,679	-	61,679		61,679	101.320	0.530
1969	52,311	-	52,311	8,161	44,150	102.520	0.431
1970	53,265	-	53,265		53,265	103.720	0.513
1971	42,352	168	42,520	8,742	33,778	105.014	0.321
1972	41,730	121	41,851	4,380	37,471	107.332	0.349
1973	33,381	32,996	66,377	384	65,993	108.710	0.607
1974	30,066	18,536	48,602	1,374	47,228	110.049	0.429
1975	24,000					111,850	0.300

¹Converted to whole crabs (i.e., frozen (mt) x 5.26).

²Converted to whole crabs (i.e., canned (mt) x 6.00).

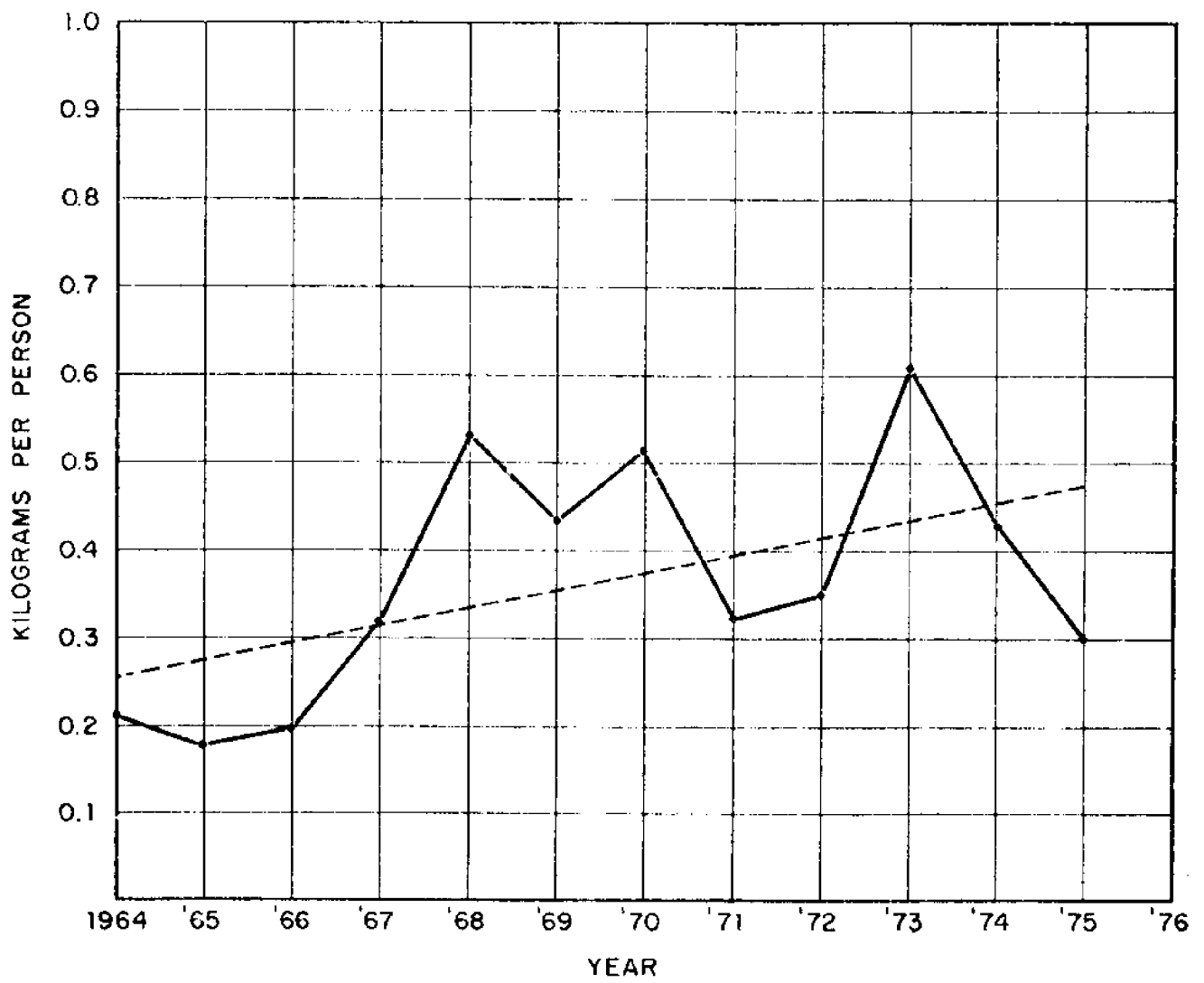


FIGURE 1
JAPANESE PER CAPITA SUPPLY OF WHOLE TANNER CRAB

economic conditions in Japan, and a further decline in 1975. Very preliminary data available for 1976 show some recovery for 1976, but still far from the peak years of 1968, 1970 or 1973.

