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Title: SOME ECONOMIC CONSIDERATIONS IN DUNGENESS CRAB MARKETING

Abstract approved: James G. Youde

The purpose of this study is to describe Dungeness crab marketing from the ocean floor to the ultimate consumer; to identify relations among the Oregon Dungeness crab industry, the Pacific Coast Dungeness crab industry, and the Alaska King crab industry; and to specify the relationships between fishermen's prices for Dungeness crab and levels of Oregon production, levels of total U. S. Dungeness crab production, levels of King crab production, and King crab prices.

Primary data were gathered from fishermen, processors, state fish agencies, and the Bureau of Commercial Fisheries. Secondary sources were utilized to gain general information on King crab fishing and processing.

Dungeness crab is usually sold by fishermen to processors. Processors generally sell the crab through brokers to fish

wholesalers, but they may also sell directly to fish wholesalers or retailers.

A definite seasonal trend was found in prices received by fishermen. However, cyclical movements have a much greater impact upon absolute price levels received by fishermen. Total catch of Dungeness crab and King crab prices were found to play important roles in determining prices received by Oregon Dungeness crab fishermen.

It is concluded from the analysis that: (1) an industry-wide commission is needed to advertise and promote Dungeness crab products; (2) the ocean fishing season should be opened January 1 instead of December 1 of each year; (3) processors should endeavor to expand into new marketing areas to increase demand for their products; (4) grades and quality standards should be established; and (5) further research is needed in the technological, biological, and economic aspects of Dungeness crab production and marketing.

SOME ECONOMIC CONSIDERATIONS IN DUNGENESS CRAB MARKETING

by

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Of course, I accept sole responsibility for all the facts and logic contained herein.

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I. INTRODUCTION

Statement of the Problem

The Dungeness crab industry constitutes a significant portion of the economies of Oregon and the other Pacific Coast states. While the value of the Dungeness crab catch constitutes only 10.3 percent of the total value of all fish caught by Oregon fishermen, it is an important part of the total income of many of the state's fishermen, processors, and fish wholesalers. The total Oregon catch during the 1964-65 ocean season was 6.24 million pounds, worth approximately 1.13 million dollars to fishermen. At average 1965 wholesale prices of $1.20 per pound for crab meat and $.35 for shell crab, Oregon processors added 680 thousand dollars to the value of the catch. Thus, the total wholesale value of the state's catch in 1965 was 1.81 million dollars. As an export commodity, Oregon's Dungeness crab also plays an important role. During the 1965-66 season, for example, approximately 67.3 percent of Oregon's total production was exported to California.

In recent years a combination of factors has presented a serious threat to the stability and growth of the Pacific Coast Dungeness crab industry. One factor is the quasi-cyclical nature of domestic

Dungeness crab production, as shown in Figure 1.1. During the past decade Oregon's production has varied from a high of 11.8 million pounds in 1957 to a low of 3.1 million pounds in 1964. The state's production was approximately 6.3 million pounds in 1965 and about 10.0 million pounds in 1966. Total production in Oregon, California, Washington, and Alaska has varied from 42.3 million pounds in 1957 to 21.3 million pounds in 1964 (Figure 1.2).

Since the Alaska Dungeness crab fishery is still being developed, there exists some justification for examining the total catch of Oregon, California, and Washington. Omitting Alaska data will enable the reader to obtain a better idea of production variation. The total catch of these three states has varied from 41.8 million pounds in 1957 to 8.6 million pounds in 1964 (Figure 1.2). During the past decade Oregon has produced an average of 31 percent of these three states' Dungeness crab production and 23 percent of total Dungeness crab production. These supply fluctuations have had an important impact upon Dungeness crab prices.

Another important factor affecting the Dungeness crab industry's growth and stability has been the introduction of Alaska King crab into traditional Dungeness crab markets. The production of King crab has climbed from 8.8 million pounds in 1956 to 131.7 million pounds in 1965 (Figure 1.3). During the recent fluctuations in Dungeness crab production and prices, King crab prices remained

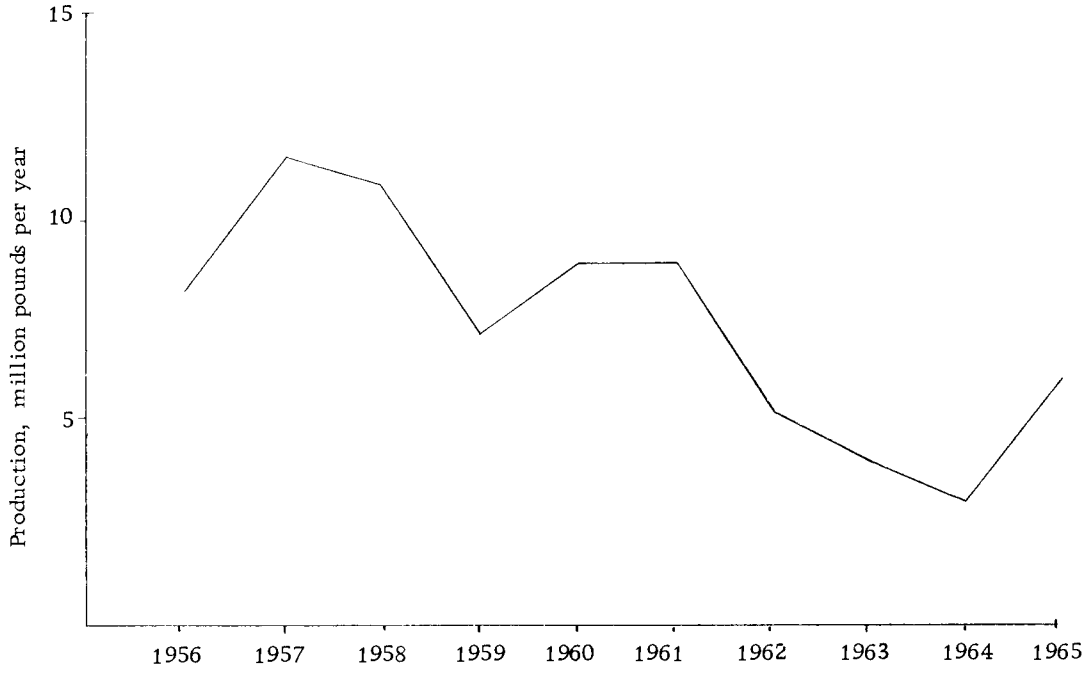

Figure 1.1 Oregon Production, by Year, 1956-1965

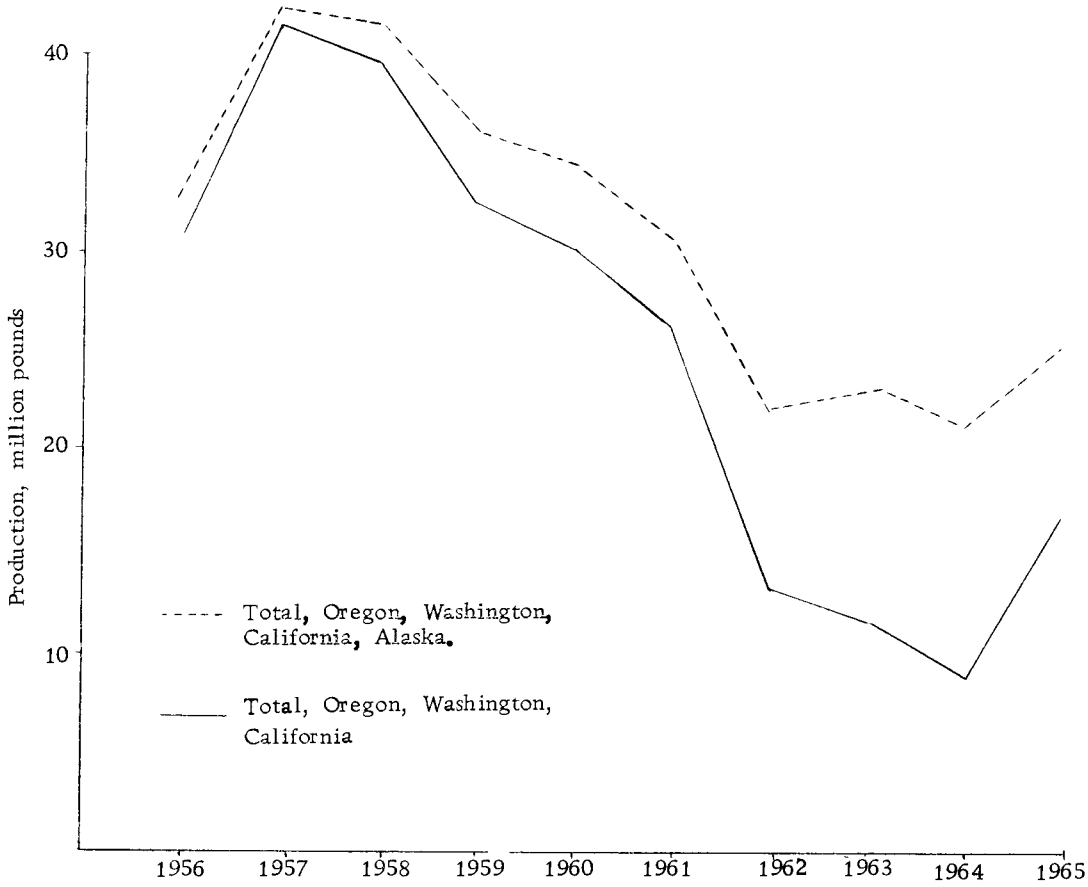

Figure 1.2 Total Production by Year, 1956-1965

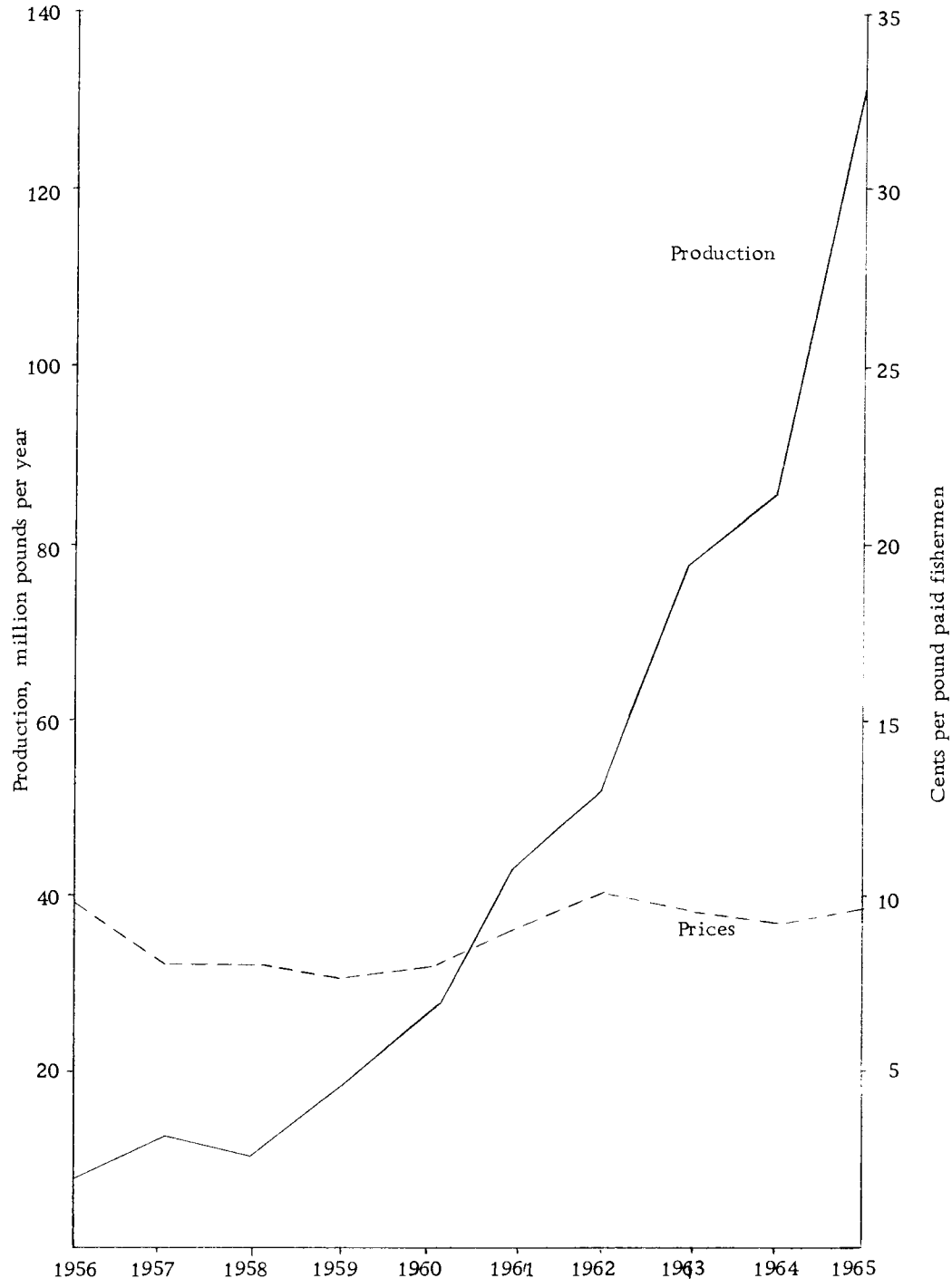

Figure 1. 3 Alaska King Crab Prices and Production by Year, 1956-1965

fairly stable at relatively low levels.

