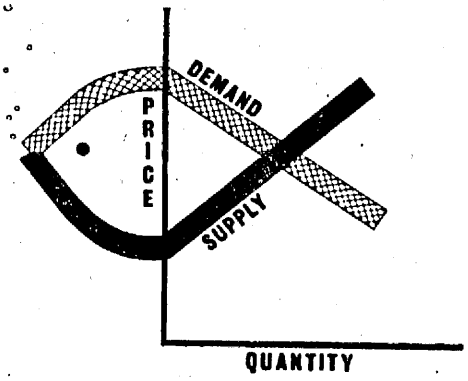

ECONOMIC STUDY OF SAN PEDRO WETFISH BOATS

By

William F. Perrin and Bruno G. Noetzel

Working Paper No. 32
October 1969

WORKING PAPER SERIES

1. An Application of an Investment Model to Channel Catfish Farming by R. Thompson and F. Mange.

2. The Development of Catfish as a Farm Crop and an Estimation of Its Economic Adaptability to Radiation Processing by D. Nash and M. Miller.

3. Design Study: An Optimum Fishing Vessel for Georges Bank Groundfish Fishery by A. Sokoloski (Project Monitor).

4. The Relation between Vessel Subsidy Percentages and the Rate of Return on Investment for Various Technologies and Scale Levels: The Haddock Fishery by D. Nash, A. Sokoloski and F. Bell (Project Monitors).

5. An Economic Justification for Recommended Legislative Changes in the 1964 Fishing Fleet Improvement Act by F. Bell, E. Carlson, D. Nash and A. Sokoloski.

6. The Economic Impact of Current Fisheries Management Policy on the Commercial Fishing Industry of the Upper Great Lakes by D. Cleary.

7. Cost and Earnings in the Boston Large Trawler Fleet by B. Noetzel and V. Norton.

8. Some Elements of An Evaluation of the Effects of Legal Factors on the Utilization of Fishery Resources by A. Sokoloski.

9. A Report on the Economics of Polish Factory Trawlers and Freezer Trawlers, by B. Noetzel.

10. An Inventory of Demand Equations for Fishery Products by D. Nash and F. Bell.

11. Industry Analysis of West Coast Flounder and Sole Products and an Estimation of Its Economic Adaptability to Radiation Processing by D. Nash and M. Miller.

12. Bio-Economic Model of a Fishery (Primarily Demersal) by E. Carlson.

13. The Factors behind the Different Growth Rates of U. S. Fisheries by F. Bell.

(continued on inside back cover)

ECONOMIC STUDY OF SAN PEDRO WETFISH BOATS

by

William F. Perrin and Bruno G. Noetzel

ABSTRACT

Because the San Pedro wetfish fleet is shrinking and is not yielding good wages for fishermen or good returns to investors, it needs to improve its economic state. The fleet is antiquated, and one way it can improve itself is by constructing new, efficient vessels, both for replacement of vessels and for expansion of the fleet to harvest presently underexploited stocks of jack mackerel and anchovies in the California Current. The study reported here investigated the feasibility of this approach. It found that, at present rates of catch and prices of fish, the construction of new vessels is not economically feasible--even if the construction is subsidized. It also found, however, that expansion of the fleet through acquisition of surplus vessels from other fisheries is feasible, given sufficient demand for wetfish at present prices.

Authors: William F. Perrin, Fishery Biologist (General), Bureau of Commercial Fisheries Fishery-Oceanography Center, P. O. Box 271, La Jolla, California 92037, and Bruno G. Noetzel, Industry Economist, Bureau of Commercial Fisheries Division of Economic Research, 7338 Baltimore Avenue, College Park, Maryland 20740.

CONTENTS

INTRODUCTION

San Pedro is the major seaport for Los Angeles, California. San Pedro wetfish boats fish for mackerel, bonito, anchovies, and tuna in local waters and land them in a fresh unfrozen condition. In recent years, vessel operators in this fleet have been financially hard-pressed; they have complained of rising costs coupled with static fish prices. At the same time, large underexploited populations of mackerel and anchovies are reported to exist in the California Current (Ahlstrom, 1968). If these resources are to be harvested by U.S. fishermen, the wetfish fleet must expand, either through recruitment of surplus vessels from other fisheries or through the construction of new vessels. Motivated by these considerations, the U.S. Bureau of Commercial Fisheries in 1968 began an investigation of the present financial condition of the fleet and the economics of the operations of wetfish boats. This paper reports the results of the study. In this introduction, we shall present background material on the makeup, history, landings, and operations of the San Pedro fleet, state the precise aims of the study, and describe the data base used.

The San Pedro wetfish boat fleet is part of the roundhaul fleet, which is made up of four types of vessels: (1) tunaboats, (2) combination boats, (3) wetfish boats, and (4) miscellaneous small roundhaul boats.

(1) Tunaboats. Tunaboats are large, long-range purse seiners that vary in fish capacity from 100 short tons to 800 short tons and that fish almost solely for tuna: yellowfin tuna (Thunnus albacares) and skipjack (Katsuwonus pelamis) off Mexico,

Central America, and South America; and bluefin tuna (Thunnus thynnus) and albacore tuna (Thunnus alalunga) off California and Mexico. McNeely (1961) has described the purse-seining gear used and the methods of fishing. Green and Broadhead (1965) have described and analyzed the costs and earnings of tropical tunaboats.

(2) Combination boats. Combination boats are purse seiners that vary in fish capacity from 140 tons to 160 tons and are medium-range vessels that fish primarily for tuna off California and Mexico and for wetfish mostly off California, with tuna making up the major part of the catch. In 1967, eight combination boats were in the San Pedro fleet.

(3) Wetfish boats. Wetfish boats are relatively small purse seiners that vary in fish capacity from 25 tons to 160 tons and that range in length from 40 to 86 feet overall. They operate within 100 miles of San Pedro. Individual trips last from 1 to 10 days, with the average being between 1 and 2 days. Scofield (1951) has described the vessels, gear and fishing methods. Recent technological developments in the fleet, including the adoption of nylon nets and hydraulic net-hauling blocks, have paralleled those described by McNeely (1961) for the tunaboat fleet. These boats fish primarily for wetfish, here defined to include bonito (Sarda chiliensis), Pacific mackerel (Scomber japonicus), jack mackerel (Trachurus symmetricus), and Pacific sardine (Sardinops caerulea) for canning and also for the fresh-fish market; and northern anchovy (Engraulis mordax) for reduction.