A linear trend line is drawn in the same graph to indicate the relationship of per capita supply of Tanner crab to time. This increasing trend seems to be supported to some degree by data from Wholesale Consumer Markets which show per capita supply of boiled Tanner crab for the years 1971-1975 (Figure 2 and Table 6).

Of particular interest in these two graphs is the cyclical nature of supply of Tanner crab, both whole and boiled. As time series on production data for all crab become more complete, the cyclical nature of particular species in relation to the entire supply may be revealed.

It is difficult to interpret, with the data available, any trend in supply of whole Tanner crab in the next 3 or 4 years. If the preliminary per capita supply value for 1975, when confirmed, remains low, then we may assume that the average level of supply of Tanner crab in the Japan market is about 35,000 mt (or the per capita supply of 0.435 kg per person). However, the value looks strange and could well be modified when the final reports for 1975 and 1976 become available.

Whatever the curve might be, up or down or stable, somewhere in the future there will be a maximum amount of crab that can be marketed in Japan. We cannot compete with the "mass-caught" species such as mackerel, jacks, sardines or saury that the housewife can buy in the Tokyo retail fish markets for \$0.10 to 0.35 a pound. Let's forget about competition from other products

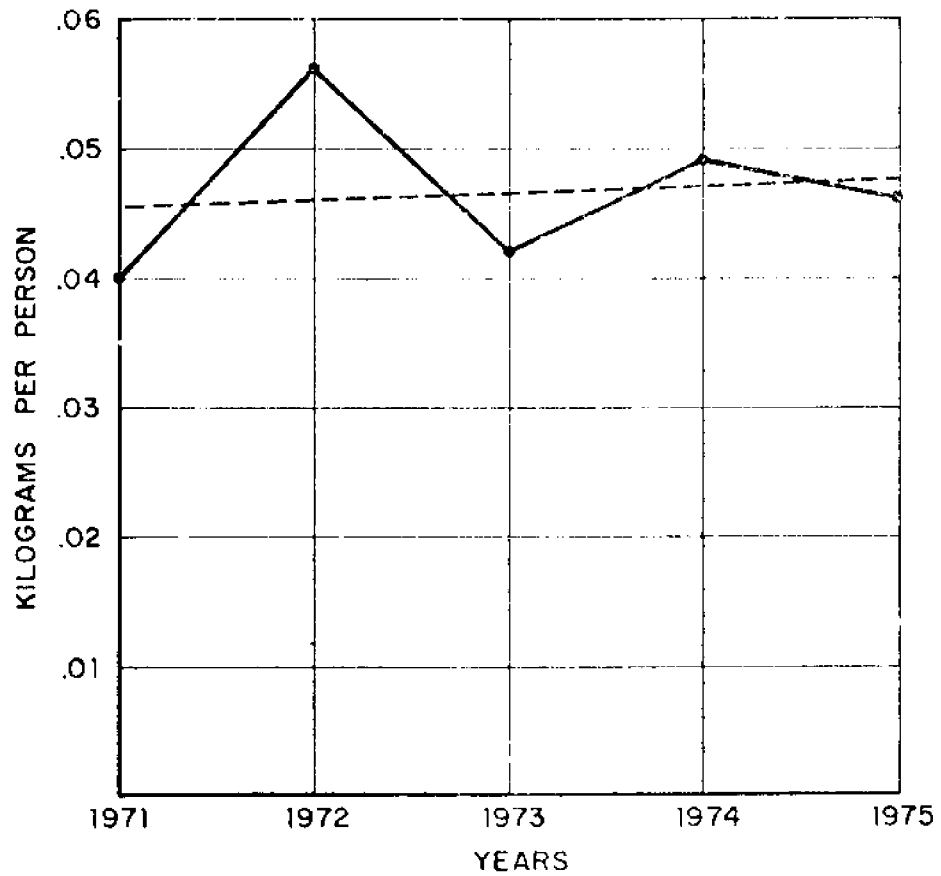


FIGURE 2
JAPANESE PER CAPITA SUPPLY OF BOILED TANNER CRAB
(ALL JAPAN CONSUMER WHOLESALE MARKETS)

Table 6. Per Capita Supply of Boiled Tanner Crab
(All-Japan Consumer Wholesale Markets)

<u>Year</u>	<u>Sales (mt)</u>	<u>Population (millions)</u>	<u>Per Capita Supply (kg per person per year)</u>
1971	4,239	105,014	0.04
1972	6,041	107,332	0.056
1973	4,597	108,710	0.042
1974	7,807	110,049	0.049
1975	5,120	111,850	0.046

or other countries and consider that the only supply of Tanner crab for Japan would come from U.S. waters harvested by U.S. fishermen. This would mean a total MSY of about 200,000 mt of Tanner crab and I cannot visualize under any circumstances that we can sell this amount to Japan -- it would mean an added per capita supply of about 1.8 kg of Tanner crab per person per year, or about 3% of their total per capita supply of fish at the present time.