A combination of these and other factors has resulted in depressed prices to Dungeness crab fishermen and processors in recent years. The conditions described above caused Oregon fishermen to seek assistance from Governor Hatfield in January, 1966. The Governor in turn instructed the Oregon Fish Commission and Oregon State University to assist the Dungeness crab industry in exploring alternative solutions to their problems. This study describes the salient features of the Dungeness crab industry and analyzes some economic factors in the marketing and pricing of Dungeness crab.

Objectives

The objectives of this study are to:

1. describe the marketing of Dungeness crab, from the ocean floor to the ultimate consumer, and recommend changes to improve marketing efficiency.
2. determine economic relations among the Oregon Dungeness crab industry, the Pacific Coast Dungeness crab industry, and the Alaska King crab industry.
3. specify relationships between Oregon Dungeness crab fishermen's prices and levels of Oregon production, levels of total Dungeness crab production, levels of King crab production, and King crab

prices.

The second chapter describes the sources of data used. Included in Chapter Three are generalizations that resulted from interviews with Oregon processors and from mail questionnaires sent to Oregon fishermen. Limited descriptive analyses of processing firms in Washington and California, Dungeness crab advertising and promotion, and Dungeness crab processing technology concludes Chapter Three. Price determination in the green[1] Dungeness crab factor market will be examined in Chapter Four. Graphic and statistical analyses will be used. The summary, conclusions, and recommendations will be presented in the final chapter.

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[1] A green Dungeness crab is one that has been caught but is not yet cooked.

II. THE DATA SOURCES

Data for this study were gathered from both primary and secondary sources. Primary data were obtained through a survey of Oregon fishermen and from interviews with processors in Oregon, Washington, and California. Relevant information was also gleaned from consultation and correspondence with officials of the Bureau of Commercial Fisheries and several state fish commissions. University personnel in Oregon and Washington were consulted to gain knowledge about the Dungeness crab industry. Secondary sources were also used to gain familiarity with the industry.

A preliminary questionnaire was designed and pretested by personal interviews with four Oregon Dungeness crab fishermen. After it was pretested, the questionnaire was modified slightly and mailed to all Oregon Dungeness crab fishermen. A copy of the questionnaire appears in the appendix.

A list of 145 Oregon Dungeness crab fisherment was obtained from the Oregon Fish Commission. Following the procedure recommended by Robin (4, p. 24-35), the fishermen on this list were sent introductory letters, questionnaires, and follow-up reminders. This procedure required a maximum of five mailings to all fishermen who did not respond to earlier correspondence. The letters were mailed at seven or eight day intervals.

The fishermen were first contacted by a pre-questionnaire letter. They were asked to assist in this research study by completing the questionnaire which they would receive shortly. They were also given a simple explanation of the purpose and importance of the study. A week later the fishermen were sent a questionnaire, as well as a self-addressed, stamped envelope and a cover letter. The letter reminded the fishermen of the previous letter and reviewed its contents. The inclusion of a return envelope was also emphasized.

A third contact was made through a follow-up letter. The letter was quite brief, reminded the fisherman of his lack of response, and emphasized the importance of his answers to the successful completion of the research study. A second follow-up letter, a second questionnaire, and another self-addressed, stamped envelope were sent to the fishermen the fourth week. The second follow-up letter emphasized the inclusion of the self-addressed, stamped envelope for the fisherman's convenience and the importance of his answers to our research.

The fifth and final contact was the third follow-up letter. Emphasis was placed upon the importance of the research and the researchers' concern about the fisherman's lack of response. He was then invited to "get in touch" with the researchers by letter or telephone if he had misplaced his questionnaires or had any questions about the project.

Using the above procedure, a return of 95 questionnaires (65.5 percent) was obtained. Nineteen questionnaires (13.1 percent) were not used in the study, leaving a return of 76 useable questionnaires (52.4 percent of the total number sent). Some of the people returning unuseable questionnaires were strictly salmon fishermen, some had quit fishing, and others could not be reached by mail. The unuseable questionnaires comprised 20.0 percent of total returns. Thus, if we assume the unused questionnaires represent a true cross section of the population in question, it seems safe to conclude that the 76 useable questionnaires represent more than 65 percent of the Oregon fishermen who fished for Dungeness crab during the 1965-1966 season.

Early in the study it was decided to interview Pacific Coast fish processors to determine their role in marketing Dungeness crab. During a meeting with Snow,[2] a list of major Oregon crab processors was compiled. The small fishermen-processors, i.e., those who sold their catch in their own retail stores were omitted from the list.

After designing a preliminary questionnaire, one processor was interviewed as a pretest. Some modifications were then made in the questionnaire before other interviews were conducted. A copy

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[2]C. Dale Snow, Head of Shellfish Investigations, Oregon Fish Commission, Newport, Oregon.

of the processor questionnaire is included in the appendix.

An appointment was made with a representative of each of the 12 other major Oregon processors. Since two firms declined to participate in the study, interviews were conducted with representatives of the remaining ten firms. The 11 participating firms handled approximately 68 percent of the green crab processed in Oregon during the past two years, and they bought crab from approximately 64 percent of the state's Dungeness crab fishermen.

Stevens[3] provided a list of crab processors in Washington that handle either Dungeness crab or King crab or both. Financial and temporal constraints made it necessary to include only firms that could be visited during the scheduled trips out of the state of Oregon. Washington firms were selected on the basis of absolute size and geographic location. Interviews were limited to firms that processed both Dungeness crab and King crab, with the exception of one large King crab processor. Representatives of five Washington firms with processing plants in Washington and Alaska were interviewed. Two firms contacted declined to participate in the study.

Three California firms were selected from a list provided by

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[3]Roy Stevens, Branch of Marketing, Bureau of Commercial Fisheries, Seattle, Washington.

Hatton[4] on the basis of geographic location and absolute size. These firms were then interviewed, and a questionnaire was completed for each one. No attempt was made to interview a large proportion of the crab processing firms in Washington and California. Rather, it was hoped to determine whether or not the marketing practices of these firms were consistent with our observations of Oregon firms. If their operations are similar, it was assumed that the conclusions of the study would also apply, with a few modifications, to processors in the other Pacific Coast states.

Quantities produced and price data were obtained from government officials. Average monthly prices for Oregon and Washington were obtained from the Bureau of Commercial Fisheries' Market News Service. From the several state fish commissions and the Bureau of Commercial Fisheries,[5] total production and total value by year were obtained. Average yearly prices were calculated by dividing each year's total value by production. As a result of his experience and research in the field of fishery economics, Dr.

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[4] S. Ross Hatton, Program Coordinator, Branch of Marketing, Bureau of Commercial Fisheries, Terminal Island, California.

[5] Oregon Fish Commission, Washington Department of Fisheries, Alaska Department of Fisheries and Wildlife. California data were supplied by Branch of Marketing, Bureau of Commercial Fisheries, Terminal Island, California.

James Crutchfield[6] was able to give suggestions on interviewing techniques and on the design of the processor questionnaire. Mr. Russell Sinnhuber[7] contributed much information on processing technology and on present technological research.

Although there exists only a limited amount of work in this area, some information was obtained from secondary sources. Articles from the Pacific Fishermen (1, 5) were studied to obtain a familiarity with the area of interest, viz., King crab fishing and processing.

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[6]Dr. James Crutchfield, Department of Economics, University of Washington, Seattle, Washington.

[7]Mr. Russell Sinnhuber, Department of Food Science and Technology, Oregon State University, Corvallis, Oregon.

III. THE DUNGENESS CRAB INDUSTRY

The Dungeness crab is handled by several market intermediaries in its movement from the ocean floor to the ultimate consumer. The typical marketing channels for this product are illustrated in Figure 3.1. The fishermen initiate the marketing process by catching the crabs in their pots and delivering them to processors or fresh marketers. The crabs are then cooked and can either be sold whole as shell crab, or the meat can be picked from the shell and sold as fresh or fresh frozen meat.

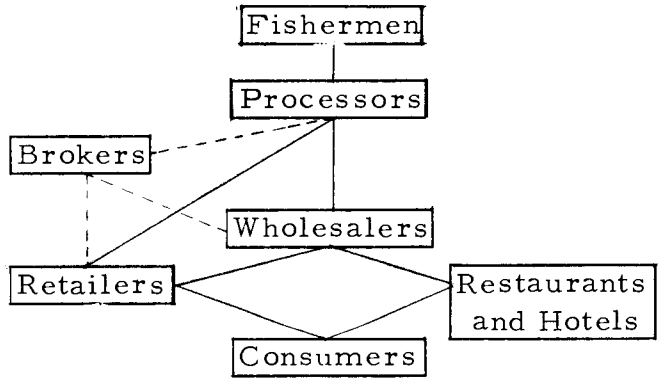

Figure 3.1 Marketing channels for Dungeness crab. Solid lines indicate physical movement of the crab and economic transactions. Broken lines indicate only economic transactions.

From the processor the crab is sold either directly or through brokers to fish wholesalers, but they may also be sold directly or through brokers to large fish retailers. A significant amount of crab

(about 20 percent) is sold directly from processors to chain store retailers. However, the most prevalent method of marketing Dungeness crab is through brokers to fish wholesalers. An important segment of total Dungeness crab volume goes from wholesalers to restaurants and fancy hotels.

The scope of this research does not allow detailed analysis of all levels in the marketing system. Rather, it is limited to an analysis of the marketing of Dungeness crab by fishermen and processors. The first two sections of this chapter examine this portion of the total marketing process in some detail.

Oregon Fishermen

As was stated earlier, over 65 percent of the Oregon fishermen returned questionnaires that were useable in this study. These 76 fishermen caught 70.5 percent of the total Dungeness crab harvested in Oregon during the 1965-66 fishing season.[8] During that season they used an average of 217 crab pots to catch an average of 92,434 pounds of crab. During the 1964-65 season the comparable averages were 210 crab pots and 80,769 pounds caught. Perusal of Table 3.1 reveals that more fishermen were in the lowest "pounds caught" category during the 1964-65 season than in the 1965-66 season.

[8]This percentage was computed by comparing this group's total catch with the total Oregon Dungeness crab catch during the 1956-66 season. The 1965-66 figures were supplied by C. Dale Snow, Head of Shellfish Investigations, Oregon Fish Commission, Newport, Oregon.

Table 3.1 Distribution of quantities of Dungeness crab caught by Oregon fishermen, 1964-65 and 1965-66

Pounds Caught	1964-65 Season				1965-66 Season			
	Fishermen		Total Catch		Fishermen		Total Catch	
	No.	%	Amount	% of Total	No.	%	Amount	% of Total
0 - 49,999	26	40.0	650,000	12.4	21	29.2	525,000	7.5
50,000 - 99,999	21	32.3	1,575,000	30.0	27	37.5	2,025,000	28.9
100,000 - 149,999	11	16.9	1,375,000	26.2	11	15.3	1,375,000	19.6
150,000 - 199,999	4	6.2	700,000	13.3	6	8.3	1,050,000	14.9
200,000 - 299,999	2	3.1	500,000	9.5	4	5.5	1,000,000	14.2
300,000 - 399,999	0	0	0	0	3	4.2	1,050,000	14.9
400,000 - 499,999	1	1.5	450,000	8.6	0	0	0	0
Totals	65	100.0	5,250,000	100.0	72	100.0	7,025,000	100.0

Three out of the top four catch categories had more fishermen in the 1965-66 season than in the previous season. In the 1965-66 season, 66.7 percent of the fishermen caught only 36.4 percent of the respondents' total catch. During the same season the 18.4 percent in the three largest categories accounted for 44.0 percent of this group's total catch.

The sale of Dungeness crab accounted for an average of 60 percent of the respondents' total fishing revenue. The sale of salmon accounted for an average of 29.0 percent of their gross fishing income. The remaining 11 percent was derived from the sale of tuna, bottom fish, shrimp, and other kinds of fish. Only 10.5 percent of the Dungeness crab fishermen fish exclusively for crab, with the rest fishing for one to three other species in addition to crab.

Apparently the large Dungeness crab catch during the 1965-66 fishing season, as compared with the previous season, had a favorable impact upon the profitability of crab fishing. Table 3.2 shows that over 53 percent of the fishermen reported higher gross incomes and larger net profits from crab fishing in 1966 than in 1965, while only 31 percent had lower gross incomes and net profits in 1966 than in 1965.

On the basis of these two seasons, it appears that fishermen's gross incomes and profits from Dungeness crab fishing may be highest during seasons of large supplies of crab and relatively low

prices. This observation is consistent with the answers given by fishermen to the following question:

Which would you prefer (check one)?

A situation where fishing is excellent, but prices poor.

A situation where fishing is poor, but prices excellent.

Of the 40 fishermen (53 percent) answering this question, 70 percent indicated the first alternative and 30 percent indicated the second alternative. Apparently the 36 fishermen (47 percent) not answering the question either did not understand the question or else had no preference of one situation or the other. Although it was not a part of the printed questionnaire, many fishermen added a third alternative. For example, many stated that they preferred "fair fishing and fair prices".