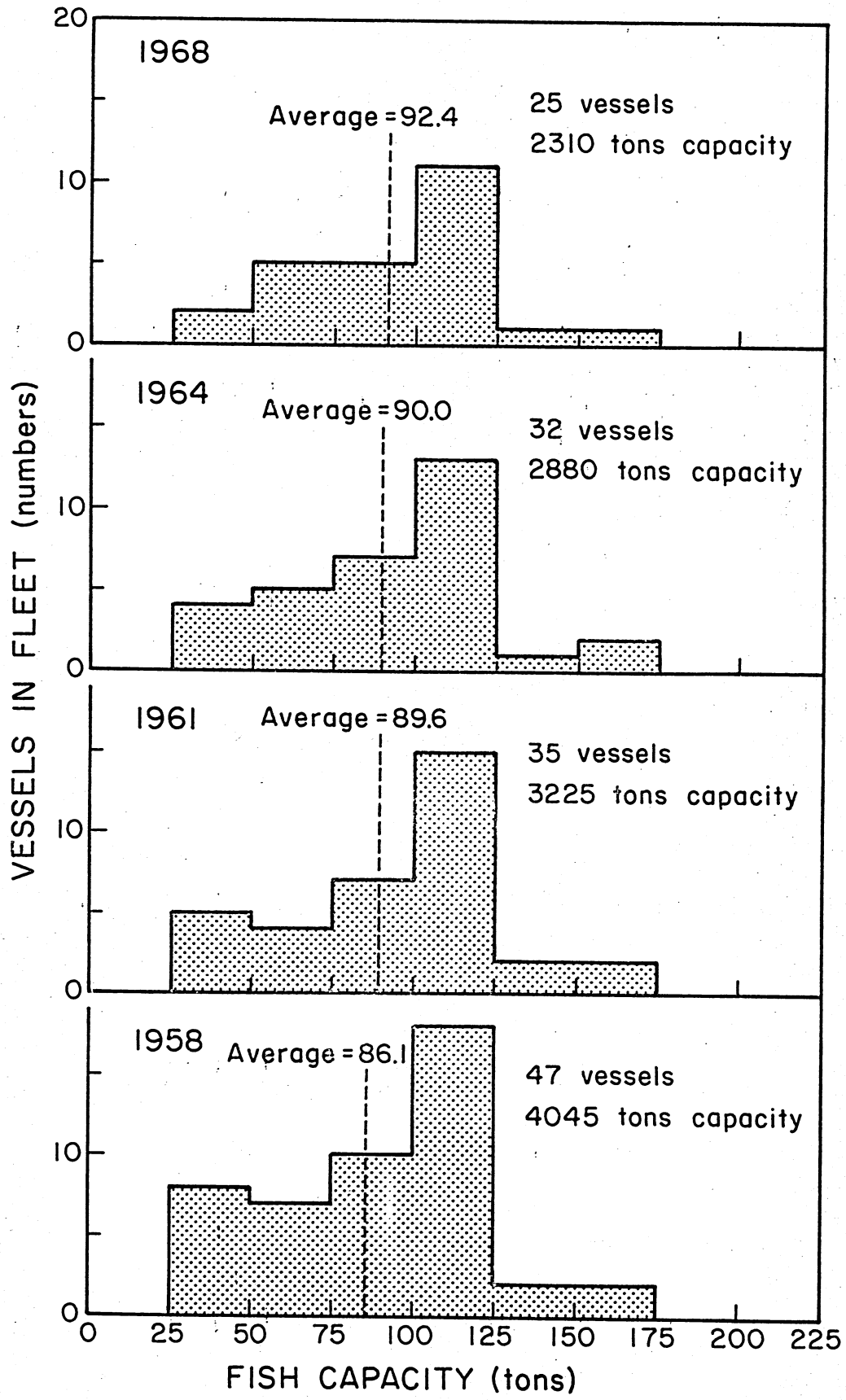

Figure 1.--SanP edro wetfish boat fleet--1958 to 1968. (These data were furnished by the Fishermen's Cooperative Association of San Pedro.)

A significant proportion of their catch, however, in terms of value is made up of bluefin and albacore tuna (see the wetfish fleet landings below). The number of San Pedro wetfish boats decreased from 47 in 1958 to 25 in 1968 (Figure 1), with the greatest reduction occurring in the boats in the size range of 25 to 50 tons.

(4) Miscellaneous small roundhaul boats. Small roundhaul boats include very small purse seiners that vary in fish capacity from 5 tons to 25 tons and "lampara" boats that vary in fish capacity from 5 tons to 40 tons and that fish for wetfish, squid (Loligo opalescens), anchovies for use as bait in sport fishing, and a wide variety of other species landed primarily for the fresh-fish markets.

Of these four types of vessels in the San Pedro roundhaul fleet, wetfish boats (Category 3 above) were the subject of this study.

Wetfish boats have had a history of coping with adversity. The decline of the California sardine fishery (Figure 2) left a sizable fleet of small purse seiners on the West Coast in need of profitable employment. Some turned to salmon seining or to tropical-tuna seining, some converted to trawling, and many became the property of foreign fishing companies and left U.S. waters; but some boats, especially those at Monterey and San Pedro, expanded their activities on Pacific mackerel, jack mackerel, bonito, and bluefin, albacore, and skipjack tuna, which they had fished less intensively while sardine were abundant. The main emphasis was on mackerel (both species). They joined a declining fleet of various types of less efficient vessels already fishing primarily for Pacific mackerel (Croker, 1938;