There is no question, however, that we can sell considerably more Tanner crab to Japan, but to do so would entail, among other things, a market development program in Japan that would increase the market demand (and raise the per capita supply curve in Figure 1). In addition (and as mentioned before), much attention should be given to the development of a domestic market for Tanner crab as well as export markets in other countries.

Price Structure

The mechanics of the Japanese marketing system will not be reviewed here since it has been described in some detail in the three articles that appeared in *Alaska Seas and Coasts* (Atkinson, 1976a, b and c). There are three channels of supply: (1) the Japanese domestic fishermen through their cooperatives, (2) the bona fide fishing companies (including a few independent vessel owners), and (3) the trading companies. It is a highly competitive industry with difficult negotiations between the fishermen and the fishing companies and much jealousy between the fishing companies and the trading companies.

There are also three levels of sales: (1) the point of landing (or the production center) and the price is somewhat comparable to the ex-vessel

Consumer wholesale price data are available for boiled king crab, Tanner crab and hair crab, by Prefecture and month.

Further search of the literature will frequently provide additional detail on crab landings and market information, and occasionally, unpublished data can be obtained from the Fisheries Agency, the Fisheries Associations and the various companies. Most of the data are in Japanese.

For an examination of the Japanese price structure for Tanner crab, only three sources of data are available: landing amounts (Table 5), and averages prices at the fishing ports (Table 7) and wholesale price data from the consumer markets for all of Japan. These have been plotted in Figure 3.

A comparison of adjusted average landed price (Table 7) with total supply for all Tanner crab and for *opilio* alone is shown in Figure 3. Note that the price has continued to rise throughout the 6-year period (1969-1974) and can probably be attributed to the growing popularity of *hairdi*. On the other hand, the supply of *opilio* has declined slightly.

In Conclusion

The main market for Tanner crab in Northeast Asian countries is Japan, where a history of fishing on their own local stocks is already established, there is a growing import market from Alaska, and the consumer demand is favorable. Korea has an import ban on all fisheries products, except for processing bond. Taiwan is interested in importing raw, frozen crab for processing and export, but tariff is too high for import of Tanner crab for domestic consumption. The Soviet Union, after the recently declared 200-mile limit

Table 7 . Supply and Price of Tanner Crab in Japan

Year	Supply (mt)		Average Price (yen per kg)	Fish Product Price Index	Adjusted Average Price (yen per kg)
	Fishing Ports ¹	"Opilio" only ²			
1967	11,304	31,864	117	.83ca	97
1968	12,079	61,679	109	.85ca	92
1969	8,762	43,025	202	.92	218
1970	4,591	52,140	222	1.00	222
1971	3,460	31,578	251	1.08	232
1972	4,427	36,271	330	1.13	291
1973	2,612	32,187	602	1.36	442
1974	1,268	30,630	810	1.63	497

¹ Sample landings and price from 67 fishing ports.

² Total supply less imports of frozen Tanner Crab from U.S. and less estimated Japanese catch of "Bairdi."