Table 3.2 Comparison of gross incomes and net profits, Oregon fishermen, 1965 and 1966

	Number	Percent
Both gross income and net profit higher in 1966 than in 1965	34	53.1
Both gross income and net profit lower in 1966 than in 1965	20	31.3
Gross income higher but net profit lower in 1965 than in 1966	6	9.4
Gross income lower but net profit higher in 1966 than in 1965	4	6.2
Total	64*	100.0

*Twelve fishermen did not answer this question.

In an effort to determine the effect of the legal season on actual fishing behavior, the fishermen were asked what determined the date at which they actually started and ceased crab fishing. Almost 90 percent indicated that the opening of the legal ocean season influenced the date at which they actually started crab fishing (Table 3.3). Only 13.2 percent indicated that the closing date of the ocean season affected their decision to cease crab fishing. Crabs becoming too scarce to make fishing profitable played the most important role in their decision, with 61.8 percent of the fishermen indicating that this was the primary factor in their decision. According to Snow,[9] during July and August Dungeness crabs enter the molt stage, at which time they shed their old shell and begin growing a new one. During this period the meat is not of the highest quality, and the yield of meat from green crab is quite low. The season is closed on August 15th to allow the crabs to grow inside their shells, thereby increasing the yield and the quality of these shellfish. By December 1st the crabs have almost filled their shells and have regained their quality; thus, the season is opened on that date.

The fishermen were asked to name the major problems facing the Dungeness crab industry and who they felt should try to solve

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[9]C. Dale Snow, Director of Shellfish Investigations, Oregon Fish Commission, Newport, Oregon.

Table 3.3 Reasons for starting and ceasing crab fishing, Oregon Dungeness crab fishermen

Reason	Start Fishing		Cease Fishing	
	No.	%*	No.	%*
Opening (closing) of the ocean season	68	89.5	10	13.2
End (start) fishing for another species	4	5.3	23	30.3
Some physical characteristics of the crab itself	6	7.9	27	35.5
Crabs becoming abundant (scarce) enough to make fishing profitable (unprofitable)	10	22.4	16	21.1

*Since the fishermen were allowed more than one choice, the total of this column will be more than 100 percent.

Table 3.4 Fishermen's major problems facing the Dungeness crab industry

	Number of fishermen indicating this category	%
Marketing and advertising problems	36	33.0
Competition from King crab	27	24.8
Miscellaneous problems*	26	23 9
Legal season problems	13	11.9
Production fluctuations	7	6.4
	109	100.0

*Includes a need for pot limits and designated fishing areas, competition from Russian fishermen, offshore mining, etc.

them (Table 3.4). The category called marketing and advertising included such things as reliance upon limited market areas, too great a margin between fishermen's price and consumers' price, and lack of processor advertising. This category accounted for 33.0 percent of the major problems listed by fishermen.

The problem of competition from King crab products in traditional Dungeness crab markets was mentioned by 27 fishermen and accounted for 24.8 percent of the problems given. The length of the ocean season, the starting date, and the existence of a legal season were included in the legal season problems category. This category accounted for 11.9 percent of the fishermen's problems. Production fluctuations added 6.4 percent and the remaining 23.9 percent was miscellaneous problems.

The fishermen were also asked if they would be willing to contribute one-half cent per pound of crab caught, if the processors would do likewise, to a Dungeness crab commission for the purpose of advertising and quality control. Of the 76 respondents, 45 percent indicated a willingness to contribute, 29 percent were not willing to contribute, and 26 percent were undecided. Although the fishermen were not made aware of this fact, Public Law 88-309 makes federal funds available on a matching funds basis to the states for research and advertising of fish and fish products. It may be that, had the fishermen been aware of this fact, more undecided

respondents would have expressed a willingness to contribute to the Dungeness crab commission. Two processors were against the formation of or contribution to a Dungeness crab commission.

Oregon Processors

As stated earlier, most fishermen sell their Dungeness crab catches to processors. These processors then sort the crabs according to size and quality. If a crab is of a certain size and has all ten legs,[10] he may be processed and sold as shell crab. The other crabs are picked, and the meat is sold as a separate product.

Shell crabs (i. e., whole cooked crabs) are cooked, cooled, and packed in ice. All shell crab is sold fresh; none is frozen. Approximately 31 percent of the crab processed by the 11 Oregon firms interviewed was sold as shell crab in 1965, with the remainder being merchandised as crab meat.

Processing of crabmeat consists of backing and butchering, cooking, cooling, picking, brining, washing, packing, and canning. Backing and butchering involves hand removal of the backs and viscera. This process kills the crab, whereas in shell crab processing the crabs are killed during the cooking process.

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[10] A large proportion of the Dungeness crabs caught are missing one or more legs.

Two types of machines are used in cooking Dungeness crab. One machine is merely a metal vat containing boiling water or live steam. The crabs are placed in wire baskets and dipped into the vats. The other type of machine consists of a continuous chain conveyor running through either boiling water or a live steam bath. The speed of the conveyor is regulated according to the temperature of the water or steam and the desired cooking time.

After cooking, the crab is cooled in cold water. Cooling allows the workers to handle the crab, and it enables the meat to be more easily separated from the shell. Once they are cooled, the crabs are moved to the picking tables where most of the shell is removed by hand from the meat. The meat is placed in a salt brine solution where the meat floats and the small pieces of shell sink to the bottom. After being rinsed in fresh water to remove the salt, the meat goes to packing tables to be placed in metal cans, weighed, and vacuum sealed. The cans of crab meat will either be frozen and sold as fresh frozen crab meat or iced to be sold as fresh meat. The average yield of meat from the whole crab is approximately 22 percent. Thus, a 2.5 pound live crab will yield an average of 0.55 pounds of meat. The yield from this size of crab actually ranges from 0.45 to 0.63 pounds of meat, however.

The 11 participating firms use refrigerated trucks to transport 98 percent of all Dungeness crab they process to buyers. Most of

the Dungeness crab produced in Southern Oregon is trucked to markets in California. A smaller but significant proportion of Northern Oregon's Dungeness crab production is also sold in California. A minor portion of Oregon's production is sold in Washington and in the Rocky Mountain states. Over 76 percent of the 1965-66 season's total catch was exported from Oregon, with 67 percent of total production moving into California markets.

Approximately 80 percent of the total Dungeness crab produced by the 11 participating firms was sold to wholesale fish buyers. The remaining 20 percent was sold directly to chain store buyers. Selling directly to chain store buyers is relatively new in the fresh fish industry. In the Dungeness crab industry direct selling has reached significant proportions only during the 1964-65 and 1965-66 seasons.

No apparent price premiums are received for any particular brand of Dungeness crab meat. All 11 participating firms sell crab meat under their own brand names, and only two of the firms pack crab meat under buyers' labels. The amount of crab meat sold in this fashion by these two firms is a very small proportion of their total sales volumes. No brand identification is used in selling shell crab.

The total maximum processing capacity of nine of the firms interviewed was 175 thousand pounds of green crab per day. The firms ranged in size from ten thousand pounds per day to 50

thousand pounds per day maximum capacity. However, most firms indicated that picking labor, not plant capacity, was the limiting factor in their firm's operation. All Oregon processing firms are located in small coastal communities where a limited supply of seasonal labor is available for crab picking.

Not only did Oregon firms exhibit a wide range in maximum capacity, but they also exhibited a wide range in total production for the 1965-66 fishing season. It can be seen from Table 3.5 that their volumes ranged under 75 thousand pounds to over two million pounds of green crab. However, even two million pounds of green crab is a relatively small absolute volume when compared to the largest King crab processor's volume of over 40 million pounds of green King crab.

The largest firm processed approximately 20 percent of Oregon's 1965-66 Dungeness crab production (Table 3.5). Oregon has processed a ten-year average of 23 percent of total U. S. Dungeness crab production. Using this figure and Oregon's 1965-66 production of 10.0 million[11] pounds, total Dungeness crab production was estimated at 43.5 million pounds. As shown in Table 3.5, Oregon's largest firm processed less than five percent of estimated

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[11] This figure obtained by personal communications with C. Dale Snow, Director of Shellfish Investigations, Oregon Fish Commission, Newport, Oregon.

total U. S. production, and Oregon's three largest firms processed less than ten percent of total production. The 11 firms interviewed processed over 70 percent of Oregon's production, but they handled less than 17 percent of the 1965-66 season's total U. S. production.

Table 3.5 Market share of Oregon Dungeness crab processing firms 1965-66

	Total Pounds*	Percent of Oregon production	Percent of total U. S. production
Largest firm	2,000,000	20.0	4.6
Three largest firms	4,000,000	40.0	9.2
Five largest firms	5,500,000	55.0	12.6
Seven largest firms	6,350,000	63.5	14.6
Nine largest firms	6,845,000	68.5	15.7
Eleven firms interviewed	7,095,000	71.0	16.3

*These figures rounded to conceal individual firm's identities.

Ten Oregon processing firms answered the following question:[12] Besides crab, what other products are sold by your firm? One firm handled clams, four handled tuna, five sold shrimp, seven processed bottom fish, and all ten sold salmon. With the exception of continuous chain cookers, all Dungeness crab processing equipment can also be used for processing shrimp. However, there exists

[12]One firm interviewed did not answer this question.

almost no common use of equipment, with the exception of the refrigeration unit, between crab and any of the other products listed above. Thus, only a small amount of equipment complementarity exists between Dungeness crab and the rest of the product mix.

Little complementarity in the product mix, small absolute volumes of Dungeness crab, and a small market share accounted for by any one firm could explain why there has been virtually no new investment in Dungeness crab processing equipment during the last 15 years.[13] The impact of this lack of investment in new equipment and processing facilities will be examined more carefully in a subsequent discussion of technology.

The 11 firms interviewed employed 93 Oregon fishermen and three Washington fishermen. An average of 8.7 boats per firm were used to procure Dungeness crabs. However, a range from three to 20 boats per firm was observed.

During the 1965-66 season the average wholesale price received by Oregon processors for Dungeness crab meat was $1.01 per pound. The average price for shell crab was 26 cents per pound. During the 1964-65 season the average wholesale price was $1.05 per pound for crab meat and 29 cents per pound for shell crab. Thus, average wholesale prices dropped four cents per pound for crab meat and

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[13]This observation was made by Mr. Russell Sinnhuber, Department of Food Science and Technology, Oregon State University, Corvallis, Oregon.

three cents per pound for shell crab from one season to the next. During this same time period the average price received by fishermen dropped about four cents per pound. Using this figure and a 20 percent yield of crab meat from green crab, ceteris paribus, one might expect a drop in wholesale prices of about 20 cents per pound for crab meat instead of the actual drop of only four cents per pound. The absence of such a decline suggests that the selling prices of processors exhibit a "downward stickiness", while prices paid fishermen fluctuate dramatically, supposedly in response to production variations and other factors. Prices received by fishermen will be examined more closely in the next chapter.

Washington and California Processors

As mentioned earlier, eight crab processing firms in Washington and California were interviewed. The sample of firms in these two states is not large enough to support generalization. Some limited observations of Dungeness and King crab marketing in these states can be made, however.

The crab processing firms interviewed in Washington and California are relatively larger, in terms of total Dungeness crab processed, than Oregon processors.[14] The out-of-state firms processed

[14] Part of the reason for this difference is that absolute size was one of the principal criteria used in selecting the out-of-state sample.

an average of 1.9 million pounds of green Dungeness crab during the 1965-66 season. This average output is over 300 percent larger than the average production of the 11 Oregon firms included in the survey. The largest firm processed 7.2 percent of estimated total Dungeness crab production in the four states, while the largest Oregon firm processed only 4.6 percent of this same total. Including Oregon firms, the four largest processors handled 23.3 percent of total Dungeness crab production, and the eight largest firms processed 36.0 percent of total production. The 17 firms in the survey handled 43.3 percent of total Dungeness crab produced in the United States during the 1965-66 season.

Oregon processors sold approximately 31 percent of their green Dungeness crab as shell crab during the 1965-66 season. The participating firms in Washington and California sold about 39 percent of their green crab as shell crab the same year. California firms sold almost 100 percent of their Dungeness crab products in California. Oregon firms sold about 67 percent of their Dungeness crab in California, while Washington firms sold only about 27 percent of their production in California. Average Dungeness crab processing capacity of Washington and California firms was about 43 thousand pounds per day, as compared to about 21 thousand pounds per day for Oregon firms in the survey.

All processing firms interviewed were asked the following

question: What do you see as major problems facing the Dungeness crab industry? Their replies have been grouped into four categories. These categories and the frequency that each category was mentioned is shown in Table 3.6.

Table 3.6 Major problems facing the Dungeness crab industry, all Dungeness crab processing firms interviewed, 1966

	Number of replies	Percent of total replies
Competition from King crab	6	27.3
Fluctuations in production	7	31.8
Marketing and advertising	8	36.4
Quality control	1	4.5
	22	100.0

The marketing and advertising category included reliance upon limited marketing areas, viz., the San Francisco Bay area and the Los Angeles metropolitan area, and lack of advertising of Dungeness crab products. As stated earlier, approximately 67 percent of the 11 Oregon firms' production was sold in the two major California markets the last two seasons. During peak production periods these markets are unable to absorb large quantities of Dungeness crab products without substantial price reductions.