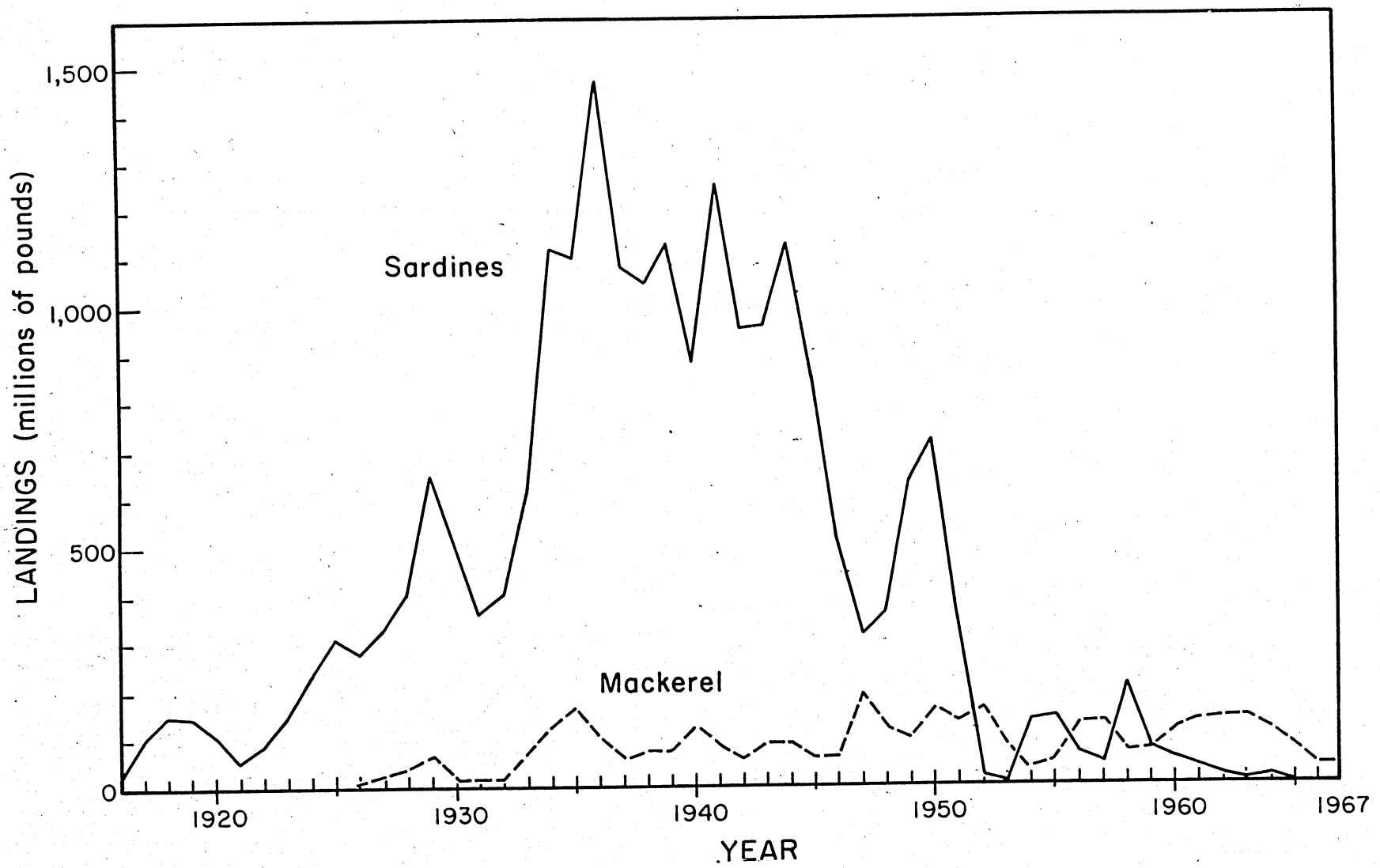

Figure 2.--Sardine and mackerel landings in California, 1916 to 1967. The data are from: Staff, Bureau of Marine Fisheries, 1949; Staff, Marine Fisheries Branch, 1954 and 1956; Staff, Marine Resources Operation, 1958; Biostatistical Section, Marine Resources Operations, 1960a, 1960b, 1961, 1963, 1964 and 1965; Greenhood and Mackett, 1965 and 1967; Heimann and Frey, 1968a and 1968b.

Roedel, 1952). When sardines in some years became temporarily more abundant, they returned for short periods to that species, so that landings of sardines and mackerel showed an inverse relation between 1952 and 1962 (Figure 2). Since 1962, the landings of sardines have been negligible, so that the fleet has depended primarily on mackerel. Thus, the wetfish boat fleet is essentially what is left of the sardine fleet. The newest boat in the fleet was built in 1947 (Table 1).

Table 2 shows the landings of the wetfish boats at San Pedro during 1963 through 1967. It also shows the percent of the total landings in California for each species making up the San Pedro wetfish boat landings.[1] During this period, landings for the fleet closely paralleled the total landings for California (Figure 3). Because the species landed vary widely in ex-vessel price (Table 3), figures for landings alone do not illustrate the species base of the fleet in economic terms. Figure 4 shows the makeup of the landings in terms of the percentage of total value accounted for by each species during 1963 to 1967.[2] The year-to-year variations in the composition of the catch reflect:

1. The decreasing population of Pacific mackerel, due to overfishing (Ahlstrom, 1968).

2. Yearly fluctuations in the abundance of the migratory bluefin and albacore tuna, probably due to varying local oceanographic conditions within the range of the wetfish fleet.

---

[1]From unpublished data furnished by the California Department of Fish and Game.

[2]From unpublished landings data furnished by the California Department of Fish and Game and from price data gathered in the present study.

Table 1.--Age structure of the San Pedro wetfish-boat fleet in 1968

Year of construction	Number of vessels	Year of construction	Number of vessels
1935	4	1942	
1936		1943	
1937	5	1944	8
1938		1945	1
1939	3	1946	1
1940	1	1947	1
1941		Total	24

Note: These data were compiled from U.S. Bureau of Customs (1965) and from information provided by the Fishermen's Cooperative Association of San Pedro.

Table 2.--Landings of the San Pedro wetfish-boat fleet, 1963 to 1967
(with percent of total California landings in parentheses)

Species	Landings in:				
	1963	1964	1965	1966	1967
	Pounds	Pounds	Pounds	Pounds	Pounds
Jack mackerel	68,783,000 (72.1)	60,325,000 (69.6)	47,523,000 (71.1)	31,044,000 (76.0)	29,447,000 (77.1)
Pacific mackerel	29,595,000 (73.5)	21,539,000 (80.3)	4,566,000 (64.8)	2,612,000 (56.4)	632,000 (54.2)
Sardines	3,538,000 (49.6)	8,270,000 (63.0)	1,110,000 (57.6)	406,000 (46.2)	40,000 (26.8)
Bonito	2,606,000 (64.8)	1,674,000 (64.1)	4,019,000 (71.3)	13,412,000 (70.0)	12,314,000 (58.0)
Bluefin tuna	3,295,000 (10.9)	2,938,000 (12.7)	2,220,000 (13.9)	1,727,000 (5.0)	1,585,000 (11.5)
Albacore tuna	375,000 (0.8)	21,000 (0.1)	694,000 (3.0)	87,000 (4.8)	1,000 (<0.1)
Anchovies	1,000 (<0.1)	170,000 (3.4)	212,000 (3.7)	30,122,000 (48.4)	37,342,000 (53.6)
Other	83,000	369,000	351,000	299,000	236,000
Total	108,966,000 (21.4)	95,602,000 (19.4)	62,062,000 (13.7)	80,523,000 (17.6)	81,777,000 (16.2)

Note 1: The data on landings of the San Pedro wetfish-boat fleet are from unpublished data furnished by the California Department of Fish and Game.

Note 2: The total California landings from which the percentages were calculated were from the Biostatistical Section, Marine Resources Operations, 1965; Greenhood and Mackett, 1966, 1967; Heimann and Frey, 1968a, 1968b.

Note 3: The other species include: skipjack tuna (Katsuwonus pelamis), bullet mackerel (Auxis thazard), Pacific pompano (Peprilus simillimus), blacksmith (Chromis punctipinnis), "smelt" (Atherinidae), halfmoon (Medialuna californiensis), "perch" (Embiotocidae), white croaker (Genyonemus lineatus), white sea bass (Cynoscion nobilis), "shark," squid (Loligo opalescens), and small quantities (less than 2,000 pounds) of several other species.

Table 3.--Average prices paid to San Pedro wetfish boats for fish

Species	Prices in:											
	1963		1964		1965		1966		1967		1968[1]	
	Cents per pound	Dollars per short ton	Cents per pound	Dollars per short ton	Cents per pound	Dollars per short ton	Cents per pound	Dollars per short ton	Cents per pound	Dollars per short ton	Cents per pound	Dollars per short ton
Bonito[2]	2.870	57.40	2.629	52.58	2.780	55.60	4.067	81.34	4.146	82.92	4.248	84.96
Bluefin tuna[2]	10.212	204.24	11.114	228.28	13.135	262.68	14.484	289.68	12.396	247.92	--	--[3]
Albacore tuna[2]	16.190	323.80	15.944	318.62	16.081	321.62	24.738	494.76	19.500	390.00	--	--[3]
Mackerel (both spp.)[2]	2.103	42.03	2.294	45.88	2.713	54.26	3.430	68.60	3.625	72.50	3.771	75.42
Sardines[2]	3.307	66.14	3.261	65.22	3.234	64.68	18.649	372.98[4]	20.000	400.00[4]	--	--[3]
Anchovies	1.698	33.96[5]	1.649	32.66[5]	1.723	34.66[5]	0.941	18.82[2]	1.000	20.00[2]	--	--[3]
Skipjack tuna[2]	9.976	199.52	--	--[6]	10.240	204.80	--	--[6]	--	--[6]	--	--[3]
Average for all species	2.465		2.665		3.300		2.948		2.679		--	

Note 1: First quarter of 1968.

Note 2: Based on settlement data gathered in the present study (see the Data Base section).

Note 3: No fish were landed in the first quarter of 1968.

Note 4: Sold mostly to fresh-fish markets.

