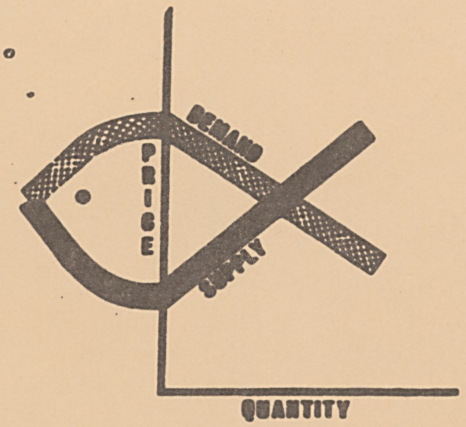


# NOT FOR QUOTATION



## Some Notes on Costs of Canned Salmon Imported From Japan

by

Bruno G. Noetzel

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U.S. NATIONAL MARINE FISHERIES SERVICE
ECONOMIC RESEARCH DIVISION

DRAFT MANUSCRIPT

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## Introduction

This report is a collection of information available on the subject of how tariffs on salmon products imported from Japan affect the competitive position of Alaska salmon canners. It has been prepared at the request of Senator Stevens' office. The specific question was how much does it cost both the United States and Japan to put salmon in the hands of U.S. consumers? The scarcity of data in the first place and also the time limitations (one month) did not permit a full answer to that question. No conclusions could be drawn because of incompleteness of data. Nevertheless, the information contained in this report gives some idea about the magnitude of values involved.

## 1--Information on Japanese Salmon Fishery

Japanese fisheries statistics indicate that salmon is produced in two distinct fisheries: the mothership fishery south of the Aleutian Islands and in the Bering Sea, and the coastal drift gill net fishery.

In the years 1963 through 1967 the mothership fishery provided 43 to 45 percent of the total Japanese salmon catch. The fleet engaged in this fishery is composed of 11 large motherships (average size around 9,000 gross tons), each accompanied by 33-34 gill net catcherboats (size 96 gross tons, with 23 crewmen). The salmon is either frozen or canned on board the mothership. Available information on the operations of the mothership fleet is presented below.

### 1.1--Annual Catch Quotas, Actual Catch, and Ex vessel Prices for Salmon

Each year's quota for the Japanese salmon mothership fishery is established by annual negotiation within the Japan-Soviet Fishery Commission (convention of the High Seas Fisheries in the Northwestern Pacific Ocean). In recent years the meetings have begun in early March and continued until about mid-April, i.e., the time when the Japanese North Pacific coastal salmon fisheries (Zone B) historically begin. Thus, in negotiations, the Japanese are usually forced to accept the Soviet terms or lose valuable fishing time.

Under the convention, the amount of the annual quota is supposedly based on an evaluation by a committee of scientists of the condition and size of the runs for each coming year. This committee meets for the first 10-14 days of the annual commission meeting and systematically reviews available catch and escapement data and attempts to reach an agreement on a forecast of the size of the run expected in the current year. Even though the scientists themselves may be in rather close agreement, the committee, in its report to the commission, has traditionally agreed only on the quite negligible runs of chinook and silver salmon and disagreed on the size of the predominant red, pink, and chum salmon runs. With no acceptable base, the Commission then proceeds to negotiate in a purely political atmosphere and eventually agrees on quotas for two fishing zones--Zone A which includes the mothership fishery and a small coastal fishery north of 45°N, and Zone B which is entirely a coastal fishery south of 45°N.

The annual quotas for the salmon mothership fishery are shown below:

Table 1.--Annual Quota for Zone A (metric tons)

| Year | Coastal Gill-net fishery | Mothership fishery | Total |
|---|---|---|---|
| 1960 | 13,500 | 54,000 | 67,500 |
| 1961 | 11,400 | 53,600 | 65,000 |
| 1962 | 10,355 | 44,665 | 55,000 |
| 1963 | 10,710 | 46,290 | 57,000 |
| 1964 | 10,335 | 44,665 | 55,000 |
| 1965 | 10,522 | 45,478 | 56,000 |
| 1966 | 9,019 | 38,981 | 48,000 |
| 1967 | 9,865 | 42,635 | 52,500 |
| 1968 | 8,737 | 37,763 | 46,500 |
| 1969 | 9,350 | 40,400 | 49,750 |
| 1970 | 8,455 | 36,545 | 45,000 |

Once the quota is set by the Commission, the Fisheries Agency then divides the share for the mothership fishery equally between catcherboats as shown in Table 2.

Table 2.--Allocation of Quota Among Catcherboats

| Year | Number of Catcherboats | Mothership quota (m. tons) | Individual Catcher-boat quota (m. tons) |
|---|---|---|---|
| 1960 | 410 | 54,000 | 131.70 |
| 1961 | 410 | 53,600 | 130.73 |
| 1962 | 369 | 44,665 | 121.04 |
| 1963 | 369 | 46,290 | 125.45 |
| 1964 | 369 | 44,665 | 121.04 |
| 1965 | 369 | 45,478 | 123.25 |
| 1966 | 369 | 38,981 | 105.64 |
| 1967 | 369 | 42,635 | 115.54 |
| 1968 | 369 | 37,763 | 102.34 |
| 1969 | 369 | 40,400 | 109.49 |
| 1970 | 369 | 36,545 | 99.04 |

The actual catch, by species, is shown in Table 3.