The second major problem voiced by Oregon processors was the fluctuations in production of Dungeness crab. Within the last

decade Oregon production has varied from a high of 11.9 million pounds of green crab to a low of 3.2 million pounds (Figure 1.1). Associated with these production variations have been fluctuations in prices paid fishermen for green crab from 8.2 cents per pound to 24.9 cents per pound (Figure 1.2).

The problem mentioned third most frequently by processors was competition from Alaska King crab products. King crab production has risen steadily from an annual production of 11.2 million pounds in 1958 to 131.8 million pounds in 1965 (Figure 1.3). During this same period wholesale prices of King crab have remained quite stable and relatively low, compared to fluctuating Dungeness crab prices. Although the King crab meat has a different texture, color, and flavor than Dungeness crab meat, the two products are similar enough for restaurants and consumers to substitute King crab for Dungeness crab, and vice versa.

One processor felt that quality control was an important problem facing the Dungeness crab industry. Crab meat has a delicate flavor and texture. If not handled carefully, crab meat will lose part of its flavor and become tough. Quality of Dungeness crab meat varies widely among processors; it also depends upon the time of the year the crabs are caught and the physical condition in which the live crabs are delivered to the processors.

The processors were then asked who they felt should attempt

to solve these problems. Their replies have been grouped into four categories as shown in Table 3. 7. Almost 30 percent of the replies indicated that the processors should attempt to alleviate these problems. Over 16 percent of the replies revealed the processors felt the fishermen should help find solutions to these problems, while 12. 5 percent of the replies disclosed that the various state fish agencies should attempt to solve these problems.

Table 3. 7 Who all processors interviewed feel should solve major problems of the Dungeness crab industry

	No. indicating each category	Percent of total replies
Fishermen	4	16. 7
Processors	7	29. 2
State Fish Agencies	3	12. 5
Did not know	10	41. 6
Total number of replies	24	100. 0

The King crab processing industry is composed of five or six large firms and a number of small firms. All five Washington firms interviewed had King crab processing plants in Alaska. Four of these firms also had Dungeness crab processing plants in Washington. These four firms handled about seven times as much King crab as they did Dungeness crab. The largest King crab processing firm handled about 50 percent of total King crab production last year, as

compared to the largest Dungeness crab processor handling only 7.2 percent of total Dungeness crab production.

Several important differences exist between the processing and marketing of King crab and Dungeness crab. All King crab meat is sold in a fresh frozen form. Dungeness crab meat is sold both fresh and fresh frozen. Dungeness crabs are also sold whole as shell crab. King crabs are not sold whole, but parts of the legs are sold in the shell. This product is called King crab sections. King crab processing plants rely more upon machinery and less upon hand labor than do Dungeness crab processing plants. For example, a rubber wringer machine is used to separate the meat from the shell in King crab legs. Hand labor is used to pick Dungeness crab meat from the shell.

Handling large quantities of King crab permits certain economies of scale in processing and transportation. For example, sufficiently large quantities of King crab are shipped to specific market destinations to allow whole carload shipments. Approximately 75 percent of the King crab sold by the five participating firms in 1965 was shipped by rail. The other 25 percent was shipped by truck. Almost all Dungeness crab is transported by truck.

Whereas Dungeness crab is sold mainly on the West Coast, Kings crab is sold throughout the United States. Some King crab

is also exported to certain European countries. Approximately 60 percent of the King crab processed by the five participating firms was sold on the East Coast in 1965. One possible reason for the large King crab marketing area, as compared to limited Dungeness crab marketing areas, is the large amount of advertising and product promotion done by King crab processors and the Alaska King Crab Marketing and Quality Control Board. Another possible reason is the selling effort put forth by the large King crab processors. The larger volumes attained by these firms necessitate a greater selling effort than the relatively small processing volumes of the Dungeness crab marketing companies.

Over 80 percent of the King crab handled by the five processing firms interviewed were sold through brokers to wholesale fish distributors. A limited amount, less than 20 percent, was sold directly to chain store buyers.

Advertising and Product Promotion

Only two of the Dungeness crab processing firms in the survey indicated that they engage in or contribute to advertising and promotion of Dungeness crab. In both cases the expenditures for these promotional activities have been very small. Before the 1965-66 ocean season very little money and effort had been devoted to advertising Dungeness crab products.

In January, 1966, the Newport Dungeness Crab Association was formed as a non-profit corporation for the express purpose of advertising Dungeness crab. What follows is a resume of the activities of this association, based on interviews with the president and treasurer of the association.

During the early part of the 1965-66 fishing season, Oregon fishermen were faced with catch limits imposed by processors and a relatively low price for green Dungeness crab.[15] The fishermen attributed these conditions to an unusually large Dungeness crab production and to competition from King crab for the consumer's food dollar. They felt that a promotional campaign was necessary to help alleviate these problems.

Since the processors were unwilling to conduct a promotional campaign for Dungeness crab, the port of Newport Dungeness crab fishermen formed a non-profit corporation. This organization was supported by voluntary contributions of one cent per pound of the fishermen's Dungeness crab catch. The association engaged a Portland advertising agency, Schowalter-Lynch, to advise them and to conduct their advertising activities. The advertising agency also spent considerable time and effort in an attempt to arouse interest and contributions among fishermen, processors, chain stores, and

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[15] The price was 12 cents per pound in Newport, Oregon.

governmental agencies.

Approximately $16,000 was contributed by fishermen during the 1965-66 crab fishing season. All but $2,500 was spent during the season, with the remainder carried over to start advertising for the 1966-67 crab marketing season. A breakdown of the association's expenditures is given in Table 3.8. Over one-half of the association's funds were spent for radio and television advertisements, with another 35 percent going for other advertising and administrative expenditures.

Table 3.8 Distribution of expenditures, Newport Dungeness Crab Association, 1965-66 Dungeness crab marketing season

Type of expenditure	(000) Dollars	Percent of total income*
Radio time	6.7	41.6
Television time	1.5	9.5
Layout	2.9	17.9
Carry-over of 1966-67 season	2.5	15.5
Miscellaneous**	2.5	15.5
Total	16.1	100.0

*Percentages shown here have been calculated from original data and rounded in presentation.

**Includes cost of incorporation, advertising agency fees, and accounting fees.

The Newport Dungeness Crab Association plans to continue to

operate during future seasons on revenues contributed on a voluntary basis by Oregon crab fishermen. Both the president and treasurer of the association believe that the advertising activities have been beneficial to both fishermen and processors by making it possible to sell larger quantities of Dungeness crab at higher prices than would otherwise prevail. They feel the marginal returns to fishermen have been greater than the cost of their contributions, and that advertising will continue to be a profitable venture for Newport fishermen.

Technology in Dungeness Crab Processing

What follows is a resume of an interview with a noted food technologist, Mr. Russell Sinnhuber.[16] Wide variations exist in quality of Dungeness crab meat and in shell crab. The quality of the final product, i.e., at the consumer level, depends upon many things. For example, length of time between processing and consumption, physical condition of the crabs when they are delivered to the processor, stage of the life cycle of the crabs when they are caught, quality control while processing, and the processing procedure all have an impact upon the quality of the final product.

Fresh meat and shell crab have a shelf life of approximately

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[16]Mr. Russell Sinnhuber, Department of Food Science and Technology, Oregon State University, Corvallis, Oregon.

one week. Frozen meat can be kept from four to six months. Both products will deteriorate if held for longer periods after processing. The fresh products will actually suffer bacteria spoilage, while the frozen meat will become tough and "woody", losing some of its flavor.

Many of the fishermen's boats do not have live tanks on board. Thus, their crabs are out of the water for long periods of time before being killed. Under these conditions, the physical fitness of the crabs deteriorate, having an adverse effect upon the quality of the final product. Another factor affecting the physical condition of the crabs is the stage of the life cycle when the crabs are caught. When the crabs molt they lose some of their original quality. Thus, a crab caught at this stage will not be of the same quality as one that has not yet molted.

There have been no significant technological innovations or new investments in Dungeness crab processing equipment during the last 15 or 20 years. This old equipment frequently wears out, and new parts are needed for replacement. Often during these periods of equipment breakdown, the crabs are allowed to stand without refrigeration. If they are still alive they must be held in live-tanks until the equipment can be repaired. Either of these conditions has an adverse effect upon the quality of the final product.

The floatation brining process to separate the crab meat from the shell also has an adverse impact upon the quality of the meat.

After being moved through the salt brine, the meat is washed with fresh water. Since washing removes some of the crab's delicate flavor, most firms avoid a thorough washing. This results in failure to remove all the salt and hastens the deterioration process characteristic of frozen Dungeness crab meat.

At the present time research is being conducted to extend the shelf life of Dungeness crab meat. One project is on irradiation-pasteurization of the meat by Miyouchi.[17] Although this method is very promising, he feels that this method will not have much impact upon Dungeness crab marketing in the immediate future. The Food and Drug Administration must approve this method, and test marketing to determine consumer acceptability is needed before any commercial application of this method can be made.

The processing costs of irradiation-pasteurization are estimated to range from 0.2 cents per pound to three cents per pound. However, storage life is extended significantly. Dungeness crab meat processed using this technique conceivably could be sold fresh (pasteurized) anywhere in the United States.

A research study on pasteurization of Dungeness crab by heat in polyethelene packages is presently being conducted by

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[17] Mr. David Miyouchi, Research Chemist, Bureau of Commercial Fisheries, Seattle, Washington. Mr. Miyouchi contributed the following observations on the irradiation-pasteurization method of processing.

Farber.[18] It is hoped that this process will also lead to increased storage life for fresh Dungeness crab products. The months of extended shelf-life which could conceivably be attained would eliminate the necessity for freezing crab meat and allow all Dungeness crab production to be sold fresh. Thus, the marketing season could also be extended, leading to a stable supply throughout the entire year.

However, it is too early to evaluate the results of their research at the present time.

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[18] Dr. Lionel Farber, Director, Seafood Research Laboratory, George Hooper Foundation, University of California, San Francisco, California.

IV. PRICE ANALYSIS

A relevant variable in appraising the performance of the Dungeness crab industry is the prices paid by processors to fishermen for green crab supplied by the latter to the former. At least two aspects of these prices--their absolute levels and their stability over time--would appear important in making such an appraisal. Thus, we now consider some aspects of the prices paid to fishermen by processors. The relative prices of Dungeness crab and King crab will be compared briefly. Then seasonal and cyclical fluctuations in Dungeness crab prices will be considered. Relationships between quantities and prices of Dungeness crab and King crab will also be examined.

In this chapter, "price" is defined as the amount, in cents per pound of live crab, paid to fishermen by processors. The major share of all Dungeness crab production consists of ocean crab, as distinguished from bay crab. Since the latter constitutes a very small proportion of total production, only ocean crab price data will be used to examine seasonal trends. The season on ocean crab opens on December 1st and closes on August 15th each year. The bay crab season is open all year.

Relative Prices of Dungeness Crab and King Crab

During the past decade Dungeness crab prices have fluctuated rather widely, while King crab prices have remained quite stable (Figure 4.1). Perusal of Figure 4.1 also reveals that Dungeness crab prices are generally higher than King crab prices.

One possible explanation of this relative difference in price is the relative costs of harvesting and processing the two species. Since King crabs are on the average four times as large and more abundant than Dungeness crabs, one might reason *a priori* that the average cost per pound of harvesting and processing Dungeness crab would be greater than the average cost of harvesting and processing King crab. King crab also lends itself to processing with more machinery and less hand labor, while Dungeness crab processing depends almost entirely upon hand labor.

The difference between the relative price stability of the two species might result from the fact that the supply of Dungeness crab is primarily determined by biological factors, while the supply of King crab, at least until now, has been primarily dependent upon fishing effort. This fact is explained in more detail in a later section.

Seasonal Price Fluctuations

Price variations that occur on a recurring basis over a

Figure 4. 1 Relative Prices, Dungeness Crab and King Crab, 1956-1965.

less-than-one-year time period are usually characterized as seasonal fluctuations. The price of crab is generally low during the early part of most Oregon ocean seasons and then rises, reaching its peak in July and August (Figure 4. 2). A simple-average method of calculating seasonal variation (6, p. 324-327) was used to compute the line shown in Figure 4. 2 as "average". This method has the advantage of simplicity both in calculation and in interpreting the results. The simple-average price for Dungeness crab rises from 13. 97 cents per pound in December, the start of the season, to 20. 30 cents per pound in August, the close of the season.

However, the simple-average method is subject to certain limitations. Exceptionally high, low, or irregular observations exert undue influence on the monthly average in question. If the cyclical movement[19] is large (relative to the seasonal movement), the changes in price which are actually a part of the cyclical movement will also tend to distort the changes in price which are in fact caused by seasonal differences. A third factor which may affect the monthly averages is the presence of long-term trends.

Thompson and Foote (6, p. 326) recommend the following method to overcome the disadvantages of the simple-average method:

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[19] A cyclical movement is a movement occurring on a recurring basis during a time period greater than one year. Cyclical movements are examined later in this chapter.