Note 5: Based on landings and value data in Biostatistical Section, Marine Resources Operations, 1965; Greenwood and Mackett, 1965 1967.

Note 6: Negligible quantities of skipjack were caught in these years by the wetfish fleet.

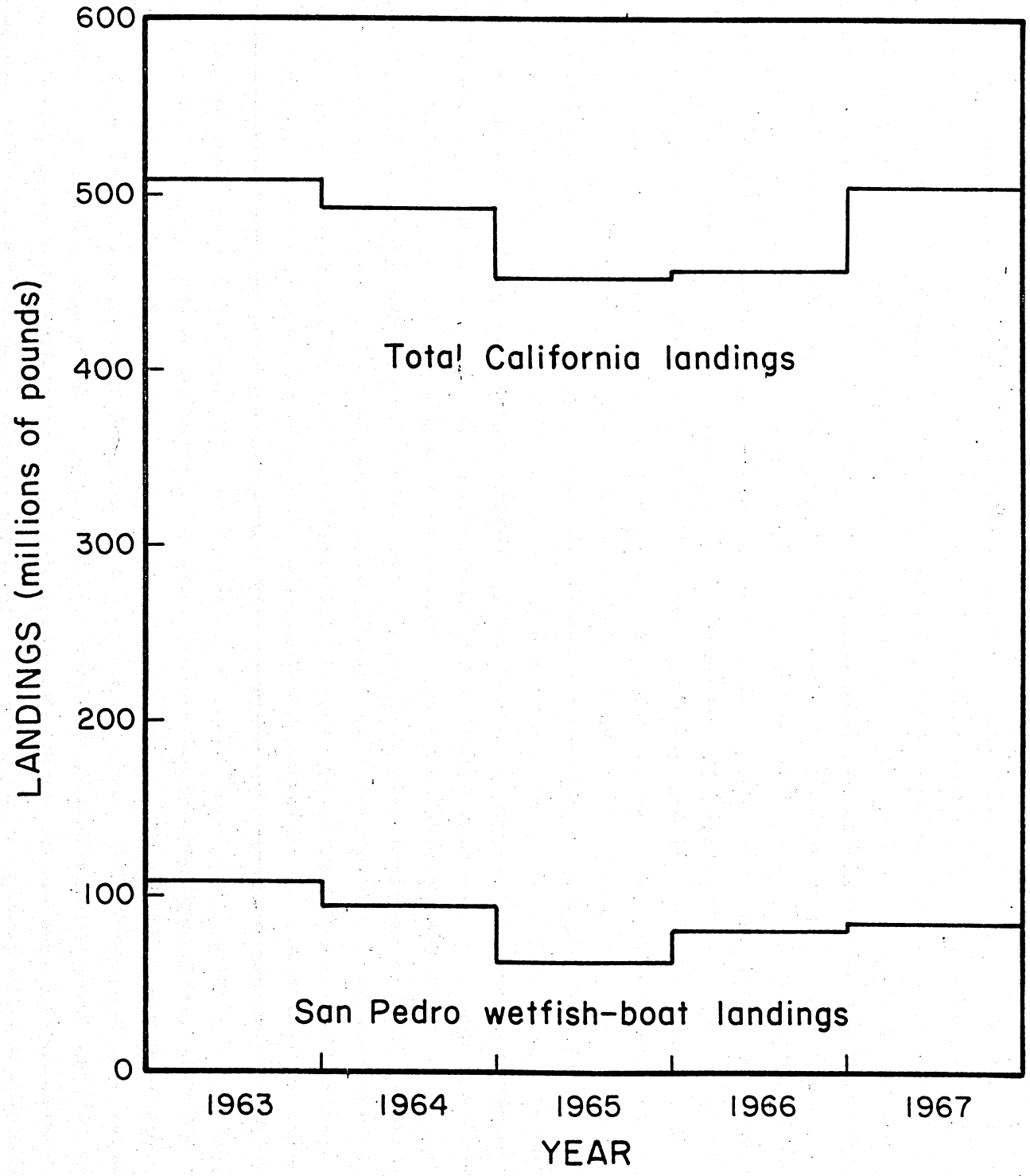

Figure 3.--San Pedro wetfish-boat landings and total California landings, 1963 to 1967. The total-landings data are from the Biostatistical Section, Marine Resources Operations, 1965; Greenhood and Mackett, 1965 and 1967; Heimann and Frey, 1968a and 1968b. The wetfish-boat landings are from unpublished data furnished by the California Department of Fish and Game.

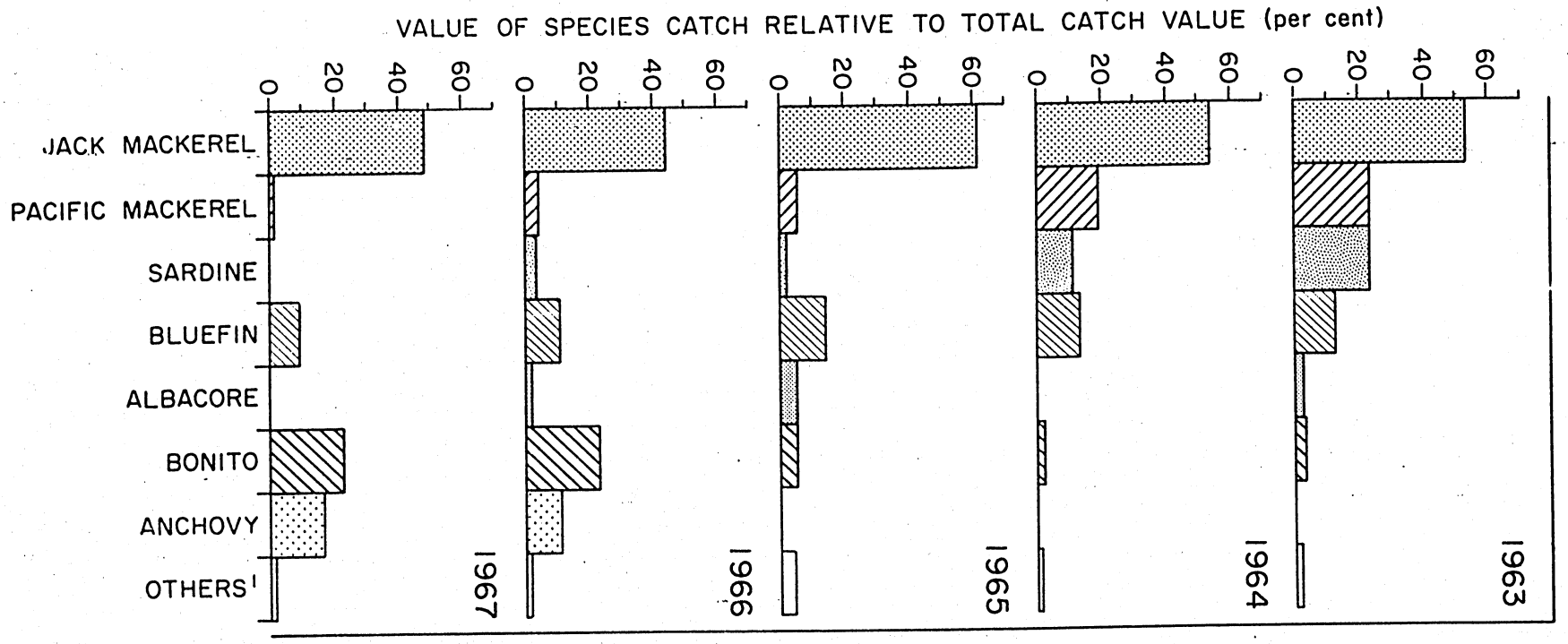

Figure 4. --Species makeup by value of catch of San Pedro wetfish boat fleet, 1963 to 1967. The figures are based on unpublished landings data furnished by the California Department of Fish and Game.