Table 3.--Japanese Mothership Salmon-Fishery, Annual Catch by Species, 1961-1969

| Year | Species | Catch (m. tons) | Purchase Price ($/kg.) | Total Amount Paid ($) | Catcher-boats (numbers) | Amount Received per Catcherboat ($) |
|---|---|---|---|---|---|---|
| 1961 | Red | 34,849 | 0.55 | 19,166,950 | | |
| | Chum | 12,907 | 0.26 | 3,405,902 | | |
| | Pink | 4,617 | 0.23 | 1,070,877 | | |
| | Coho | 647 | 0.37 | 238,132 | | |
| | King | 105 | 0.37 | 38,646 | | |
| | Total | 53,125 | | 23,920,507 | 410 | 58,343 |
| 1962 | Red | 24,586 | 0.55 | 13,522,300 | | |
| | Chum | 13,547 | 0.28 | 3,763,056 | | |
| | Pink | 1,631 | 0.25 | 400,954 | | |
| | Coho | 4,395 | 0.33 | 1,465,000 | | |
| | King | 441 | 0.33 | 147,000 | | |
| | Total | 44,600 | | 19,298,310 | 369 | 52,299 |
| 1963 | Red | 19,071 | 0.56 | 10,753,925 | | |
| | Chum | 12,137 | 0.31 | 3,708,528 | | |
| | Pink | 9,591 | 0.25 | 2,357,787 | | |
| | Coho | 5,226 | 0.33 | 1,742,000 | | |
| | King | 244 | 0.33 | 81,333 | | |
| | Total | 46,269 | | 18,643,573 | 369 | 50,525 |
| 1964 | Red | 14,131 | 0.60 | 8,521,778 | | |
| | Chum | 17,964 | 0.33 | 5,873,230 | | |
| | Pink | 3,051 | 0.26 | 802,582 | | |
| | Coho | 8,198 | 0.36 | 2,921,457 | | |
| | King | 1,139 | 0.36 | 406,243 | | |
| | Total | 44,483 | | 18,525,290 | 369 | 50,205 |
| 1965 | Red | 24,709 | 0.68 | 16,696,420 | | |
| | Chum | 11,588 | 0.37 | 4,243,139 | | |
| | Pink | 6,081 | 0.29 | 1,791,530 | | |
| | Coho | 2,580 | 0.40 | 1,030,638 | | |
| | King | 472 | 0.40 | 188,552 | | |
| | Total | 45,430 | | 23,950,299 | 369 | 64,906 |

Table 3.--Japanese Mothership Salmon-Fishery, Annual Catch by Species, 1961-1969 (continued)

| Year | Species | Catch (m. tons) | Purchase Price ($/kg.) | Total Amount Paid ($) | Catcher-boats (numbers) | Amount Received per Catcherboat ($) |
|---|---|---|---|---|---|---|
| 1966 | Red | 15,706 | 0.69 | 10,819,689 | | |
| | Chum | 18,305 | 0.39 | 7,220,306 | | |
| | Pink | 3,279 | 0.32 | 1,038,350 | | |
| | Coho | 1,062 | 0.43 | 457,283 | | |
| | King | 615 | 0.43 | 264,792 | | |
| | Total | 38,967 | | 19,800,420 | 369 | 53,660 |
| 1967 | Red | 16,694 | 0.69 | 11,500,311 | | |
| | Chum | 14,244 | 0.42 | 6,014,133 | | |
| | Pink | 10,630 | 0.33 | 3,484,278 | | |
| | Coho | 605 | 0.46 | 278,972 | | |
| | King | 371 | 0.46 | 171,072 | | |
| | Total | 42,544 | | 21,448,766 | 369 | 58,127 |
| 1968 | Red | 12,810 | 0.67 | 8,646,750 | | |
| | Chum | 16,919 | 0.44 | 7,519,556 | | |
| | Pink | 4,885 | 0.33 | 1,601,194 | | |
| | Coho | 2,111 | 0.46 | 973,406 | | |
| | King | 917 | 0.46 | 422,839 | | |
| | Total | 37,642 | | 19,163,745 | 369 | 51,934 |
| 1969 | Red | 11,687 | 0.69 | 8,037,267 | | |
| | Chum | 15,592 | 0.54 | 8,402,356 | | |
| | Pink | 9,270 | 0.34 | 3,193,000 | | |
| | Coho | 2,556 | 0.57 | 1,461,194 | | |
| | King | 1,170 | 0.57 | 666,250 | | |
| | Sub-total | 40,275 | | 21,760,067 | 369 | 58,970 |
| | Bonus | | | | | 9,722 |
| | TOTAL | | | | | 68,692 |

As indicated by data in Table 3, the average price paid in 1969 by the motherships to the catcherboats (ex vessel price) was (in cents per pound):

| | | |
|---|---|---|
| Red | - | 31.25¢ |
| Chum | - | 24.44¢ |
| Pink | - | 15.62¢ |
| Coho | - | 25.83¢ |
| King | - | 25.83¢ |
| weighted average | | 24.50¢ |

Including the bonus paid in 1969 ($9,722 per vessel), the average price received by the fishermen was 28.55 cents per pound.

1.2--Crew Wages on Salmon Gill Net Vessels

In Japan, costs and earnings investigations are based on annual Fisheries Economic Surveys, Fisheries Catch Surveys, Fisheries Census, and other surveys. Unfortunately the operations of the salmon mothership fleet are not covered by the Fisheries Economic Survey. The only information available on the costs of operation of a gill netter in this fishery is that on the cost of labor. From this, the total cost of vessel operation has been estimated.

In 1969, crew members of a gill netter fishing in the Bering Sea received four types of payment: fixed salary, per diem, share, and bonus. The bonus was paid for the first time in 1969, and it may be considered as an addition to share (the same formula for distribution among the crew was applied).

The total crew wages per vessel were in 1969 (for the whole season, i.e., approximately 3 months):

| | |
|---|---|
| fixed salary | $5,795 |
| per diem | 3,398 |
| shares and bonus | 8,847 |
| total | $18,040 |

(or $784.34 per man)

The range of wages per crewman was from $451.00 (deckhand) to $877.42 (chief fisherman).

Compared with wages paid in 1964, the three components have been increased:

| | | |
|---|---|---|
| fixed salary | - | by 84.4 percent |
| per diem | - | by 41.0 percent |
| shares and bonus | - | by 83.6 percent |

For the 1970 season, fixed salary has been increased by 5.9 percent from the 1969 level. Per diem and shares stayed unchanged. The new contract provides for a bonus to all members of the crew in the amount of one percent of the value of the catch exceeding 30 million yen.[1] Also a death benefit of 1.7 million yen[2] is provided in the new contract (there were no fringe benefits in previous years).

1/Approximately 83.3 thousand dollars.

2/Approximately 4.7 thousand dollars.

In 1964 the whole crew of 23 men received 26.1 shares (highest was 1.8 share to the chief fisherman, lowest was 1.0 share to a fisherman). In 1969 the total amounted to 26.3 shares with the only change being that for the chief fisherman (from 1.8 to 2.0 shares). The shares for all other crew members remained unchanged.

The 83.6 percent increase in the share component (as shown above) resulted mainly from the difference in the value of catch per vessel. In 1964, this value was $50,205, while in 1969 it was $68,693. The latter included a $9,722 bonus. In both years the figures represent the means for 369 vessels.