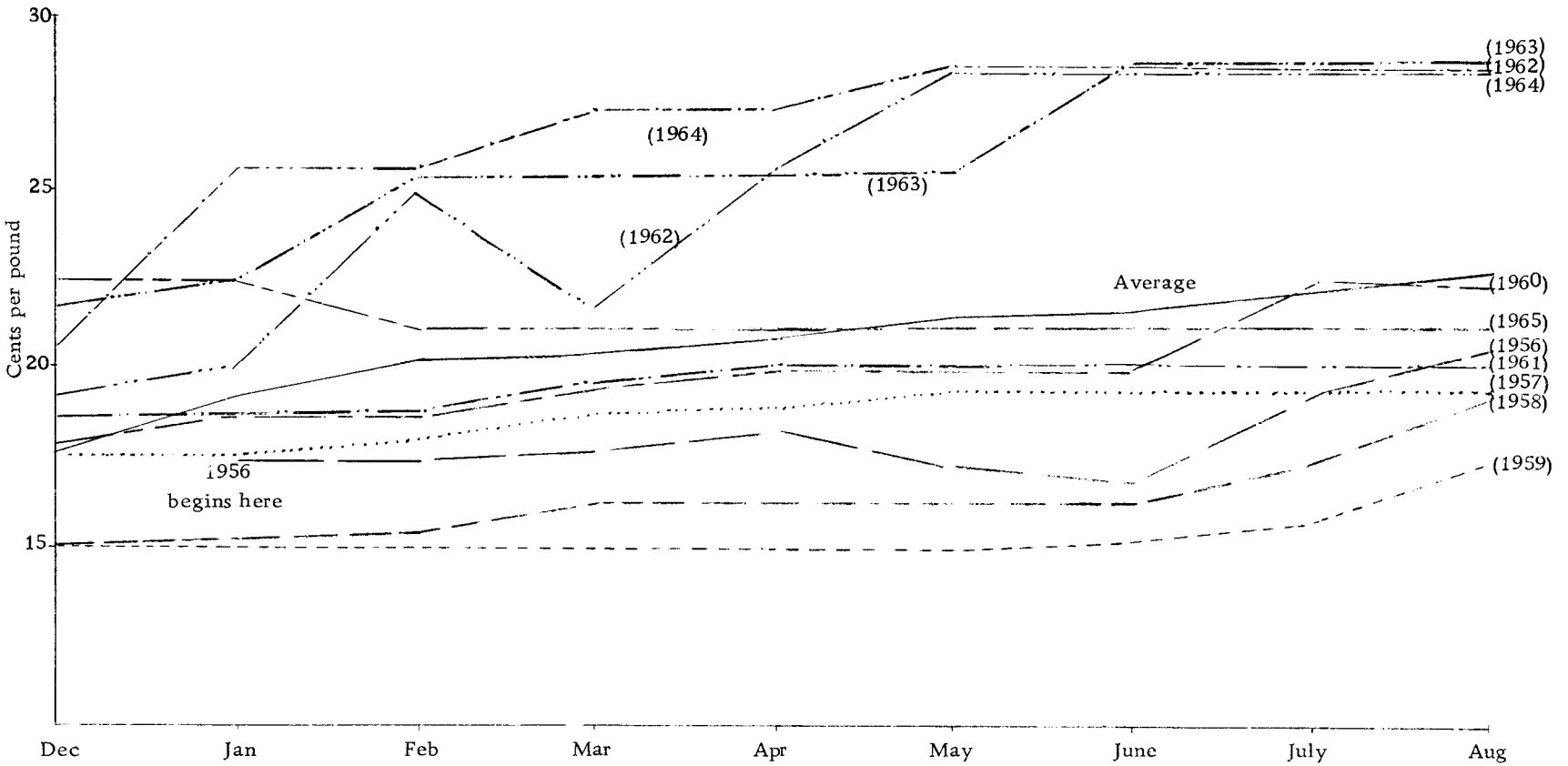

Figure 4.2 Oregon Dungeness Crab Prices by Month, 1956-1965

> (1) Compute a 12-month moving average, centered. (2) Express the original data, month by month, as percentages (relatives) of the moving average. (3) Arrange all of the individual January relatives thus secured in an array; then strike off the extremes, i.e., the unusually high or low relatives included in the array. (4) Average the remaining relatives included in the array for January. (5) Do the same for each of the other months. (6) Express each monthly average so obtained as a relative or index number by dividing it by the average of all the monthly averages, then multiplying by 100.

The graph of the monthly prices received by fishermen during the last decade, expressed as a percentage of an adjusted nine-month moving average, is shown in Figure 4.3. The relative or index numbers obtained by step (6) in the above procedure are also shown in Figure 4.3. and are labeled "index". These index numbers rise from 82.90 percent in December to 120.64 percent in August.

Thus, it can be seen that a definite seasonal movement does exist in Dungeness crab prices. During the early part of the season crabs are quite abundant and easily caught. During the latter part of the season the catch of crab decreases considerably as they become more scarce. Peak demand for Dungeness crab is in the summer months. Thus, there is a smaller supply and a larger demand during the summer months than there is during the earlier part of the season. Since prices are determined by supply and demand, this situation results in higher prices during the latter part of the season.

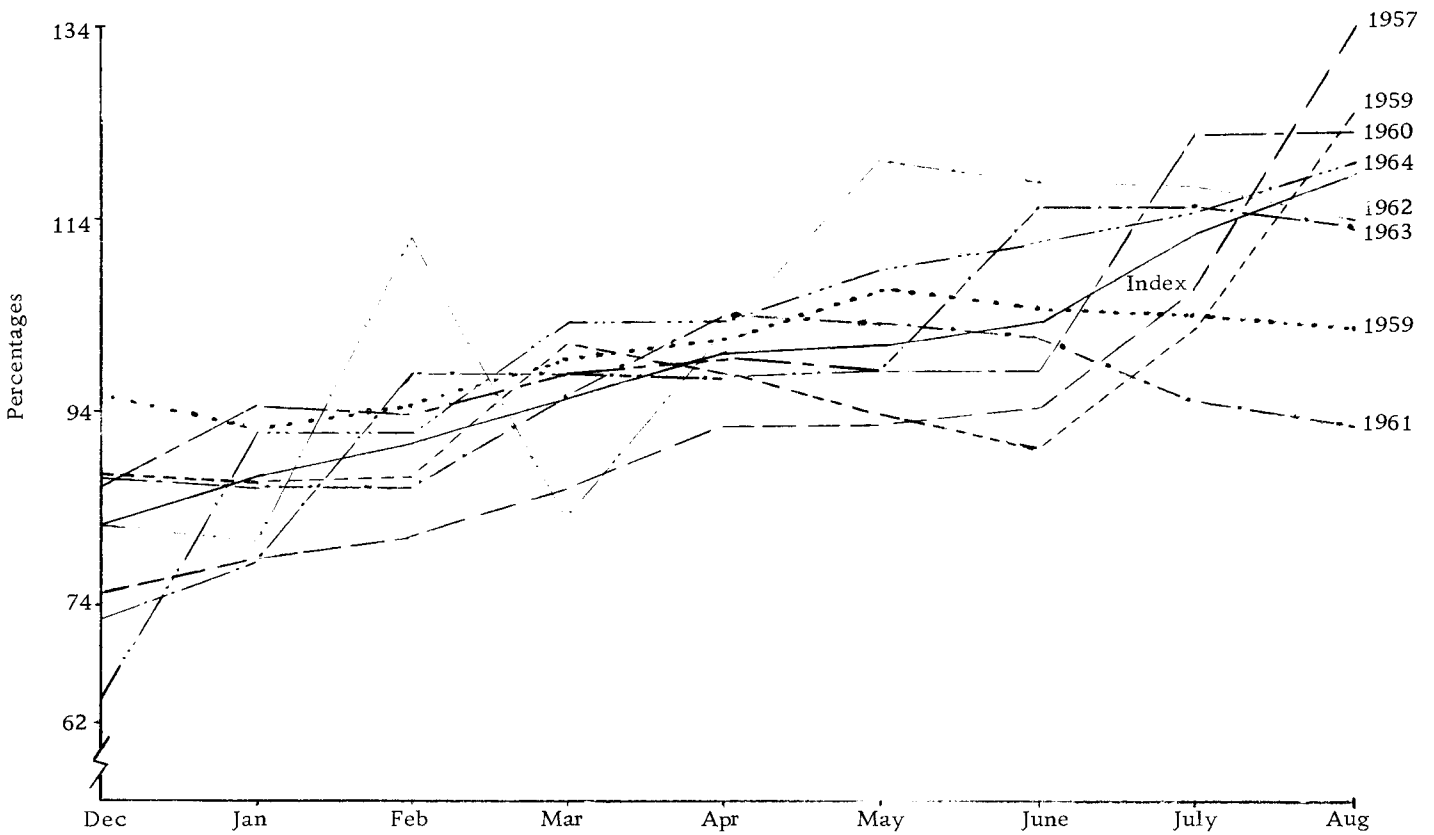

Figure 4.3 Oregon Dungeness Crab Prices by Month, Expressed as a Percentage of a Nine-Month Moving Average.

Cyclical Price Fluctuations

Price variations that occur on a recurring basis over some time period longer than one production or marketing season are generally characterized as cyclical fluctuations. This type of price movement is commonly found among agricultural commodities with large changes in supply and relatively stable demand. Considerable evidence also exists to suggest that Dungeness crab production and prices have behaved in a quasi-cyclical manner during the past decade.

The quasi-cyclical movement that has occurred in the catch or supply of Dungeness crab from 1956 through 1965 is shown in Figure 1.2. Perusal of this graph and Figure 4.1 reveals an inverse relationship between supply of Dungeness crab and prices paid to fishermen. When supplies were high, as was the case in 1956, 1957, and 1958, prices were relatively low. When supplies were low, as was the case in 1962, 1963, and 1964, prices were relatively high.

Figure 4.4 more closely reveals the inverse relationship between price and quantity in the Oregon Dungeness crab factor market. Least squares regression was used to fit a line to the data. Using Oregon prices to fishermen, P_D, as the dependent variable, and the quantity of Dungeness crab caught in Oregon, x_1, as the independent variable, the following equation was computed:

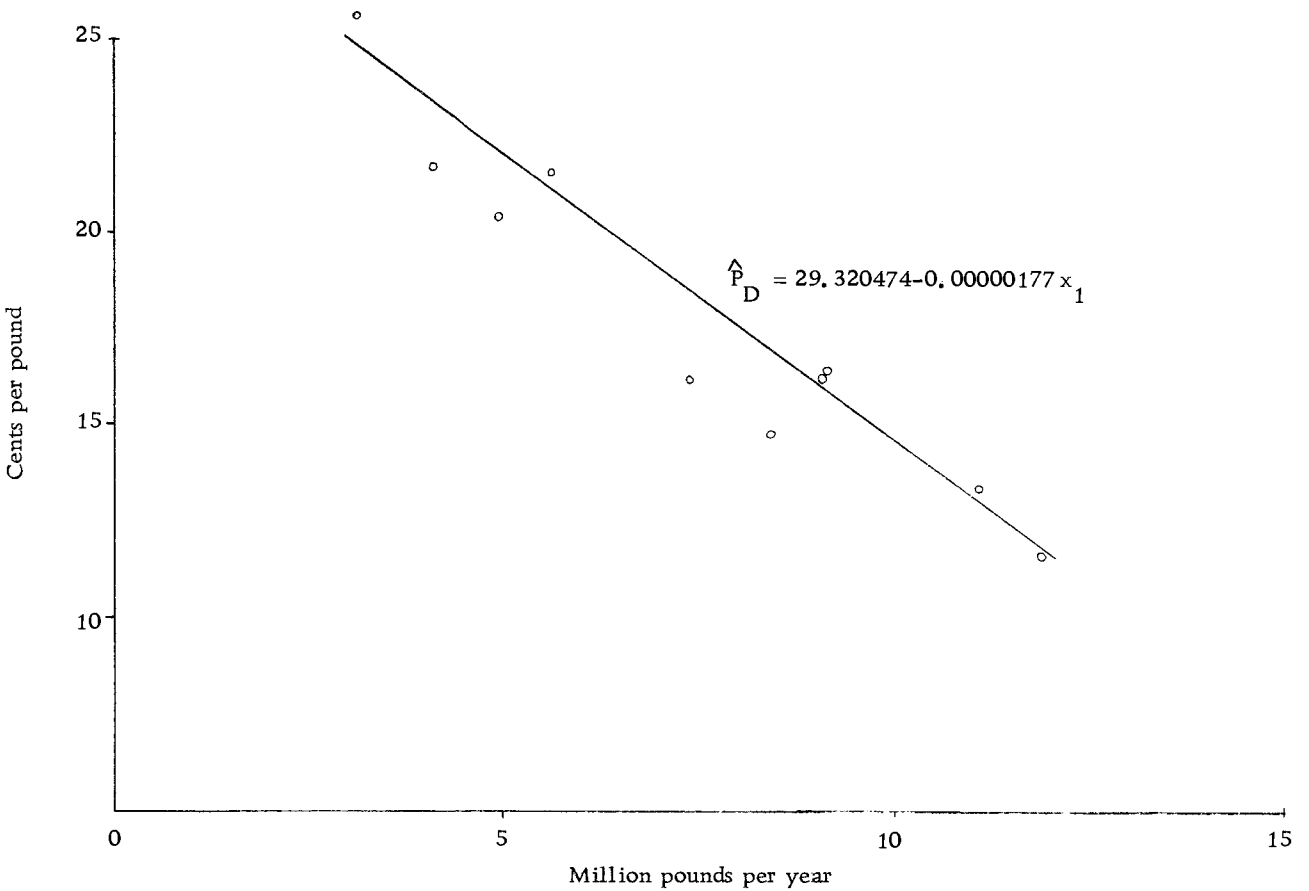

Figure 4.4 Oregon Prices and Quantities by Year, 1956-1965.