3. Yearly fluctuations in the demand for bonito by the processors.

4. A legal moratorium on sardine fishing (as of 1967), following a drastic decline in abundance.

5. The legalization by the California state legislature of the taking of anchovies for reduction to fish meal (as of November 1965).

Although these data and observations indicate that the San Pedro wetfish industry is not in a strong position economically, they do not supply sufficient information for a complete analysis. The overall purpose of the work reported here therefore was to gain a complete view by means of a detailed economic study. The main specific aims of this study were:

1. To determine the condition of the wetfish boat fleet at San Pedro (as of March 1968) with respect to (a) productivity, revenue, and profits of the fleet, (b) capital structure and return on investment, (c) crew earnings, and (d) employment.

2. To present a model with which prospective wetfish operators may predict costs and earnings under varying conditions of such factors as composition of the catch, characteristics of the vessel, value of the vessel, and size of the crew.

3. Then, using the model developed, to examine the economic feasibility of constructing new wetfish boats and of expanding the fleet.

An understanding of the data in this report and of the discussion of the data requires an understanding of share-out procedures--that is, of the way in which the proceeds of the catch are divided up between owner and crew. A discussion of these procedures therefore follows.

A share-out, or "settlement," is made by the boat owner when enough fish have been sold to more than cover expenses, usually once a month at the end of the "dark" (of the moon). Because the lunar month is 29-1/2 days, sometimes more than one settlement occurs in a calendar month. A settlement usually is not made, however, when insufficient fish are caught to cover operating expenses during the lunar period. In this event, income and expenses are held over until a successive period. Occasionally, a settlement may be made even when expenses are not met, and negative "shares" are computed and deducted from the shares in the following settlement.

The settlement is computed on a "settlement sheet" having a standard format. Copies of the settlement sheet are retained by the boat owner and his accountant, and a copy is forwarded to the labor union representing the crew. Computing the settlement involves four steps as follows:

(1) Operating costs or "trip expenses" are deducted from gross revenue. By union agreement, only certain items of expense may be deducted from the gross. These deductible items include fuel, lubricating oil, salt, ice, foreign fishing licenses, seal and shark control (explosives and rifle ammunition), airplane spotting services, and contributions to the welfare fund, the pension fund, and the patrol agency.

The patrol agency is maintained by the union members. It has the duty of policing the collective bargaining agreement and of checking weights and payments.

Other expense items formerly deducted from the gross but not allowable under present agreements included: lobbying, attorneys' fees, donations, appliances, and rental and repairs of electronic equipment. Only the last item appeared frequently on settlement sheets included in the sample used in the present study.

The gross revenue as construed here excludes the value of rejected fish, overlimits, and fish transferred to other vessels, but it does include the value of fish transferred from other vessels.

(2) The net proceeds (gross income minus trip expenses) are divided into the boat share and the gross crew share. The division is made according to a schedule established by agreement with the labor unions (Table 4). When refrigeration equipment is used, the vessel receives an additional 3 percent of the net proceeds.

(3) The crew's gross share is split equally among the members of the crew, including any owners who serve as crew members. If a crewman was not on the boat for the entire fishing period, his share is prorated accordingly. This prorating is done by making a "split"--that is, by computing separate settlements for the segments of the period with crews of different sizes. For example, if 10 men worked for 14 days and 11 men worked for an additional 12 days, a separate settlement is computed for 14 days with 10 shares and for 12 days with 11 shares. Fuel,

Table 4. --Share-out schedule for San Pedro wetfish boats

Boat's hatch capacity	Boat's share	Crew's share	Members in crew including skipper
Tons	Percent	Percent	Number
1 to 25	34-3/4	65-1/4	5 to 6
26 to 50	36-1/2	63-1/2	6 to 7
51 to 75	37-1/2	62-1/2	9 to 10
76 to 100	39	61	10 to 11
101 to 125	39-1/2	60-1/2	10 to 11
126 to 150	41-1/2	58-1/2	11 to 12
151 and up	42-1/2	57-1/2	11 to 12

Note: These data were furnished by the Fishermen's Cooperative Association of San Pedro.

welfare, pension, electronics, and most "other trip expenses" are prorated to the segments. Patrol and airplane spotting costs are deducted from the gross for the segment in which these costs occurred. Likewise, catch income belongs to the segment during which the fish were caught. For this report, the average size of crew to the nearest whole man during the month is used.

(4) The cost of provisions and of galley supplies such as crockery and cooking utensils is split equally among the members of the crew and is deducted from their shares.

The data for this report were obtained primarily from records maintained by bookkeeping and accounting firms for the vessel owners. These records include: (1) copies of the settlement sheets together with copies of receipts for fish sold to wholesalers or processors during the period covered by each settlement and (2) balance sheets, profit-and-loss statements, tax forms, and other documents pertaining to the finances of the corporation or partnership operating the vessel.

Access was not gained to the company records of some vessels. For these vessels, settlement information was obtained from the copies of settlement sheets retained by the unions, but neither catch nor corporation financial data were obtainable.

Data on total landings by the wetfish-boat fleet were furnished by Marine Resources Operations of the California Department of Fish and Game.

Estimates of costs of constructing new vessels were obtained by direct interview with shipbuilders. Market values of vessels in the existing fleet were obtained from county tax records. Information on insurance rates was obtained from marine insurance agents.

As was just indicated, complete data could not be obtained. Consequently, this report is based on sample data. The sizes of the samples for (1) the annual financial data, (2) the costs and earnings data for monthly settlements, and (3) the catch data were as follows:

(1) Annual financial data. The sample included annual data on finances for 12 vessels from 1963 to 1965 inclusive, for 14 vessels for 1966, and for 15 vessels for 1967. These data represented about 44 percent of the total vessel years for the fleet during the period. The data were not strictly comparable on a time axis because the fiscal year used varied from company to company.

(2) Revenue and cost data for monthly settlements. We obtained access to monthly settlement sheets for 22 vessels. The sample included data on revenue, itemized trip expenses, and crew size from 940 settlements from January 1963 to March 1968, inclusive (Table 5). Three vessels entered the sample in 1965, one vessel entered in 1966, and the other 18 vessels were covered for the entire period. Each vessel was not represented by a settlement for each month during the sample period, because of tie-ups due to repairs, modifications, and labor disputes and because catches in some months were too small to justify settlement. The settlements in the sample represent from 52.4 percent (1963) to 78.8 percent (1967) of the total revenue of the wetfish boat fleet (Table 5).

Table 5.--Sample size of revenue and cost data for monthly settlements

Year	Settlements in sample	Vessels in sample	Revenue in sample	Revenue relative to total revenue for fleet
	Number	Number	Dollars	Percent
1963	169	18	1,413,000	52.4
1964	163	18	1,394,000	54.7
1965	174	21	1,499,000	73.2
1966	194	22	1,796,000	75.6
1967	188	22	1,726,000	78.8
1968	52	22	346,000	——

Note 1: The data on total revenue are estimates based on unpublished landings data furnished by the California Department of Fish and Game and on price data from the present study.