The average gross revenue per vessel in the last five years was:

| Year | Gross Revenue Per Vessel (dollars) |
|---|---|
| 1965 | 64,906 |
| 1966 | 53,660 |
| 1967 | 58,127 |
| 1968 | 51,934 |
| 1969 | 68,693 |

The total crew shares were calculated in the following way (for example in 1969):

| | |
|---|---|
| gross revenue | 21,229,333 yen[3] |
| bonus | 3,500,000 yen |
| Total | 24,729,333 yen |

| | | |
|---|---|---|
| the first 15,000,000 yen at 8 percent to the crew | = | 1,200,000 yen |
| the next 5,000,000 yen at 17 percent to the crew | = | 850,000 yen |
| the balance over 20,000,000 yen at 24 percent to the crew | = | 1,135,000 yen |
| total crew shares | | 3,185,000 yen |

Based on information on other fisheries, and also on information on other countries' fisheries (including U.S.), a reasonable assumption can be made that the cost of labor accounts for 33 to 40 percent of the total cost of vessel operation.

[3]The values are shown in Japanese currency to illustrate the actual computation of crew shares. The exchange rate is 360 yen to one U.S. dollar.

In 1969 the total labor cost per vessel was equal to $18,040 and the average catch per vessel was 240,000 pounds of salmon. Based on these figures and on the assumed share of labor cost in total cost--the average cost per pound of salmon is estimated to be in the range equal to 18.8¢ to 22.8¢ (cost to the fishing vessel owner).

Preliminary results from an analysis of cost and earnings in the Alaskan salmon fishery indicate the following cost per pound:

| | | |
|---|---|---|
| gill netters | (1-2) | 23.65¢ |
| purse seiners | (4-5) | 17.98¢ |

The number in parenthesis gives the crew size on these vessels.

1.3--Cost of Canning

In 1969 there were 11 motherships in operation and the average catch per ship was 3,661 m. tons, of which 29 percent or 1,062 m. tons were red salmon. The motherships produce canned salmon as well as frozen salmon. A note in the August 5, 1969, issue of the Suisan Keizai Shimbun indicates that the export price of canned red salmon to the United Kingdom was increased "to cope with the reduced canned red salmon production by the motherships whose catches of red salmon this year were largely frozen because of the strong domestic demand for the frozen product." There is no information available on the cost of mothership operations. The costs of raw fish and packing material needed to produce one pound of canned red salmon are:

| | | |
|---|---|---|
| raw salmon--1.52 pounds @ 31.25¢ | = | 47.88¢ |
| cans and cartons ($2.50/pack of 48 talls) | = | 5.21¢ |
| | | 53.09¢ |

This, however, is only a part of the total production cost.

2--Cost of Canning of the Alaska Red Salmon

Some elements of cost of canning can be found in a 1966 study by Stephen B. Mathews, now with the Department of Fisheries, State of Washington.[4] For the purpose of that study, only operating costs were considered. These operating costs consist of the following:

[4]"The Economic Consequences of Forecasting Sockeye Salmon (Oncorhynchus Nerka, Walbaum) Runs to Bristol Bay, Alaska" by Stephen B. Mathews, University of Washington, Seattle, Washington, 1966 (unpublished doctoral dissertation).

a. Sunk operating costs (for a 2-can line cannery) - $375,000

b. Fishing costs (company fishing-vessels) - $100,000

c. Variable operating costs, proportional to the pack ($18.14 - $20.03 per case).

A copy of the chapter: Capacity and Cost Structure of the Canning Industry is appended.

The cost of raw fish is the highest cost item. This cost amounts to $13.24 per case (see Table 9 of enclosure) and is based on 1965 prices for fish. With 1969 ex vessel price applied[5] (24¢ per pound) and under the assumption that two-thirds of vessels are independent and one-third of vessels are company owned (this assumption was made in the Mathews' study)--the cost of raw fish would be $15.56 per standard case (or 32.42¢ per pound). This is a 17.5 percent increase over the 1965 cost.

If all the fish processed by a cannery were delivered by independent fishermen, the cost of raw material would be 24¢ x 1.52 = 36.48¢ per pound of canned salmon. As mentioned before, this cost in the Japanese mothership operations is 47.88¢ per pound.

3--U.S. Imports of Canned Salmon

Imports of canned salmon constitute only a small fraction of the total supply of this product, as can be seen from the following tabulation:

| Year | U.S. pack | Percent of total supply | Imports | Percent of total supply | Imports from Japan only |
|---|---|---|---|---|---|
| | Thousand pounds | Percent | Thousand pounds | Percent | Thousand pounds |
| 1965 | 174,413 | 99.9 | 101 | .1 | 25.6 |
| 1966 | 209,161 | 99.7 | 589 | .3 | 510.0 |
| 1967 | 99,473 | 99.9 | 121 | .1 | 103.4 |
| 1968 | 165,490 | 97.1 | 4,955 | 2.9 | 856.0 |
| 1969 | 120,948 | 98.2 | 2,217 | 1.8 | 541.4 |

[5]This was the price paid to independent fishermen. The company vessels, according to Mathews, are paid two-thirds of that price, and all operating costs are covered by the canning company.

Imports from Japan alone, ranging from 0.01 percent of total supply in 1965 to 0.5 percent in 1968, can be broken down into two categories: not in oil and in oil. The quantities, values, and average prices[6] for these imports were as follows:

| Year | Imports of canned salmon from Japan | | | | Average prices for: | |
|---|---|---|---|---|---|---|
| | not in oil | | in oil | | not in oil | in oil |
| | Pounds | Dollars | Pounds | Dollars | Cents per pound | |
| 1965 | 20,353 | 14,104 | 5,319 | 9,593 | 69.3 | 180.35 |
| 1966 | 502,244 | 271,214 | 7,775 | 12,663 | 54.0 | 162.87 |
| 1967 | 96,056 | 71,929 | 7,347 | 13,801 | 74.88 | 187.84 |
| 1968 | 846,425 | 552,134 | 9,563 | 18,956 | 65.23 | 198.22 |
| 1969 | 531,263 | 343,504 | 10,129 | 18,954 | 64,66 | 187.13 |

For comparison, wholesale prices of U.S. pack of red and pink salmon (not in oil) are given below:

| July-June marketing year | red | pink |
|---|---|---|
| | Cents per pound | |
| 1964-65 | 82.85 | 44.56 |
| 1965-66 | 76.17 | 56.64 |
| 1966-67 | 74.88 | 57.85 |
| 1967-68 | 82.92 | 65.64 |
| 1968-69 | 84.81 | 63.81 |
| week ending July 4, 1970 | 94.79 | 67.70 |

These U.S. pack prices are for salmon packed in one-pound cans. The price per pound is higher for salmon packed in 1/2-pound cans: by 15.55 percent for red salmon, and 18.75 percent for pink salmon (based on data for week ending July 4, 1970).