(1) $\hat{P}_D = 29.320474 - 0.0000177 x_1$ [20]

A R^2 value of .897 was obtained, indicating that the quantity of Dungeness crab caught explained almost 90 percent of price variation during 1956-65, the period under consideration.

Is price dependent upon the quantity of crab caught, as is indicated above, or is the quantity caught dependent upon price? At first glance, it seems that both relationships would hold. Since it is determined by supply and demand, price would certainly appear to depend upon the quantity of Dungeness crab caught. One might also reason that, at a higher price, more fishermen would commence crab fishing, a greater effort would be exerted by existing fishermen, and more crabs would be caught. Thus, the quantity caught would be dependent upon the price of crab.

While the above a priori reasoning is probably valid, there is strong evidence to suggest that the quantity of Dungeness crab caught is not primarily a function of price, but rather is dependent upon the amount of legal crab available[21] for harvest. Biologists estimate that over 90 percent[22] of all legal crabs are caught each year. The

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[20] X_1, when subjected to a t test with eight degrees of freedom, was found significant at the 99 percent confidence level.

[21] A legal ocean crab is at least 6-1/4 inches, measured across the back, and must be male.

[22] This figure obtained by personal communications with C. Dale Snow, Director of Shellfish Investigation, Oregon Fish Commission, Newport, Oregon. His studies give him the basis for this figure.

quantity of legal crab available each year depends upon a number of environmental factors. Unfortunately, biologists have not yet been successful in relating the specifics of these factors to Dungeness crab production. In any event, it appears that the supply of Dungeness crab is determined primarily by biological factors which determine the amount of Dungeness crab available for harvest and is influenced to a lesser extent by price.

Dungeness Crab Production and Prices

Oregon is hardly an isolated production or market area for Dungeness crab. As mentioned earlier, over 67 percent of Oregon's Dungeness crab is sold in California markets. Thus, one would expect a priori that the total quantity of Dungeness crab caught in all states would influence the Oregon price to fishermen. The relationship between Oregon's price and total Dungeness crab production is shown in Figure 4.5.

Least squares regression was used to compute the following equation:

$$(2) \quad \hat{P}_D = 37.35338 - 0.00000068 x_2^{23}$$

where P_D = prices received by Oregon Dungeness crab fishermen

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$^{23}X_2$, when subjected to a t test with eight degrees of freedom, was found significant at the 99 percent confidence level.

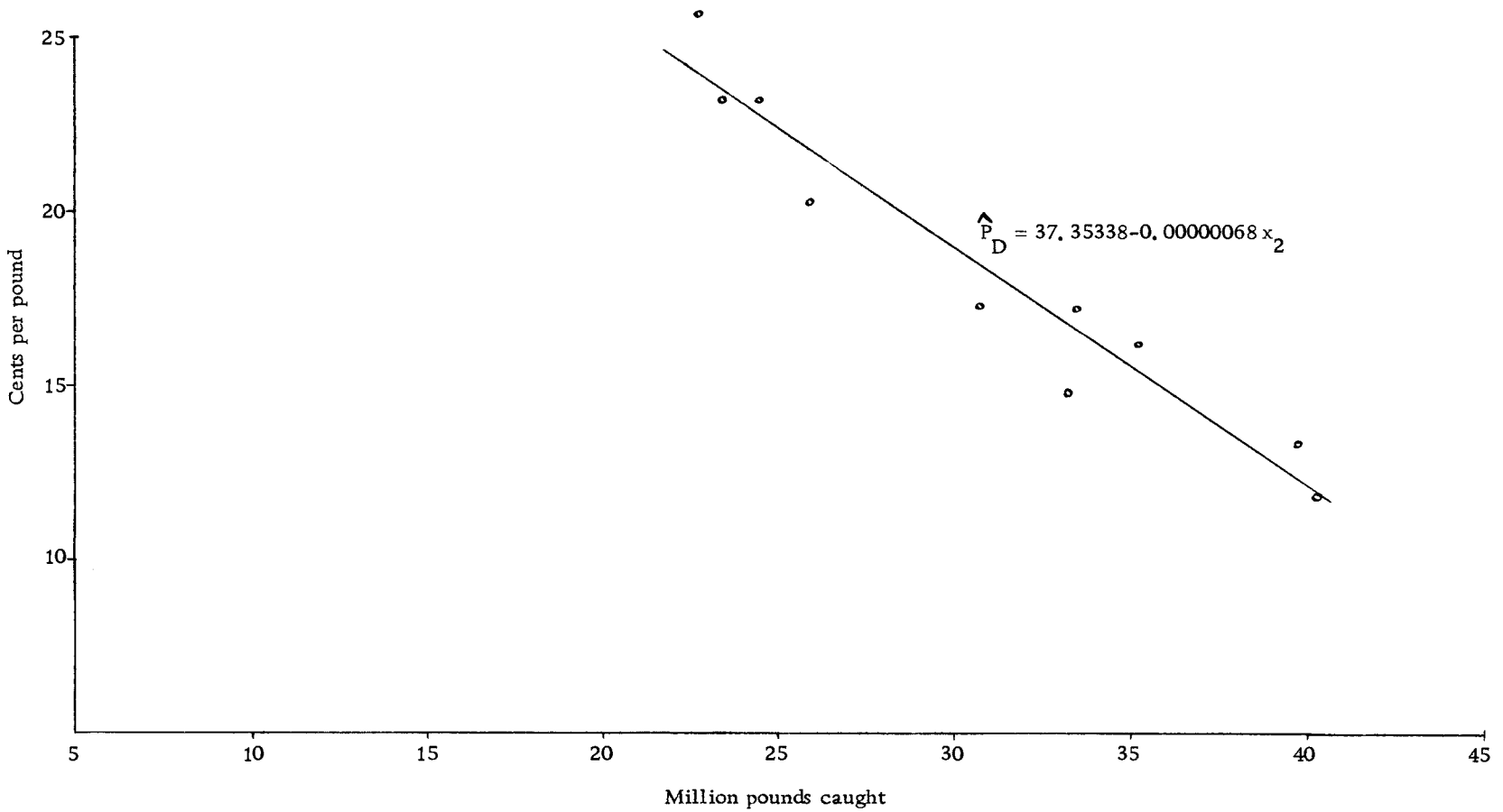

Figure 4.5 Oregon Prices and Total Quantities Caught, 1956-1965.

x_2 = total quantity of Dungeness crab caught in Oregon, Washington, California, and Alaska.

The graph of this equation is shown in Figure 4.5.

An R^2 value of .93 was computed, indicating that the total quantity of Dungeness crab caught in the four states explained 93 percent of the Oregon price variation during this time period. Both Oregon Dungeness crab production and total Dungeness crab production seem to have a significant impact upon Oregon price.

Step-wise, least squares multiple regression analysis was used to explain the variation in the prices paid Oregon Dungeness crab fishermen during the past decade and to examine the relative effects of the following variables:

P_D = prices of Oregon Dungeness crab.

x_1 = quantity of Dungeness crab caught by year in Oregon.

x_2 = total quantity of Dungeness crab caught by year in Oregon, Washington, California, and Alaska.

x_3 = average price paid fishermen for King crab.

x_4 = quantity of King crab caught by year.

Using all four independent variables, an R^2 value of .982 was obtained. However, two of the variable, x_1 and x_4, were not significant when subjected to a t test with five degrees of freedom at the 95 percent confidence level. These two variables, x_1 and x_4, increased R^2 by only .004. Thus, x_1 and x_4 have been omitted from

the following equation:

$$(3) \quad \hat{P}_D = 66.35631 - 0.00000091\, x_2 - 2.42802\, x_3$$

X_2 and x_3 are significant, using a t test with seven degrees of freedom, at the 99 percent confidence level. An R^2 value of .978 was obtained using these two variables. The total quantity of Dungeness crab caught, X_2, explained 92.9 percent of the variation in prices. King crab price, x_3, explained an additional 4.9 percent of the variation in prices.

The X_2 coefficient, -0.00000091, means that for each additional increment in supply of one million pounds of Dungeness crab, the predicted price of Dungeness crab in Oregon will be 0.91 cents per pound lower than the original price. The relationship between Oregon Dungeness crab prices and King crab prices indicates complementarity between the two products rather than the expected substitute relationship. One possible explanation is that the large amount of King crab advertising carried on by firms in the industry and by the Alaska King Crab Marketing and Quality Control Board may have increased demand for Dungeness crab as well as for King crab products.

An F test was computed to test the validity of equation (3), using the following formula (7, p. 324):

$$(4) \quad F = \frac{R^2}{1-R^2} \cdot \frac{N-k-1}{k}$$

where R^2 = coefficient of determination

N = number of observations, 10

k = number of prediction variables, 2.

The computed value of F, 155.09, was significant at the 99 percent confidence level with seven and two degrees of freedom. Thus, the test of the entire model, as well as individual t tests of the two independent variables, meet recognized criteria for statistical validity.

King Crab Production and Prices

The annual King crab harvest has risen dramatically during the last decade, from 8.8 million pounds in 1956 to 131.7 million pounds in 1965 (Figure 1.3). This phenomenal increase can be attributed to fishermen harvesting virgin stocks of King crab, i.e., stocks of King crab that have never been fished before. There is presently a great deal of uncertainty as to what the sustained yield of the King crab fishery will be.[24] Each processor has a different, usually optimistic, estimate, and each is making future plans according to his own estimate. Each biologist also seems to have a different estimate.

During this rise in total production of King crab, prices have remained quite stable. Average annual prices paid fishermen for

[24]A sustained yield is a maximum amount of annual harvest that can be taken from the fishery without causing a decrease in the total population over time.

King crab are also shown in Figure 1.3. In 1956 the average price received was 9.7 cents per pound. Apparently the tremendous increase in total catch has had little or no effect upon King crab prices.

When King crab price (P_K) is plotted as the dependent variable and quantity of King crab caught (x_1) as the independent variable, a slightly positive, almost horizontal relationship is noted (Figure 4.6). The line

$$(5) \qquad \hat{P}_K = 8.317449 + 0.000000013\, x_1$$

was computed by least squares regression to fit the data in Figure 4.6. An R^2 value of .36 was obtained, indicating that the annual quantity of King crab caught explained only 36 percent of the variation in annual average price.

Step-wise, least squares regression analysis was also used to determine relations between King crab prices and other variables. The average annual price paid King crab fishermen (P_K) was the dependent variable, and the following three independent variables were used:

x_1 = Quantity of King crab caught, by year.

x_2 = Average yearly price of all Dungeness crab.

x_3 = Total quantity of Dungeness crab caught, by year.

The quantity of Dungeness crab caught (x_3) came in first in the step-wise regression and was found to be significant, when subjected to a t test with six degrees of freedom, at the 99 percent

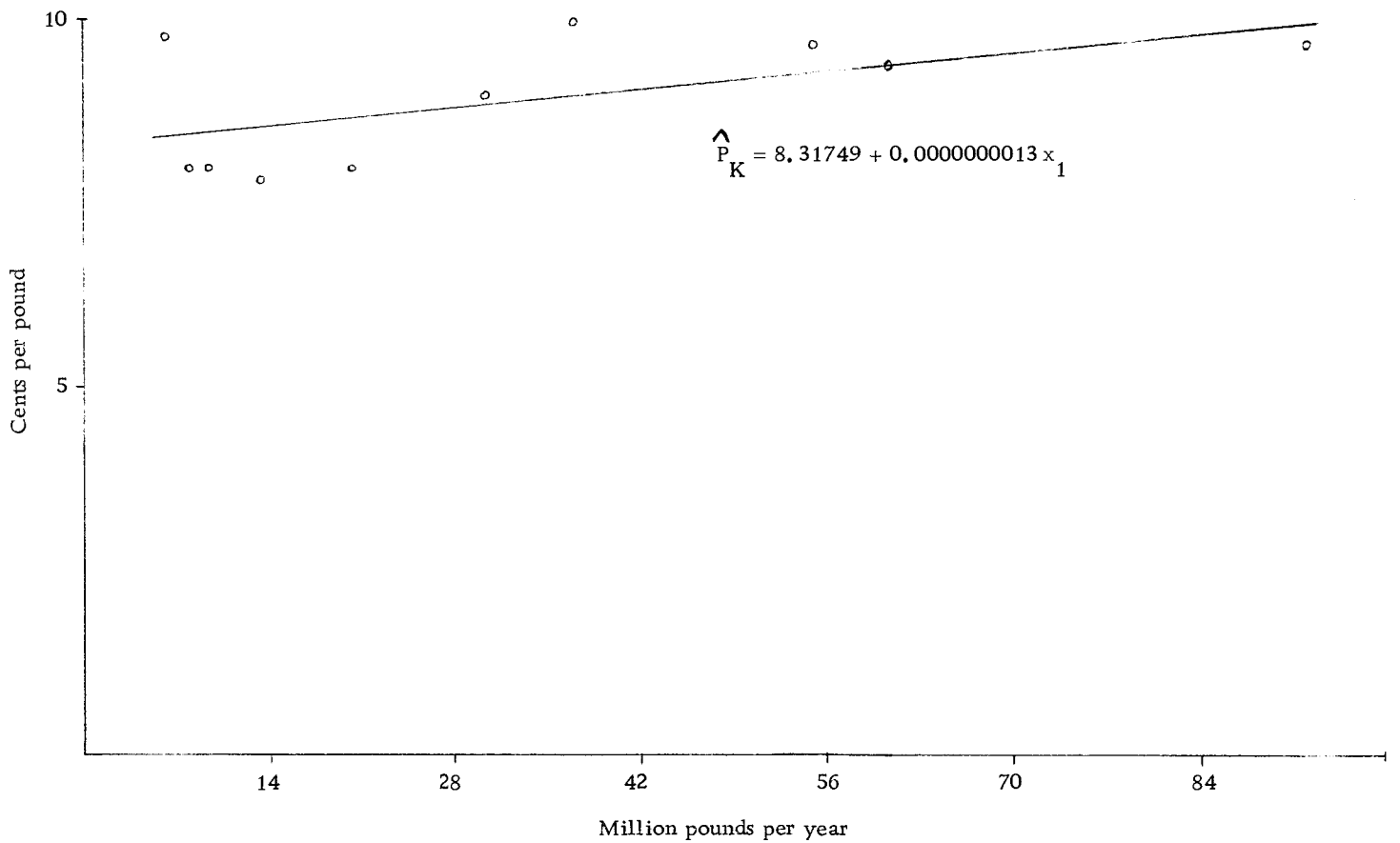

Figure 4. 6 Alaska King Crab Prices and Production, 1956-1965.