Note 2: The data for 1968 are for only the first quarter of the year.

(3) Catch data. Data on species, weight, and price of the catch were gathered for 826 settlements for 18 of the 22 vessels for which cost and revenue data were obtained. For the remaining 4 vessels, catch data correlated with settlements were not available. Table 6 shows the percentage in the sample of the total wetfish boat fleet landings for each major species. Pacific mackerel and jack mackerel were combined into a single category "mackerel", because many of the cannery receipts used as the sources of data in this study did not specify the species of mackerel purchased. The sample is skewed toward tuna and away from sardines, anchovies, and bonito for most of the years. This bias for the higher-priced species is also reflected in a comparison of the elements of the last column of Table 5 with those of the last row of Table 6. For example, the sample for 1963 includes 38.2 percent of the total fleet landings but it includes 52.4 percent of the value of the landings. This skewness must be taken into account when an empirical costs-prediction model is constructed based on the present sample.

A portion of the catch in the sample for each year was classified as "other or unidentified (single price paid for a mixed catch, or itemized cannery receipt not available)." Table 7 shows the percentage of the value of the landings in the sample classified in this category for each year. The proportion of this value that should pertain to each species--thereby providing a basis for increasing the percentage by weight listed as included in the sample (Table 6)--is not known. A decreasing percentage for sardines in Table 6, however, is almost certainly due in part to the fact that a greater percentage of the total landings of sardines in southern California are from mixed catches of mackerel and sardines (Greenhood, 1965). The composition of these mixed catches was estimated in the landings data furnished by the

Table 6.--San Pedro wetfish boat landings included in sample by species, 1963 to 1967

Species	Landings included in the sample relative to the total wetfish landings in:				
	1963	1964	1965	1966	1967
	Percent	Percent	Percent	Percent	Percent
Mackerel	44.4	46.9	58.0	62.4	71.2
Sardines	20.2	42.9	22.3	10.0	5.5
Bluefin tuna	68.0	63.0	73.0	74.1	60.1
Albacore tuna	67.1	—	57.3	71.4	—
Bonito	30.0	30.9	19.2	55.5	60.7
Anchovies	—	0.0	0.0	41.1	65.1
Average	38.2	38.9	38.3	52.4	54.8

Note: Where no data are given, the landings of the given species were nelegible (see Table).

Table 7.--Relative value of landings classified as "other or unidentified", 1963 to 1968

Sample year	Relative value of landings classified as "other or unidentified"
	Percent
1963	2.4
1964	10.1
1965	8.3
1966	4.0
1967	6.9
1968 (1st)	1.1

California Department of Fish and Game but not on the cannery receipts that were the sources of catch data for this study.

I. FINANCIAL CONDITION OF THE FLEET

In our evaluation of the financial condition of the fleet, we consider the following factors: (A) productivity, revenue, and profit, (B) capital structure and return on investment, (C) crew earnings and (D) employment.

A. Productivity, Revenue, and Profits

Productivity per vessel in terms of tons of fish landed showed no net gain from 1963 to 1967 (Table 8). Landings per vessel in 1967 ranged from 535 tons to 2,570 tons (Figure 5). The average vessel revenue showed a net increase, but the total fleet revenue decreased due to the decrease in the number of vessels. The vessel average annual revenue for the period ranged from 45,145 dollars to 119,610 dollars with the grand average being 77,557 dollars (Figure 6).

For the purpose of this analysis, profits (or losses) shown in Profit and Loss Statements have been adjusted by adding salaries paid to officers of the corporations. Wages, commissions, and bonuses paid to these officers for serving as crew members are part of the corporation's operating costs (included in crew wages). Salaries in general were a form of draws on account of future profits, but in some cases part of these salaries might be considered as managerial cost. Since, from the records made available, it was not possible to separate these two types of payments, all salaries paid to officers were added to profits. With

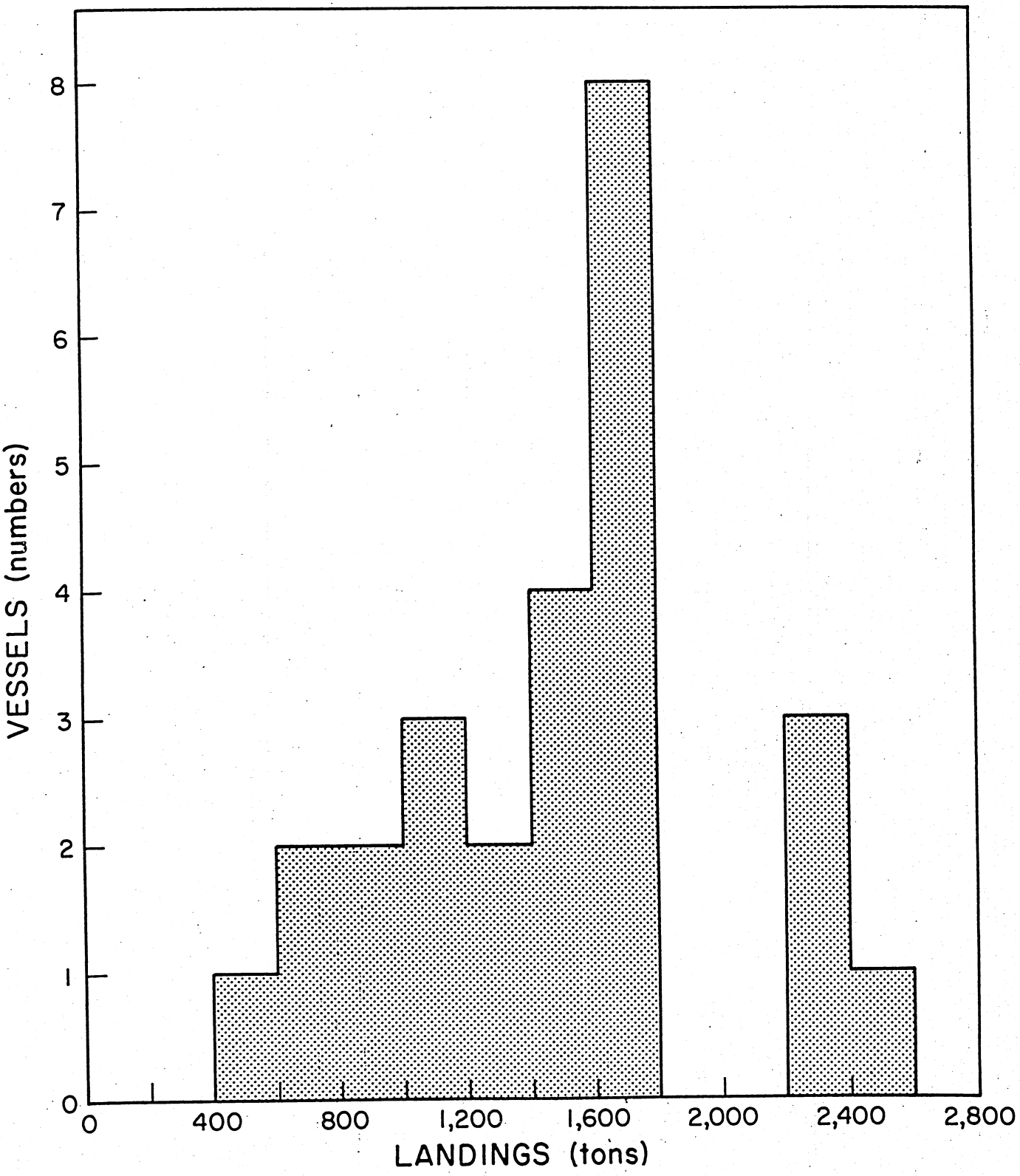

Figure 5.--Frequency distribution of total landings per vessel for 1967 by San Pedro wetfish boats. This graph is based on unpublished landings data furnished by the California Department of Fish and Game.