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[6]The average price was calculated by dividng the dollar value of imports by the quantity (pounds). The dollar value shown in import statistics is defined generally as the market value in the foreign country and therefore excludes U.S. import duties, freight charges from the foreign country to the U.S., and insurance.

As for the imports from Japan--no information on the size of cans or on the species of salmon (red, pink, or others) is available. The import prices shown above (canned salmon, not in oil) may represent a combination of species and of various can sizes.

The following tabulation shows the import prices plus import duty:

| | Prices for imported canned salmon (Japan) | | | | | |
|---|---|---|---|---|---|---|
| | not in oil | | | in oil | | |
| Year | import price | duty | total | import price | duty | total |
| | ----------Cents per pound---------- | | | | | |
| 1965 | 69.30 | 10.40 | 79.70 | 180.35 | 45.99 | 226.34 |
| 1966 | 54.00 | 8.10 | 62.10 | 162.87 | 41.53 | 204.40 |
| 1967 | 74.88 | 11.23 | 86.11 | 187.84 | 47.90 | 235.74 |
| 1968 | 65.23 | 8.48 | 73.71 | 198.22 | 44.60 | 242.82 |
| 1969 | 64.66 | 7.76 | 72.42 | 187.13 | 37.43 | 224.56 |

As a result of modifications provided for by Pres. Proc. 3822 (Kennedy Round) for the years 1970-1972, the 1969 import prices (64.66¢ and 187.13¢ per pound) would be subjected to the following duties:

| | Years | | |
|---|---|---|---|
| TSUS[7] item | 1970 | 1971 | 1972 |
| | ------cents per pound------ | | |
| 112.18 (not in oil) | 6.47 | 5.82 | 4.85 |
| 112.52 (in oil) | 32.75 | 28.07 | 23.39 |

4--Japanese Exports of Fishery Products

The magnitude of Japanese exports of canned salmon to the U.S. can be evaluated when compared with other fishery products and with total Japanese exports. Fisheries Statistics of Japan, a publication of the Ministry of Agriculture and Forestry, provides the data presented in Table 4. For comparison, data for two years, 1964 and 1967, are shown.

[7] Tariff Schedules of the United States.

Table 4.--Japanese Exports of Fishery Products to the United States

| Commodity | Japanese exports to U.S. 1964 | | 1967 | |
|---|---|---|---|---|
| | Thousand dollars | % | Thousand dollars | % |
| Frozen | | | | |
| Tuna, marlin and swordfish | 24,719 | 39.9 | 17,969 | 35.9 |
| Others | 6,336 | 25,3 | 6,883 | 21.0 |
| Total frozen | 31,055 | 35.7 | 24,852 | 30.0 |
| Canned | | | | |
| Mackerel | --- | -- | 1,151 | 4.1 |
| Tuna | 20,850 | 55.4 | 26,884 | 52.2 |
| Salmon | 25 | .06 | 316 | .7 |
| Saury | 67 | .7 | 67 | 3.5 |
| Crab | 800 | 6.2 | 2,435 | 23.6 |
| Others | 7,394 | 25.1 | 6,829 | 50.2 |
| Total canned | 29,136 | 22.1 | 37,682 | 24.8 |
| Salted and dried | 1,125 | 17.6 | 1,289 | 16.1 |
| Oil and fats | 2,378 | 10.1 | 1,843 | 20.1 |
| Pearls | 21,114 | 38.3 | 17,398 | 31.6 |
| Other fishery products | 5,392 | 50.5 | 8,864 | 46.4 |
| Total | 90,219 | 28.7 | 91,928 | 28.2 |

Note: The percent figures represent the share of exports to U.S. in total Japanese exports.

In 1967, exports of canned salmon to the U.S. were less than one percent of total Japanese exports of canned salmon for that year. Compared with exports of other fishery products to the U.S., the canned salmon accounts for only one-third of one percent of the total.

The highest ranking receiver of Japanese exports of canned salmon is the United Kingdom. In 1964 and 1967, the values of these exports were $32,564,000 and $37,261,000, respectively. These values represent a 76.6 percent and 80.4 percent, respectively, share in Japanese total exports of canned salmon.

For comparison, exports of canned salmon from U.S. to Great Britain are presented in Table 5.

Table 5.--U.S. Exports of Canned Salmon to Great Britain

| Year | Quantity pounds | Value dollars | Average Value cents/pound |
|---|---|---|---|
| 1965 | 16,550,967 | 10,842,937 | 65.5 |
| 1966 | 14,358,031 | 10,371,446 | 72.2 |
| 1967 | 16,324,914 | 12,700,570 | 77.7 |
| 1968 | 3,305,063 | 2,838,667 | 85.9 |
| 1969 | 8,122,832 | 6,383,065 | 78.6 |

Data presented in this and the preceding section indicate that the U.S. (Alaskan) and Japanese salmon canners are in competition in their export markets, specifically in the United Kingdom, rather than in our domestic market.

Summary

Operations of Alaskan canneries in the Bristol Bay are based on annual runs of red salmon (sockeye) into Alaskan rivers. The same resource is exploited in high seas by a Japanese fleet of 11 motherships, accompanied by 369 fishing vessels. The catch is processed on board of the motherships. Crew costs on the Japanese fishing vessels increased by 74 percent over the period from 1964 to 1969. The cost of catching salmon is estimated to be 18.8¢ to 22.8¢ per pound in the Japanese operations which compares with 18¢ to 23.6¢ per pound in the Alaskan salmon fishery. In 1969 the Japanese gill netters received 31.25¢ per pound of red salmon delivered to the motherships while the ex vessel price in the Bristol Bay landings was 24¢ per pound.

U.S. imports of canned salmon from Japan are small relative to imports of other fishery products from that country. About 80 percent of Japanese exports of canned salmon is directed to the United Kingdom, where they compete with U.S. exports.