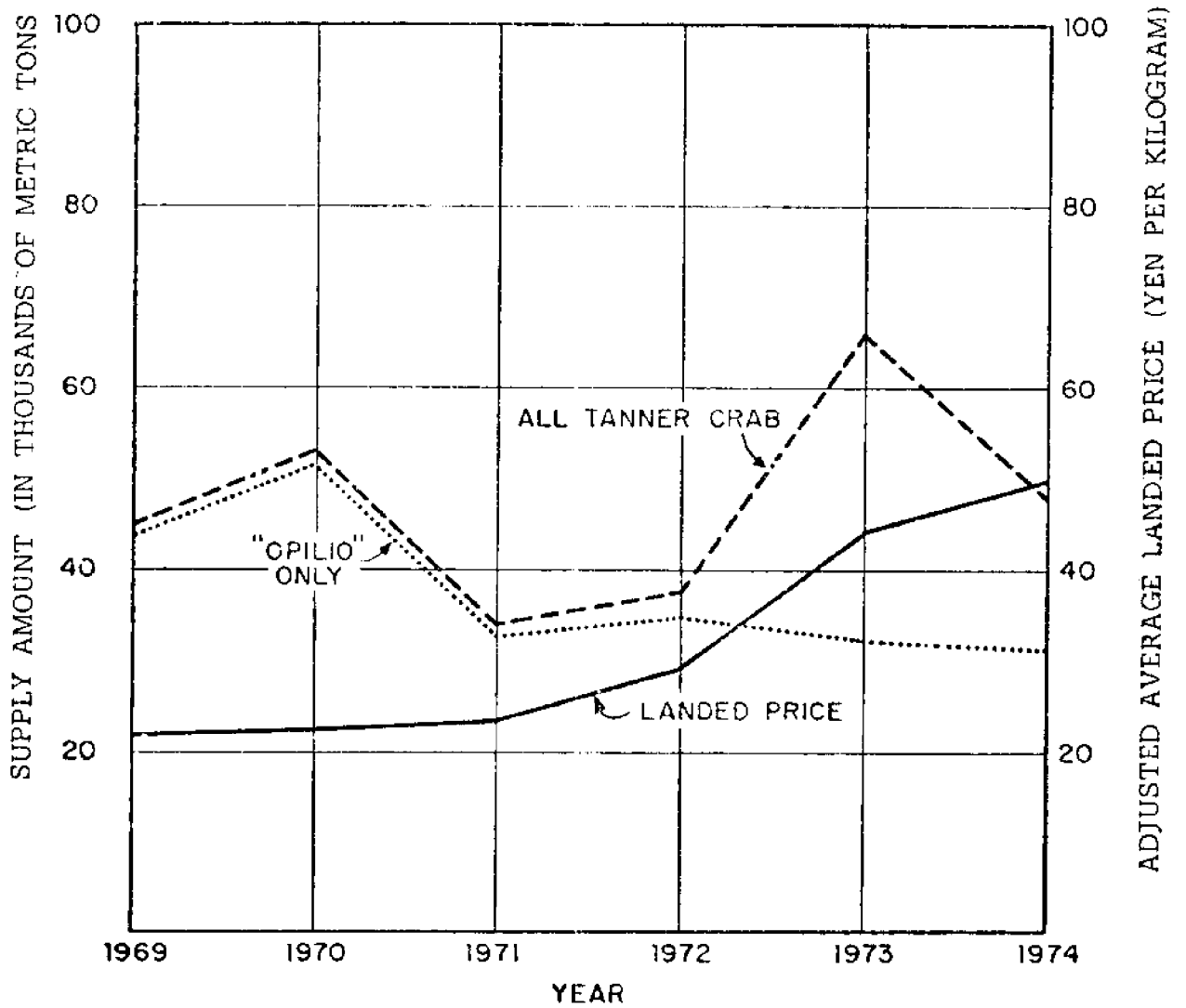


FIGURE 3
 COMPARISON OF LANDED PRICE WITH TOTAL SUPPLY OF TANNER CRAB ("BAIRDI" AND "OPILIO") AND "OPILIO" ONLY

price, (2) the consumer wholesale market (such as the Tokyo Fish Market) and the price is fixed by auction with a 5.5% commission or a negotiated price with a 2.5 or 3.0% commission, and (3) the retail price in various cities. There are several levels of middlemen between each category.

On the whole, the Japanese Government publishes excellent statistics when we consider the variety of species and products and fishing areas. Most frequently, however, the statistics lack the detail necessary for a study of a single species, such as Tanner crab, but instead, we generally find all crab species lumped together into a single category for "crab." There are some exceptions.

Total landings are available for King crab, Tanner crab, blue crab and others, by year and by gear. Mothership production figures are available for king crab and Tanner crab processed aboard motherships. Data on the production of canned crab are available for king crab and others. Import data are for all crabs combined but basically all imports of frozen crab from the United States is for Tanner crab and usable. Export data are only for canned crab (i.e., king crab, Tanner crab, hair crab, "Hanasaki" crab and others).

Market price data are similarly mixed. Tanner crab (fresh and chilled) are available from the Production Centers on a sample basis, earlier from 287 fishing ports, later from 67 fishing ports -- not total. Frozen crab data are available from mothership statistics for king crab, Tanner crab and others.

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APPENDIX G
STUDY TEAM MEMBERS AND OTHER CONTRIBUTORS

APPENDIX C

STUDY TEAM MEMBERS AND OTHER CONTRIBUTORS

Study Team Members

Eric Anderson *	National Marine Fisheries Service, Northwest and Alaska Region
Don Collinsworth	Alaska Department of Fish & Game
Abby Gorham †	University of Alaska Sea Grant Program
Howard Ness *	National Marine Fisheries Service, Southwest Region
Frank Orth *	University of Alaska Sea Grant Program
Lewis Queirolo *	Alaska Commercial Fisheries Entry Commission
Jim Richardson *	University of Alaska Sea Grant Program

Other Contributors

Clinton Atkinson*	Fisheries Consultant
Richard Marasco	National Marine Fisheries Service, Northwest and Alaska Region
George Rogers	University of Alaska, Institute of Social and Economic Research
George Tanonaka	National Marine Fisheries Service, Northwest and Alaska Region

*Co-author

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