Table 8.--Productivity of San Pedro wetfish boat fleet

Year	Average landings per vessel	Average revenue per vessel	Total revenue of fleet
	Tons	Dollars	Dollars
1963	1,473	73,000	2,697,000
1964	1,366	73,000	2,549,000
1965	872	57,000	2,048,000
1966	1,184	70,000	2,375,000
1967	1,461	78,000	2,191,000

Note: These figures are based on unpublished data on landings furnished by the California Department of Fish and Game and on the price data in Table 3.

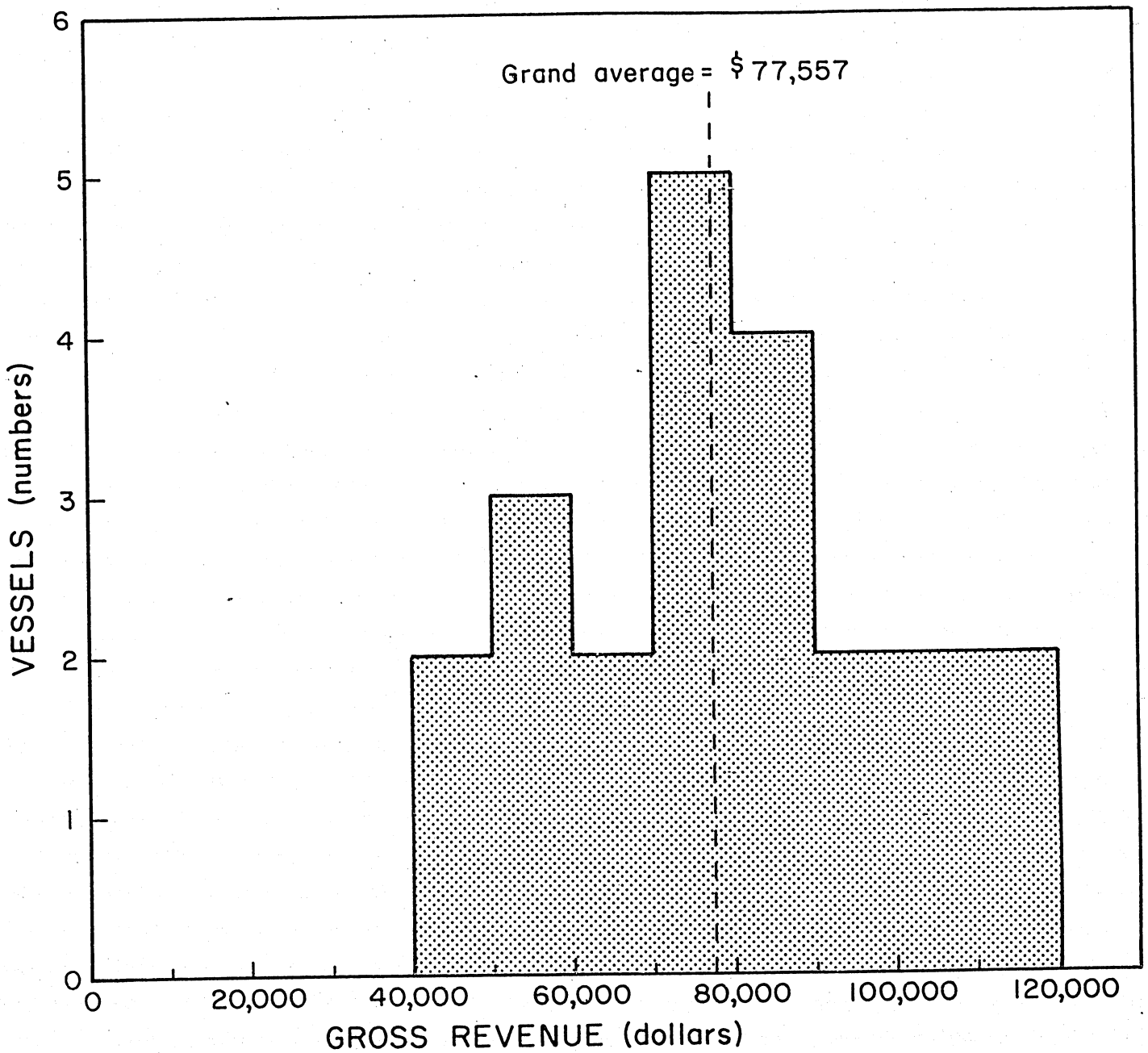

Figure 6.-- Frequency distribution of average annual gross revenue per vessel from 1963 to 1967. The graph is based on settlement data.

these adjustments, the average values of gross profit (before taxes) for the whole fleet ranged from 5,100 dollars per vessel in 1963, to 10,726 dollars in 1966, as shown in Table 9A. While some of the vessels showed losses as the end result of their operations, the majority closed the year with profit. Out of 65 vessel-years analyzed, 51 (or 78.5 percent of them) were profitable.

The two subgroups of vessels from Table 9A are further characterized by the range of profits or losses in each year and by the quartile values of profits. Table 9B shows the range of profits, and Table 9C shows the range of losses. In general, the median values (Q_2) are lower than are the mean values shown in Table 9A.

A regression of profit on gross revenue (Figure 7) shows that the breakeven point for a vessel in the fleet in 1967 was about 70,000 dollars gross revenue, In that year, gross revenue ranged to over 150,000 dollars.

B. Capital Structure and Return on Investment

The 1967 balance sheets for 15 vessels showed total assets of 476,700 dollars, or 31,780 dollars per vessel. The assets for individual vessels ranged from 4,679 dollars to 63,844 dollars. On the average, 82.8 percent of the total assets were made up of fixed assets--that is, of the depreciated value of the vessels and equipment. Current assets (cash in the bank, accounts receivable, and other) formed the remaining 17.2 percent of the total assets.

Table 9A.--Average values of gross revenue and profit (or loss) per vessel, 1963 to 1967

Year	Data for:								
	All vessels			Profitable vessels			Nonprofitable vessels		
	Vessels	Gross revenue	Profit before taxes	Vessels	Gross revenue	Profit before taxes	Vessels	Gross revenue	Profit before taxes
	Number	Dollars	Dollars	Number	Dollars	Dollars	Number	Dollars	Dollars
1963	12	77,770	5,100	9	84,893	7,706	3	56,400	-2,719
1964	12	76,072	7,600	11	77,710	8,504	1	58,058	-2,355
1965	12	76,847	5,660	10	82,671	7,191	2	47,726	-1,992
1966	14	98,105	10,726	12	103,950	13,329	2	63,034	-4,888
1967	15	78,110	5,104	9	91,113	10,577	6	58,604	-3,106

Note: These figures are based on data from profit and loss statements.

Table 9B.--Range of profits on profitable vessels, 1963 to 1967

Year	Range of profits
	Dollars
1963	1,416 to 14,570
1964	1,453 to 27,568
1965	2,291 to 17,641
1966	1,869 to 39,558
1967	1,366 to 33,741

Table 9C.--Range of losses on unprofitable vessels, 1963 to 1967

Year	Range of losses
	Dollars
1963	803 to 3,737
1965	1,072 to 2,912
1966	415 to 9,361
1967	210 to 6,524

Note: In 1964, only one vessel closed the year with a loss.