confidence level. X_2, average yearly price of Dungeness crab, was significant at the 95 percent confidence level, but x_1, the last variable to enter, was significant at only the 40 percent confidence level. Although an R^2 value of .87951 was obtained for the complete equation, the annual quantity of King crab caught, x_1, added only .00006 to R^2. Therefore, x_1 has been dropped from the following equation:

$$(6) \quad \hat{P}_K = 18.21055 - 0.23948\, x_2 - 0.000000189\, x_3$$

No doubt there exists a strong relationship between King crab prices at the retail level and supply of Dungeness crab at the retail level. Since the demand at the fishermen's level is a derived demand,[25] the supply of Dungeness crab also has an impact upon prices at the fishermen's level. An R^2 value of .68 was obtained for x_3 (the annual quantity of Dungeness crab), the first variable to enter the step-wise regression, indicating that x_3 explained 68 percent of King crab price variation from 1956 to 1965.

It is concluded from the above analysis that the annual catch of King crab has had almost no effect upon the prices paid fishermen for King crab during the last decade. Also, prices paid fishermen have not declined, as one might expect from the tremendous increase in supply. Several factors might explain these findings. For example, there exists strong evidence to indicate that the price of

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[25]Derived demand is the demand at the retail level less the costs of processing and distribution and profits earned by middlemen in the marketing system.

King crab is dependent upon the relative bargaining strength of processors and the King crab fishermen's bargaining association. Each year, before the opening of the season, the King crab fishermen's association bargains with the various processors to arrive at a price for the coming season. Although data were not available to test this hypothesis, apparently this barter price has a strong impact upon prices paid King crab fishermen throughout the remainder of the season.

There has also been a large increase in demand for King crab. King crab processors and the Alaska King Crab Marketing and Quality Control Board have done considerable advertising and product promotion throughout the United States. King crab processors and brokers have also entered the California crab market, offering former Dungeness crab buyers stable prices and a constant supply throughout the year. Many California institutions[26] have switched from Dungeness crab to King crab for use in crab salads and crab cocktails.

Although there exists a definite seasonal movement in prices paid fishermen, cyclical movements have a much greater impact upon the absolute levels of prices than do seasonal movements. A strong relationship exists between prices received by Oregon Dungeness crab fishermen and the total U. S. supply of Dungeness

[26]Restaurants, night clubs, and other large crab users.

crab. Dungeness crab prices are also influenced by King crab prices.

Total quantity of King crab has almost no effect upon King crab prices. Rather, it is thought that the relative bargaining strengths of processors and the King crab fisherman's bargaining association play a much greater role in price determination than total quantity caught.

Of course, the multiple regression analyses used in this chapter do not infer cause-effect relationships, but only statistical relations between the variables analyzed. For example, the reader should not conclude that the total quantity of Dungeness crab caught actually causes 68 percent of the variation in King crab prices. A third variable not used in the regression analysis, but correlated with both variables, may actually be the causative factor.

V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary and Conclusions

As was mentioned in Chapter I, this study has three objectives. The first objective is to describe the marketing of Dungeness crab. The second objective is to determine relationships among the Oregon Dungeness crab industry, the Pacific Coast Dungeness crab industry, and the Alaska King crab industry. The last objective is to specify the relationship between Oregon fishermen's prices for Dungeness crab and the levels of Oregon and total U. S. Dungeness crab production, the prices for King crab, and the levels of King crab production.

Oregon fishermen; Oregon, Washington, and California processors; the state fish agencies in Oregon, Washington, and Alaska; and the Bureau of Commercial Fisheries all provided data and advice for this study. Secondary sources also provided limited amounts of data.

Approximately 60 percent of the Oregon Dungeness crab fishermen contacted had higher gross income and profits in 1966, a year of relatively large catch, than they had in 1965, a year of relatively small catch. At least 70 percent of the fishermen preferred good fishing and poor prices to poor fishing and good prices. Thus, it

appears that, at least over the range of production covered by these two years, Oregon fishermen face a relatively elastic demand for the Dungeness crab they supply to processors.

Almost 90 percent of the fishermen in the survey stated that the opening date of the Dungeness crab ocean season influenced the time at which they actually started crab fishing. Only 13 percent indicated that the closing date affected their decision on when to cease crab fishing. Almost 62 percent of the fishermen indicated that crabs becoming too scarce to make fishing profitable influenced their decision of when to cease crab fishing.

When fishermen were asked to list the major problems facing the Dungeness crab industry, 33 percent gave advertising and marketing problems, 25 percent listed competition from King crab, and 42 percent listed problems with the legal season, fluctuations in production, and miscellaneous problems.

Processors felt that advertising and marketing problems, production fluctuations, competition from King crab products, and quality control were the major problems facing the Dungeness crab industry.

Over 76 percent of Oregon's annual Dungeness crab harvest is exported via refrigerated trucks to surrounding states. Sixty-seven percent of the state's production is trucked to California. Wholesale fish buyers bought 80 percent of Oregon's production from processors,

and 20 percent was bought by chain store buyers.

Both individual firm capacity and production vary in Oregon. Capacity ranged from ten thousand to 50 thousand pounds per day, while production varied from 75 thousand to two million pounds during the 1965-66 marketing season. Oregon's largest firm processed 20 percent of the state's production last year, but it handled less than five percent of estimated total U. S. production.

The firms interviewed sold other fish products besides crab. All firms sold salmon, 70 percent sold bottom fish, 50 percent sold shrimp, 40 percent sold tuna, and ten percent sold clams. Little equipment complementarity exists between Dungeness crab and the other species in the product mix. Thus, each firm must have special equipment, e. g., crab cookers and brine tanks, to process and market crab.

Washington and California processing firms follow essentially the same marketing procedures as Oregon firms. There were, however, several minor differences. Major differences exist between the processing and marketing of Dungeness crab and King crab. One of the major differences is the market structure of the two industries. The Dungeness crab processing industry is composed of many relatively small firms. The largest Dungeness crab processing firm handles only seven percent of total U. S. production. The largest King crab processing firms handles almost 50 percent of

total King crab production. The King crab industry is comprised of a few large firms and several small firms.

Differences also exist in processing equipment, transportation, and market areas. King crab is advertised extensively by processors and by the Alaska King Crab Marketing and Quality Control Board. Limited advertising and promotion is conducted for Dungeness crab products. The Newport Dungeness Crab Association does some advertising, but processors make limited expenditures for this activity.

Prices received by fishermen for Dungeness crab have generally been higher and have fluctuated more widely than King crab prices. Dungeness crab prices show a definite seasonal trend. Prices start out relatively low at the beginning of the legal season and rise throughout the season, reaching a peak in August. However, cyclical fluctuations in price have had a far greater impact upon fishermen's revenues than have seasonal fluctuations. Prices have varied inversely to the quasi-cyclical movement in total catch or supply of Dungeness crab during the last decade. With an increase of one million pounds of Dungeness crab caught, the predicted price of Dungeness crab at the fishermen's level will be 0.91 cents per pound lower than the original price. If King crab prices increased one cent per pound at the fishermen's level, the predicted fishermen's price for Dungeness crab would be 2.43 cent per pound lower

than the original price.

Annual King crab production has risen dramatically during the last ten years. The increased production, however, has had almost no influence upon prices received by King crab fishermen. Their prices have remained almost constant during the last decade. In the regression analysis annual quantity of King crab explained only .00006 of the variation in King crab prices during this period. The annual quantity of Dungeness crab caught explained 68 percent of King crab variation, while prices received by Dungeness crab fishermen explained an additional 20 percent of this price variation.

Recommendations

On the basis of this study's findings, the following recommendations are made as possible solutions to some of the Dungeness crab industry's problems:

1. Fishermen, processors, and other industry groups should explore the possibility of establishing an industrywide Dungeness crab commission. The primary purpose of such a commission would be to advertise and promote Dungeness crab products, thereby increasing the demand for these products and allowing them to compete more effectively with Alaska King crab. Since the Dungeness crab industry is in fact composed of processors and fishermen in all four Pacific Coast states, a

four-state commission would be preferable to an Oregon commission. However, an Oregon commission would be a good place to start, and it would be preferable to no commission at all.

Federal funds are available under Public Law 88-309 for advertising and product promotion. These funds could be matched with funds collected by the Dungeness crab commission and used for advertising and promotion. The majority of Oregon fishermen and processors have indicated a willingness to contribute one-half cent per pound each to a commission. Oregon's 1965-66 seasonal harvest was approximately ten million pounds of crab. An assessment of one cent per pound (one-half cent per pound from both fishermen and processors) would have resulted in collections of one hundred thousand dollars during the 1965-66 season. If this money had been matched by Public Law 88-309 funds, a total of two hundred thousand dollars would have been available for advertising and promoting Dungeness crab products. If all four states had participated in such a commission last season, estimated collections would have totaled about 438 thousand dollars, and matching funds could have resulted in 876 thousand dollars being available for advertising and promoting Dungeness crab products.

King crab processors have advertised very successfully for a number of years. The Alaska King Crab Marketing and Quality Control Board was formed by the state of Alaska for advertising King crab and for the establishment of grades and standards of quality. The advertising programs conducted by this board through its private advertising agency apparently have been very successful. It appears that the Dungeness crab advertising program initiated last year by the Newport Dungeness Crab Association has also been a worthwhile venture. However, it is questionable whether a program financed by voluntary contributions from a small number of fishermen will have as great an impact on demand over time as an industry-wide effort supported by both fishermen and processors.

In light of this evidence, it is recommended that an industry wide Dungeness crab commission be established.

2. The feasibility of opening the ocean season for Dungeness crab on January 1st instead of December 1st should be explored.

Dungeness crab processors are faced with peak production of crab during the early winter months of each season, peak demand for crab during the summer months, and a limited storage life for frozen crab meat. By delaying the opening of the season one month, the required storage time would be reduced substantially. Since quality declines as storage time

increases, the general quality of Dungeness crab meat should be improved.

The present capacity of nine processing firms apparently is large enough to handle the maximum annual Dungeness crab production in approximately two months.[26] Their capacity, plus the capacity of other Oregon firms, is large enough that processing capacity does not present a deterrent to opening the ocean season on January 1st. The extra month of closed season would also allow the crabs to fill out their shells more fully, thus increasing the yield of meat from green crab.

Since crabs becoming too scarce to make fishing profitable influenced the decision of when to cease crab fishing for over 60 percent of the Oregon fishermen in the survey, the extra month of closed season probably would not significantly change the total annual volume of Dungeness crab caught. On the other hand, the elimination of one month of fishing would be expected to reduce fishermen's costs of harvesting Dungeness crab.

3. The possibility of expanding into new market areas should be examined. King crab has been sold throughout the U. S. Presently Dungeness crab is consumed almost exclusively on the West Coast.

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[26] Two firms interviewed did not answer this question.

Alternative methods of transportation should also be investigated. For example, it may be feasible to sell Dungeness crab meat in certain Midwest markets. If meat were shipped by air freight, it could be in retail markets within 24 hours of being killed. It may also be possible for two or more processors to ship frozen Dungeness crab meat in one shipment, obtaining the rail rate savings associated with whole carload shipments.

It seems reasonable to assume, ceterus paribus, that an expansion of marketing areas would increase total demand for Dungeness crab. This expansion in demand could result in greater returns to both fishermen and processors.

Processors and officials of the industry commission recommended above should investigate the feasibility of market expansion.

4. Additional technological research should be conducted in Dungeness crab processing. Dungeness crab meat is now picked from the shell entirely by hand. Research needs to be conducted to develop mechanical means of picking the crab meat from the shell to eliminate part of the present labor requirement.