APPENDIX

## Capacity and Cost Structure of the Canning Industry*

### Capacity

Two important parameters determine the maximum productive capacity of the Bristol Bay canning industry. The first is the maximum amount of canning machinery in terms of one-pound lines (two half-pound lines equalling a one-pound line, etc.) that can be operated at any one time. The second is the maximum output of canned salmon per day that an "average" can line is capable of sustaining over more than merely a day or so. From the 1965 season, when industry was well prepared for an extremely large run, estimates were obtained of both parameters.

At the peak of the 1965 run, the 11 major shore-based canneries were running a total of 26 one-pound lines, 7 half-pound lines and 2 quarter-pound lines. This represents 30 one-pound-line units. In addition, fish were shipped during the season to another major shore-based cannery outside Bristol Bay during the season with one full and 2 half-pound lines. This represents 2 more one-pound-line units. Finally, there were a number of freezer ships, floating canneries and other miscellaneous operations which, in 1965, put up about 80,000 cases. This represents possibly 2 more one-pound units of production, and brings the total maximum capacity to 34. This approximate level of capacity has prevailed for at least the past decade with the addition of some new facilities, balanced by the closing down of some old ones.

Some canneries have additional half-pound lines of machinery which are not included in this total since, for example, a cannery with 3 one-pound lines and one half-pound line of machinery may only have living facilities for 3 crews of cannery workers. The half-pound line could be

* Chapter from: "The Economic Consequences of Forecasting Sockeye Salmon (Oncorhynchus Nerka, Walbaum) Runs to Bristol Bay, Alaska: A Computer Simulation Study of the Potential Benefits to a Salmon Canning Industry from Accurate Forecasts of the Runs," by Stephen B. Mathews, Univ. of Wash., Seattle, Wash., 1966 (unpublished doctoral dissertation).

run at the slack part of the season, but at maximum productive capacity only the one-pound lines would be operated. Thus, the additional half-pound line could not properly be included in calculating maximum capacity for the total industry.

From June 27 to July 9, 1965, a 13-day period during which the industry ran at top speed, the fishery took 14,923,310 sockeye (Pennoyer and Seibel, 1966). Since the fish must be canned shortly after being caught, it is assumed they were canned in about this same time interval. In 1965 the fish averaged 16.89 to the case (Table 8). With 34 one-pound-units processing the catch, the average pack per line per day is as follows:

$$\frac{14{,}923{,}310 \text{ fish}}{16.89 \text{ fish/case} \times 13 \text{ days} \times 34 \text{ lines}} \doteq 2{,}000 \text{ cases.}$$

Similar computations in 1956, when the industry was unprepared for the unexpectedly large run and operated at about one-half capacity, yielded a similar figure.

The sustained output of a can line is limited by the hours per day it can be run. The Bristol Bay canneries have living facilities for only about one crew per line, and can therefore run a line for only as long as these men can work in a day. Extra crews are not brought in to work the cannery while the regular crews sleep. The maximum hours per day that most canneries seem able to sustain is about 16 hours. I doubt that many canneries could operate their lines longer than this even with extra crews, since it takes time after the lines have stopped to catch up on cooking, storage, clean-up and so on.

Table 8. Bristol Bay inshore catches, packs, fish per case, and proportion of 2-ocean sockeye salmon in the inshore catches and runs, 1957-1965

| Year | Catch (millions of fish) | Pack (millions of cases) | Fish per case | Proportion of catch | 2-ocean run |
|---|---|---|---|---|---|
| 1956 | 8.881 | .680 | 13.06 | - | - |
| 1957 | 6.275 | .566 | 11.09 | .23 | .30 |
| 1958 | 2.986 | .278 | 10.74 | .45 | .54 |
| 1959 | 4.608 | .330 | 13.96 | .78 | .84 |
| 1960 | 13.705 | .887 | 15.45 | .80 | .88 |
| 1961 | 11.913 | .964 | 12.36 | .28 | .36 |
| 1962 | 4.718 | .385 | 12.25 | .71 | .70 |
| 1963 | 2.871 | .233 | 12.32 | .52 | .58 |
| 1964 | 5.591 | .404 | 13.67 | .72 | .77 |
| 1965 | 24.729 | 1.464 | 16.89 | .90 | .93 |
| Weighted $\overline{X}$ | | | 13.94 | | |

Sources:

1) Catches: 1956-1964, International North Pacific Fisheries Commission (1956-1964); 1965, preliminary data from Alaska Department of Fish and Game, December, 1965.

2) Packs: Listed in Table 3.

3) Proportions of 2-ocean fish in catch were calculated from a number of sources dealing with specific fishing districts, which were as follows: Naknek-Kvichak and Egegik districts, 1957-1962, Dr. Charles DiCostanzo, U.S. Bureau of Commercial Fisheries Biological Laboratory, Auke Bay, Alaska (personal communication, January, 1966); Ugashik district, 1957, Kerns (1963); Ugashik district, 1958-1962, Dr. Charles DiCostanzo (personal communication, January, 1966); Nushagak district, 1957-1962, Burgner (1964); all districts, 1963, Siniff (1964); all districts, 1964, Pennoyer and Seibel (1964); all districts, 1965, preliminary data from Alaska Department of Fish and Game, December, 1965.

4) Proportion of 2-ocean fish in run: Listed in Table 6.

## General Cost Discussion

As for most other industries, the two broad categories of cost in the Bristol Bay salmon canning industry are fixed costs and operating costs. Operating costs can further be separated into sunk operating cost and variable operating costs.

Fixed costs are the constant yearly costs to the canneries which are independent of planned or actual production. They must be met whether or not the cannery operates, if the Bristol Bay enterprise is to remain in business. Fixed costs in this industry include depreciation and regular maintenance on buildings, machinery, and floating equipment; home office expense; interest on loans for purchase of capital items; fire and damage insurance; and canning machinery rentals.