The possibility of utilizing crab processing wastes, i.e., backs, shells, and viscera, should be explored. A fish meal

plant located in the middle of the Oregon coast might utilize the wastes from Dungeness crab and other fish products from the state's entire fish industry. The potential volume for this type of plant is quite large. For example, during the 1965-66 crab fishing season, about 5.3 million pounds of crab wastes alone were produced in Oregon.

5. The feasibility of establishing grades and quality standards for Dungeness crab products should be explored. At the present time the crab the consumer buys in one time period may not have the same color, texture, odor, or flavor as the crab purchased during a different time period. As a result of this situation many consumers are reluctant to buy Dungeness crab. A provision for inspection and grading by the USDI, similar to the red meat inspection conducted by the USDA, needs to be established to grade crab products, encourage quality control, and protect consumers.

The establishment of grades and quality standards is another useful function that an industry commission might perform. Such an inspection program could complement the advertising and promotional activities of such an organization. Dungeness crab products that have met certain minimum standards could carry a label to this effect. It might even be feasible to "brand" shell crabs as a means of distinguishing

them from uninspected products.

6. In the area of biological research, a study is currently being conducted by the Oregon Fish Commission to reduce the mortality rate of young Dungeness crabs. However, more studies are needed to find means of increasing production and reducing cyclical fluctuations. For example, the possibilities of a hatchery plan or commercially farming of Dungenss crab needs investigation. A larger, more stable harvest of Dungeness crab would help alleviate many of the industry's problems.
7. It is recommended that further economic studies be made to determine costs of harvesting, processing, and marketing Dungeness crab. A descriptive analysis of the other marketing channels, viz., wholesale fish buyers, fish brokers, chain store buyers, and restaurants, should be included. Determination of consumer demand in present and potential market areas is another subject worthy of research. These types of data are needed to make policy decisions and to help Dungeness crab industry personnel find solutions to their problems.

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APPENDIX

OREGON STATE UNIVERSITY
Department of Agricultural Economics
Corvallis, Oregon 97331

CRAB MARKETING RESEARCH QUESTIONNAIRE

CONFIDENTIAL

Name _____ Date _____

Address _____ Name of Boat _____

1. How many crab pots did you use in the last two seasons?

   1965-66 _____pots. 1964-65 _____pots.

2. How many pounds of crab did you catch in the last two seasons?

   (PLEASE CHECK ONE FOR EACH YEAR).

1965-66	1964-65
0- 49, 999	0- 49, 999
50, 000- 99, 999	50, 000- 99, 999
100, 000-149, 999	100, 000-149, 999
150, 000-199, 999	150, 000-199, 999
200, 000-299, 999	200, 000-299, 999
300, 000-399, 999	300, 000-399, 999
400, 000-499, 999	400, 000-499, 999
500, 000-599, 999	500, 000-599, 999
600, 000-699, 999	600, 000-699, 999
700, 000-799, 999	700, 000-799, 999
800, 000-899, 999	800, 000-899, 999

3. What percent of your total fishing income is derived from the sale of Dungeness crab?

   (CHECK ONE)

0- 9%___	20-29%___	40-49%___	60-69%___	80-89%___
10-19%___	30-39%___	50-59%___	70-79%___	90-99%___
		100% ___		

4. For what other species do you fish? (PLEASE LIST)

Species	% of total fishing income

5. What determines the date at which you actually start crab fishing? (CHECK ALL THAT APPLY)

   Opening of the ocean season (Dec. 1) _____
   End of fishing for a different species _____
   Some physical characteristic of the crab itself _____
   Crabs becoming abundant enough to make fishing profitable _____
   Other (PLEASE LIST) _____

6. What determines the date at which you actually cease crab fishing in the spring? (CHECK ALL THAT APPLY)

   Closing of the ocean season (Aug. 15) _____
   Some physical characteristic of the crab itself (for example, molting) _____
   Crabs become too scarce to make a profit fishing for them _____
   Other (PLEASE LIST) _____

7. To what processor(s) did you sell your crab last season? (IF MORE THAN ONE, PLEASE INDICATE THE PERCENT SOLD TO EACH) _____

8. How is the price at which you sell crab determined? _____

9. How did your 1966 gross income (income before expenses) from crab fishing compare with that of 1965? (CHECK ONE)

   1966 was higher than 1965_____ 1966 was lower than 1965_____

10. How did your 1966 net profit (income after expenses) from crab fishing compare with that of 1965? (CHECK ONE)

    1966 was higher than 1965_____ 1966 was lower than 1965_____

11. In general, would you prefer (CHECK ONE):

    _____ A situation where fishing is excellent, but prices poor.

    _____ A situation where fishing is poor, but prices excellent.

    Why?_____

12. Please give a brief description of your boat and crab fishing and handling equipment (including total value): _____

13. What do you see as major problems facing the Dungeness crab industry?_____

14. What can be done to solve these problems? _____

15. Who should try to solve them?_____

16. Would you be willing to contribute 1/2¢ per pound to a Dungeness crab commission for the purpose of advertising and quality control, if processors would do likewise?

    Yes_____ No_____ Undecided_____

COMMENTS:

_____

CRAB MARKETING STUDY

CONFIDENTIAL

OREGON STATE UNIVERSITY Corvallis, Oregon 97330
Department of Agricultural Economics

A. GENERAL

1. Firm Name_____ Date _____

   Firm Address_____ Person completing

   _____ ques._____

   position_____

2. Does your firm market Dungeness crab_____ King crab_____ Both (circle one)

   If Dungeness crab only, omit questions 3-4 and Section C, page 5-7.

   If King crab only, omit questions 3-4 and Section B, page 2-4.

3. Of the total poundage of crab your firm markets, what percent is accounted for by:

	1965-66	1964-65	1963-64
Dungeness crab	_____	_____	_____
King crab	_____	_____	_____

4. Which would you rather handle:

   Dungeness_____ King_____ No Preference_____

   Why would you rather handle one or the other? _____

5. What do you see as major problems facing the Dungeness crab and King crab industries?_____

   _____

6. What can be done to solve these problems and who should attempt to solve them?_____

   _____

B. DUNGENESS CRAB

1. How many pounds of Dungeness crab did your firm sell in 1965-66?_____ 1964-65_____

   1963-64_____

2. What percent of total Dungeness crab sales did each of the following products contribute?

	1965-66	1964-65	1963-64
Canned crab meat	_____	_____	_____
Frozen meat	_____	_____	_____
Fresh meat	_____	_____	_____
Whole crab	_____	_____	_____
Other (please list) _____	_____	_____	_____
_____	_____	_____	_____

3. What was the average price received for each of the following crab products?

	1965-66	1964-65	1963-64
Canned crab meat			
Frozen meat			
Fresh meat			
Whole crab			
Other (please list)			
_____			

4. In the 1965-66 season, what were the average prices received in the following three-month period?

	Dec-Feb	Mar-May	Jun-Aug	Sept-Nov
Canned crab meat				
Frozen meat				
Fresh meat				
Whole crab				
Other (please list)				
_____				

5. Was the 1965-66 season a typical year, as far as price trends within the season? Yes___No___
If not, please describe a typical seasonal price trend: _____

6. To what type(s) of buyer(s) did you sell your Dungeness crab products last year? Please list the approximate percent of total Dungeness crab sales for each type:

	Type of dealer	%	Type of dealer	%
Canned crab meat				
Frozen meat				
Fresh meat				
Whole crab				
Other (please list)				
_____				

7. Have the types of buyers you sell to changed significantly in the last five years? Yes___No___
If so, please describe the change: _____

8. What do you consider to be your major market area(s)? Please list the approximate percent of total Dungeness crab sales made in that area last year:

	Market area	%	Market area	%
Canned crab meat				
Frozen meat				
Fresh meat				
Whole crab				
Other (please list)				
_____				

9. Has your primary market area(s) changed significantly during the last five years? Yes___No___
If yes, please describe the change: _____

10. What different methods of transportation does your firm utilize in transporting Dungeness Crab products from plant to customer? Please list the approximate percent of total volume shipped by each method last year:

	Method of Trans.	%	Method of Trans.	%
Canned crab meat				
Frozen meat				
Fresh meat				
Whole crab				
Other (please list)				

11. Have your methods of shipping changed significantly within the last 5 years? Yes__No___
If so, please describe change:_____

12. Does your firm sell Dungeness crab products under its own private brand names? Yes___No__
If yes, please list the brands and the products:

Brand	Product

13. Does your firm package Dungeness crab products under private labels owned by other companies? Yes_____No_____
If yes, please list brands and products:

Brand	Product

If yes, what percent of your total Dungeness crab sales volume is accounted for by private label business?_____%

C. KING CRAB

1. How many pounds of King crab did your firm sell in 1965-66?_____1964-65_____
1963-64_____

2. What percent of total King crab sales did each of the following products contribute?

	1965-66	1964-65	1963-64
Canned crab meat			
Frozen meat			
Fresh meat			
Whole crab			
Other (please list)			

3. What was the average price received for each of the following crab products?

	1965-66	1964-65	1963-64
Canned crab meat			
Frozen meat			
Fresh meat			
Whole crab			
Other (please list)_____			

4. In the 1965-66 season, what were the average prices received in the following three-month period?

	Dec-Feb	Mar-May	June-Aug	Sept-Nov
Canned crab meat				
Frozen meat				
Fresh meat				
Whole crab				
Other (please list)				
_____				

5. Was the 1965-66 season a typical year, as far as price trends within the season? Yes__No__
If not, please describe a typical seasonal price trend:_____

6. To what type(s) of buyers(s) did you sell your King crab products last year? Please list the approximate percent of total King crab sales for each type:

	Type of dealer	%	Type of dealer	%
Canned crab meat				
Frozen meat				
Fresh meat				
Whole crab				
Other (please list)				
_____				

7. Have the type of buyers you sell to changed significantly in the last five years? Yes__No__
If so, please describe the change:_____

8. What do you consider to be your major market area(s)? Please list the approximate percent of total King crab sales made in that area last year:

	Market area	%	Market area	%
Canned crab meat				
Frozen meat				
Fresh meat				
Whole crab				
Other (please list)				
_____				

9. Has your primary market area(s) changed significantly during the last five years? Yes__No__
If so, please describe the change:_____

10. What different methods of transportation does your firm utilize in transporting King crab products from plant to customer? Please list the approximate percent of total volume shipped by each method last year:

	Method of Trans.	%	Method of Trans.	
Canned crab meat				
Frozen meat				
Fresh meat				
Whole crab				
Other (please list)				
_____				

11. Have your methods of shipping changed significantly within the last 5 years? Yes___No___
    If so, please describe change:_____

12. Does your firm sell King crab products under its own private brand names? Yes___No_____
    If yes, please list the brands and the products:

Brand	Product
_____	_____
_____	_____

13. Does your firm package King crab products under private labels owned by other companies? Yes___No___
    If yes, please list brands and products:

Brand	Product
_____	_____
_____	_____

    If yes, what percent of your total King crab sales volume is accounted for by private label business?_____%

D. PROCESSING FACILITIES

1. What type of equipment do you employ in processing crab?_____
2. What is the approximate present value of the above equipment?_____
3. How much of the above equipment must be used exclusively in crab processing, and how much can be used for processing other fish products?
   _____% crab exclusively _____% can be used for other products
4. What is the maximum number of pounds of crab you could handle with the new facilities and existing facilities? _____pounds.
5. Do you plan to expand processing facilities in the near future? Yes____No____
   If yes, what will be the maximum number of pounds of crab you could handle with the new facilities and existing facilities? _____pounds.

E. SALES

1. Besides crab, what other products are sold by your firm?_____
2. What percent of total sales was accounted for last year by crab products?_____%
3. What were your total sales in 1965-66? $_____ 1964-65 $_____ 1963-64 $_____
4. What percent of total sales was spent on advertising and promotion last year? _____%
5. What other firms do you compete with in the sales of your crab products? _____
   _____
6. What percent of total Dungeness crab sales are made by your company?_____%
   What percent of total King crab sales are made by your company?_____%
   What percent of total crab sales are made by your company? _____%
7. Has your market share changed during the past five years? Yes_____No_____
   If yes, please describe:_____

F. ADVERTISING AND PRODUCT PROMOTION

1. Does your firm employ an advertising agency to conduct its promotional activities? Yes__
   No____

2. What is the nature of any promotional campaigns carried on for either Dungeness or King crab products (please specify which) in the last two years?_____

3. What percent of the total advertising budget is spent on promoting Dungeness crab products _____King crab products_____

4. Why do you promote King crab more than Dungeness crab, or vice versa?_____

G. CRAB PROCUREMENT

1. How many boats fished for crabs for your firm during 1965-66?_____Low. _____Average. _____High.

2. Are your fishermen under contract to fish exclusively for your firm? Yes_____No_____

3. How do you determine the price you pay fishermen for crab?_____

4. What services do you provide for your fishermen (fringe benefits)? _____

5. How much, per pound, are these services worth to the fishermen? _____¢ per pound.

6. Do you purchase crabs from any source other than fishermen? Yes____No_____
If yes, what are the other sources and what percent of total crab purchases do they represent?
_____

COMMENTS:

_____