Operating costs vary from year to year and are related in some manner to output of the industry. Sunk operating costs are the substantial obligations that must be made prior to the season because of the geographic isolation of the fishery, to bring the industry to some particular level of productive capacity. These could conceivably range from zero, if all the canneries decided not to operate during a particular season, to some maximum amount required to fully prepare all canneries. It is important to point out that sunk operating costs do not depend on actual output, but output may depend on sunk operating costs. Most regular wages and employee benefits are sunk costs. So are travel and living costs of the cannery employees since the company pays these. Other items whose costs fall into this category are freight of supplies to Bristol Bay; repair parts for cannery tenders,[6] docks, and buildings;

[6] Tenders are vessels of about 80-120 feet which pick up the catches from the fishing boats on the fishing grounds and deliver them to the canneries.

tender charters and expenses of running tenders to Bristol Bay; and interest on funds borrowed to finance the season's operation. Some of the fuel for heat, power generation, and tender operation should also be considered as part of the sunk costs of opening the cannery, but fuel costs also tend to vary with output.

Variable operating costs, strictly speaking, depend only on canned salmon output, being zero at zero output and rising in some functional manner with output. Most of the important variable costs are by and large directly proportional to the size of the pack. Raw fish is the most important variable cost, and since it is now being bought by the pound, it is expected that it will in the future be largely proportional to pack. When fish were bought by the piece, the cost of raw fish per case depended on the average size of the fish, which in turn depended on the ocean-age composition of the catch. Other items whose costs vary directly with the pack are cans, cartons, salt, various expendable canning supplies, freight to Seattle of the pack, handling at the docks, marine insurance on the pack, incentive or "lay" wage payments (explained below), and fuel to generate power, cook the canned fish, and run the tenders. After the pack reaches Seattle, there are some further variable costs which apply to the final wholesale price and are essentially proportional to pack. These are for labeling, storing, advertising, transporting, and selling.

As far as could be determined, the only important variable costs that are not directly proportional to the pack are overtime labor costs, which are treated in a general discussion of labor costs. Some variable costs may increase at a more rapid rate than output and thus cause the

variable cost function to curve upwards in the range of high outputs according to the classical economic description (Samuelson, 1964). For example, machine breakdowns and fish wastage and spoilage may increase as the cannery is pushed towards its limit. However, there was no systematic information available that would indicate any substantial concavity in the variable cost curve, and I do not believe it would affect the over-all analysis to assume linearity through the entire range of outputs of the industry. If there were substantial wastage and spoilage during years when the canning facilities were used intensively, the ratio of the total catch to the total pack should indicate this. However, even during the exceptional run of 1965, the quantity of fish per case (Table 8) was not much greater than would be expected from the small average size of the fish due to the high proportion of ocean fish.

## Labor Costs

Labor costs are exceeded only by raw fish costs in over-all importance. This section is intended to clarify the treatment of labor costs in the simulation model.

Excluding fishermen who are paid according to their catch, there are three basic kinds of labor costs in operating a cannery - regular or base wages, hourly overtime, and "lay" or incentive payments. The base salary may be on a monthly basis, such as that for carpenters, tender crews, stewards, and some categories of inside cannery workers; it may be on a seasonal basis, such as that for machinists and some of the lesser supervisory positions; or it may be on an hourly basis, such as that for most inside cannery workers. Regardless of the basis of

payment, the base salary of most employees is a guaranteed, seasonal obligation for the cannery, and is therefore a sunk operating expense. In other words, once the company has incurred the expense of transporting an employee to Bristol Bay, it is likely to keep him there through the season. Some local labor is hired on a casual basis, but most employees are brought in for the season only.

In addition to their base salaries, most workers receive hourly overtime wages for working over eight hours a day. Most overtime wages are treated as variable costs in this study since they become significant only when the cannery operates over eight hours per day. If the catch is small in comparison to the facilities prepared to process it, overtime costs will be small. The larger the pack, given a fixed level of industry preparation, the greater the overtime costs. Therefore, overtime costs should be roughly proportional to the amount of the pack put up on overtime.

Certain categories of employees are given lay payments in proportion to the pack of the cannery. These incentive payments are generally stated as so many dollars per worker per thousand cases. Lay payments vary from worker to worker, from cannery to cannery, and from season to season. However, an average value per case was estimated from the data made available.

## A Simple Cost Model

A summary diagram of canning industry costs appears in Figure 9. Three curves are shown relating total cost and pack for three levels of preseason preparation of the industry. Level 1 might be 10 can-lines of total readied facilities; level 2, 20 lines; and level 3, 30 lines.

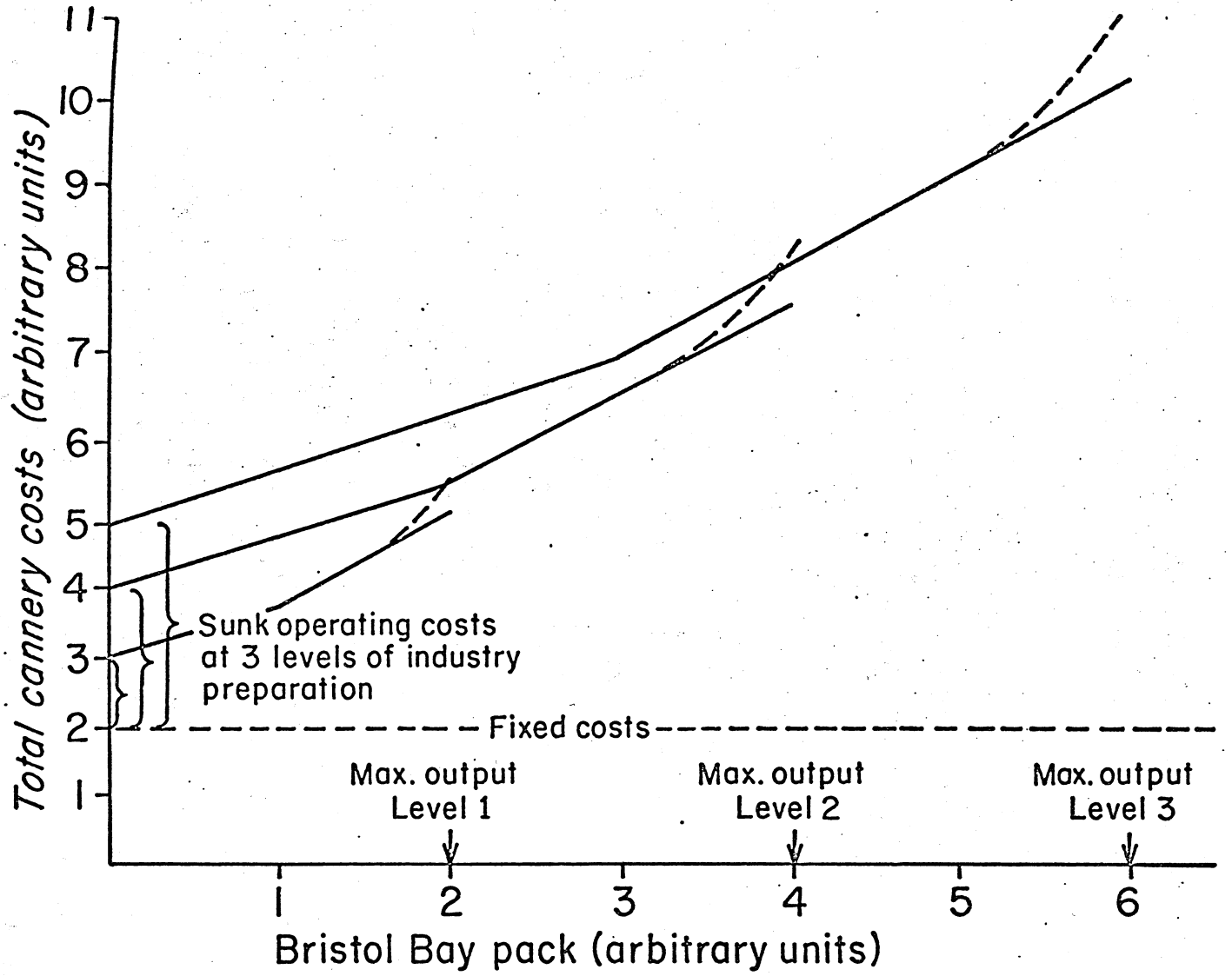


FIG. 9. Diagrammatic representation of the cost structure of the Bristol Bay salmon canning industry.

Fixed costs, being constant, are shown by the horizontal dotted line. Sunk operating costs for each curve are represented by the vertical distance between the intercept of the curve with the vertical axis, and fixed cost. Above these are variable operating costs, rising linearly with output. The change in slope of each curve represents the point at which the industry must start to can fish on overtime. Linearity remains beyond this point since overtime costs and overtime pack are assumed proportional. Finally, for each curve a maximum output is reached, where all readied facilities are utilized to their fullest extent throughout the season. The possible curvilinearity of the variable cost function as maximum output is approached is indicated by the dotted extensions of the cost curves.

## Costs of Company Fishing Operations

So far the discussion of costs in the Bristol Bay canning industry has not included the costs of company fishing operations. These vary greatly since some canneries obtain all of their fish from independent fishermen while others maintain sizeable fleets of company-owned boats. Even canneries with no company fishermen generally have some fishing costs other than raw fish costs, for although they charge independent fishermen for food, fuel, and supplies, a net cost to the canneries of providing these services seems to prevail.

It is likely that even if a cannery decided not to process fish in a particular season, it would at the very least maintain a fishing operation and consolidate with another operating cannery. Good fishermen are a valuable commodity which the company would not chance to lose by holding them idle during an anticipated slack year. Thus, since most

of the costs associated with the company fishing operation, such as "run money" (for time spent in transit and preparation of the gear prior to the season), employee benefits, travel, and maintenance for company fishermen, and fuel and supplies for the fishing boats, will likely be incurred regardless of the extent of preparations within the cannery itself, these costs should theoretically be regarded as fixed costs. However, the canneries surveyed for cost information reported their fishing costs, other than depreciation, interest charges, and basic upkeep that apply to boats and gear, on their operating cost statements. To avoid possible confusion, these costs have been included in the model in the computations of operating margin, whereas all other fixed costs in the canneries are excluded from the model.

## Results of the Cannery Cost Survey

Operating cost sheets for the years 1961-1965 were obtained from six Bristol Bay canneries which reasonably covered the size range of canneries in Bristol Bay. The figures presented below for an "average" Bristol Bay cannery are a composite from the data for all six canneries. I have not presented in detail the cost information which was made available because this is not necessary for forecast evaluation, and I did not wish to divulge any more information than necessary, in deference to the wishes of the companies. Specific values are presented only for major cost categories.

The total sunk operating cost of opening a cannery on a 2-line basis averaged about $375,000. The items included in this total are listed in approximate order of importance in Table 9. The sunk cost of opening each additional line in a cannery, if planned before the season,

Table 9. Summary of operating costs for an "average" Bristol Bay cannery operating 2 can lines

| Sunk operating costs | Fishing costs | Variable operating costs |
|---|---|---|
| Total - $375,000 | Total - $100,000 | Pack proportional costs |
| Items included in total<br>1) Base wages, including employer paid benefits and some basic overtime for can-line workers, machinists, carpenters, mess-house crews (portion of wages), tender crews and miscellaneous employees<br>2) Food, living, and travel expenses for employees in item (1).<br>3) Portion of fuel for power generation, heating, cooking, and operation of tenders, trucks and tractors<br>4) Freight north of fuel, food, and canning supplies<br>5) Portion of repair parts and supplies for docks and buildings<br>6) Tender parts<br>7) Administrative and office expense<br>8) Interest to finance season's operation<br>9) Tender charters, leases, and licenses for misc. vehicles<br>10) Hospital expenses | Items included in total<br>1) "Run money" and employer-paid benefits for company fishermen<br>2) Food, living and travel expenses for company fishermen and other employees associated with the fishing operation<br>3) Fishing boat fuel, repair parts and expendable supplies<br>4) Base wages for misc. shore workers associated with the fishing operation (including portion of mess-house crews)<br>5) Portion of fuel for heating and power generation | Costs per case of fish - $13.24<br>Other costs per case<br>Half-pound case - 6.79<br>One-pound case - 4.90<br>Total costs per case<br>Half-pound case $20.03<br>One-pound case 18.14<br>Items included in other costs per case<br>1) cans, cartons, salt, glue<br>2) freight of pack<br>3) "lay" wage payments<br>4) handling at docks<br>5) fuel for power generation<br>6) fuel for tender operation<br>7) repair parts for cannery machinery<br>8) insurance on pack<br>9) miscellaneous expendable canning supplies<br>Overtime costs per case<br>Half-pound case $ 1.25<br>Full-pound case 2.50 |

averaged about $75,000. Thus, the sunk cost of opening a 4-line cannery at full capacity is about $525,000. Some canneries have a degree of flexibility in that they can open at a low level, say at 2 lines, and add extra lines during the season if an unexpectedly large run occurs. In this case, the cannery merely flies in extra crews of can-line workers who may be available on a standby basis, and utilizes the machinists and other support personnel already on hand to a greater extent. The sunk cost of adding an extra line on an emergency basis is about $45,000 if done early in the season, or some fraction of this amount if done later in the season. Much of the cost of opening an emergency line is for the regular wages, employee benefits, travel, and living expenses of the extra workers.

It may seem that the cost of opening a line on an emergency basis is disproportionately low in comparison to the cost of planned expansion. However, if the extra lines are readied before the season, there may be provision for extra support and supervisory personnel in the cannery, extra tender crews, more supplies, more preseason repair and replacement costs, and more interest on greater short-term loans to finance the greater operation. Therefore, while the average cost to a cannery of opening an extra line on an emergency basis is $45,000 or less, the average cost of a planned extra line is higher. In choosing to open at a low planned capacity and add more lines during the season, a cannery may be saving some money in some years, but it also is taking the chance of losing potential pack from the early segment of a large run. It is likely that the average daily output of a line opened on an emergency basis is less than one opened well before the season. This was not established,

and in the model all operating lines were considered equally efficient. However, the decision rules in the model for opening emergency lines were somewhat conservative, which should reflect in overall effect the expected relative inefficiency of the emergency line compared to the planned line.

The cost of the company fishing operations was highly variable. An average of about $100,000 was calculated for the canneries surveyed, but this is not an adequate representation of any particular cannery, since those surveyed either had extensive company fishing operations or few, if any, company fishermen. However, since it is assumed that total fishing costs in Bristol Bay, other than raw fish costs, are relatively invariant from year to year, it makes no difference to assume that an "average" cannery has some intermediate-sized fishing operation. The items included in the $100,000 cost of the fishing operations are listed in Table 9 in approximate order of importance.

Of the variable operating costs, those that tend to be directly proportional to pack are quite standard. The average per half- and one-pound cases (excluding raw fish) were $6.79 and $4.90 respectively. The items included in these figures are listed in Table 9. I have not included any of the variable expenses added to the pack after Seattle delivery, such as labeling and selling costs, for reasons which will later be apparent. The source of the cost differential is the higher cost of cans and cartons for a half-pound case (96 cans), compared to a one-pound case (48 cans). Also, some minor differences were assumed in the costs of fuel, repair parts, and miscellaneous canning supplies between half- and one-pound cases since a half-pound line must be run

twice as long as a one-pound line to produce a case.

Determining a reasonable value for raw fish cost in the model was a problem, since the basis of purchasing fish changed between 1965 and 1966. With the new requirement for buying fish by the pound, it was assumed that fish costs would be directly proportional to pack. The cost of raw fish per case used in the model was based on two statistics: (1) the average fish per case for the past 10 years, weighted according to yearly pack (Table 8); and (2) the 1965 fish prices of $.68 and $1.09 for fish caught by company and independent fishermen, respectively. Of the fishermen supplying the canneries surveyed in 1965, which represent a fair cross section of the entire fishery, about two-thirds were independent and one-third company. These proportions are approximate only, and there may be some difference in fishing ability between the two types of fishermen. However, since only a reasonable figure for projection was desired, an average price, with weights of 1 and 2 for company and independent prices, respectively, was assumed to be $.95. This was applied to the 10-year average of 13.94 fish per case, and the average of $13.24 per case for raw fish costs was obtained. Pack proportional costs were then assumed to total $20.03 and $18.14 per half- and one-pound cases, respectively.

Overtime costs per case packed on overtime were calculated from the following information: (1) a schedule of hourly overtime rates, including employee benefits, paid to various categories of cannery workers, (2) the average number of each type of employee per can line, and (3) the average hourly output of a can line, 125 cases, based on an average sustained output of 2,000 cases in a 16-hour day. The cost added to

producing a one-pound case on overtime was calculated to be $1.25. The overtime cost of a half-pound case was assumed to be twice this, $2.50, since the half-pound line must be run twice as long to produce a case. There may be a few less employees required on the average to operate a half-pound line but not substantially less according to cannery officials.

A final cost included in the model is a tax levied by the State of Alaska on the pack. This is 3 per cent of the wholesale value of the pack at the time of delivery to Seattle.

Some arbitrary allocations of certain operating costs to major cost categories had to be made in calculating the costs of an "average" cannery, and the basis of such allocations should be stated. (1) Travel, food, and other living expenses, unless a breakdown was stated, were divided between sunk operating cost in the cannery and fishing costs. The ratio of company fishermen (and certain other employees connected with the fishing operation only) to cannery workers, either known from information available or estimated, was the basis for this division. (2) Fuel for power generation, scows, and trucks, as well as miscellaneous expendable supplies for operating the cannery are partially sunk costs, but also tend to vary with output. Their reported cost in 1963, a year of very low production, was assumed to be the sunk cost of such items. The differences between the 1963 and the 1965 costs, the 1965 pack being very large, were divided by the difference in pack for the reporting company to arrive at values to apply to variable costs. (3) Certain categories of workers, for example mess-house crews and tender crews, seem to receive at least some overtime wages regardless of cannery output because of the nature of their jobs. The 1963 cost was

again used as a base and a basic total overtime cost which is included as part of the base salary expense in sunk operating costs was calculated for an average cannery.

More difficult to allocate into major cost categories were the costs of repair and replacement parts and materials. Although these costs were reported on operating cost sheets, those that were the result of weathering, aging, or incurred in some way independent of use, were actually fixed costs. Furthermore, if the repairs depend on use they may be sunk or variable operating costs or in part each of these. Specifically, repair parts for a cannery tender are likely the result of use but, since much of the running time of the tender is independent of pack, the expense for these repair parts like that for fuel, are at least partly a sunk cost. There was no evidence from the data on hand to indicate that the expense varied with the pack, so the cost of all tender repair parts was considered a sunk operating cost. As another example, the mere use of cannery buildings and docks, regardless of the quantity of fish packed, places wear and tear on the facilities which would not be incurred if the cannery were not operated. However, in normal operations some expenses are incurred for repair materials that are independent of use. Therefore, only one-half of the cost of these materials when reported on operating cost sheets was considered a sunk operating cost, and the rest was considered a fixed cost. Finally, the cost of parts for canning machinery probably varies with the pack, and the reported cost was therefore treated entirely as a variable operating cost.