Table 9D. --Quartile values of profits, 1963 to 1967

Year	Profits in quartile:		
	Q_1	Q_2	Q_3
	Dollars	Dollars	Dollars
1963	6,256	7,067	10,551
1964	2,180	6,708	11,534
1965	2,712	4,894	12,310
1966	3,971	8,249	31,159
1967	2,281	5,248	18,341

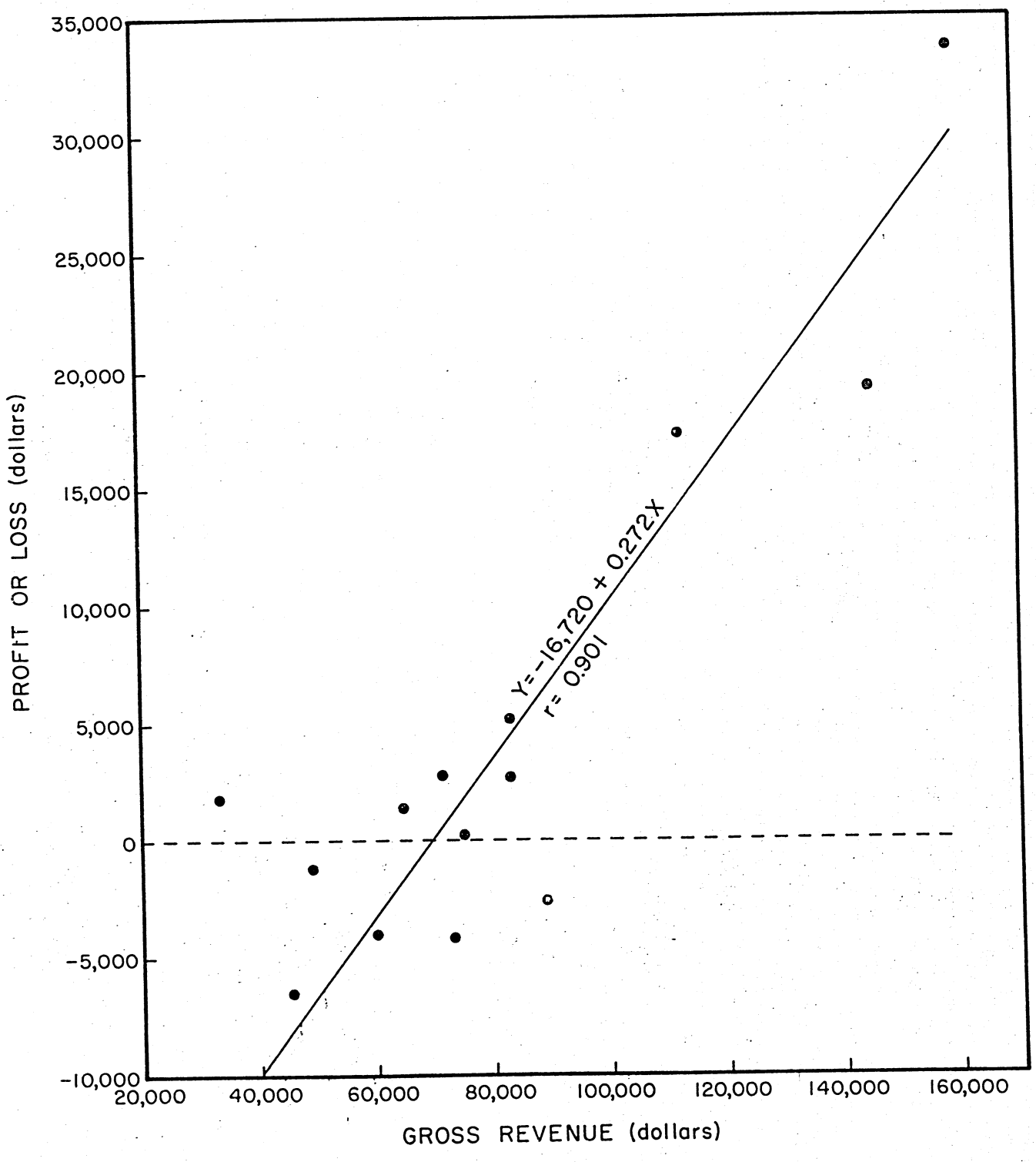

Figure 7.--Relationship between profit or loss and gross revenue for 14 San Pedro wetfish boats in 1967. This plot is based on profit and loss statements.

The average market value of these vessels as estimated by the Office of Assessor, County of Los Angeles, was about 41,000 dollars--that is, it was about 1-1/2 times the book value.

Table 10A shows the sources from which the total assets were financed.

This capital structure reflects rather unfavorable financial conditions in the fleet as a whole. The low amount of quick assets (which in this case is equivalent to current assets) relative to current liabilities, as indicated by a ratio of approximately 0.5:1, might be a reason for banks to refuse loans. While a sizable part of total assets (27.4 percent) was financed by stockholders in form of notes and loans, 51 percent of all notes and long-term liabilities (i.e. over 171,000 dollars) came from canneries, which are recipient of fish landed by this fleet. Needless to say, this financial dependence on canneries puts the vessel owners in a disadvantageous position when prices for fish are negotiated.

The low level of equity capital for the whole group (average 15.1 percent) is effected by six corporations, which show a deficit from 5,000 dollars to 36,000 dollars (average 13,500 dollars). Table 10B shows the capital sturcture for the remaining nine companies.

In this group of nine vessels current liabilities exceeded current assets by about 2,500 dollars per vessel, indicating a need for working capital. The average equity capital for a vessel in this group was 17,500 dollars, while fixed assets showed

10A

Table A.--Sources from which the total assets of wetfish boats were financed in 1967

Sources	Amount relative to the total amount	
	Percent	Percent
Accounts payable	14.32	
Notes payable	8.25	
Notes from stockholders	8.99	
Total current liabilities		31.56
Mortgages and long-term loans	34.93	
Loans from stockholders	18.40	
Total long-term liabilities		53.33
Capital stock plus accumulated earnings		15.11
Total liabilities and capital = assets		100.00

Table 10B.--Sources from which assets of nine of the stronger corporations were financed

Sources	Amount relative to the total amount	
	Percent	Percent
Accounts payable	12.06	
Notes payable	9.38	
Total current liabilities		21.44
Mortgages and long-term loans	22.20	
Loans from stockholders	11.36	
Total long-term liabilities		33.56
Capital stock plus accumulated earnings		45.00
Total liabilities and capital		100.00

a value of 34,200 dollars per vessel. The average profit of 8,300 dollars per vessel indicates the following rates of return on investment:

47.4 percent - when related to equity capital,

24.3 percent - when related to fixed assets.

It should be pointed out that the high rate of return on equity capital (47.4 percent) is artificially inflated by abnormal financing practices for these vessels. It was observed that a major part of profits is being drawn each year by the corporation's officers in the form of salaries or bonuses. This action leaves the corporations with low equity capital and with no working capital (see previous section).

For a group of five vessels, with equity capital ranging from 18,355 dollars to 37,970 dollars, the return on investment was 13.3 percent. The median value for this group, 28,162 dollars will be used below for predicting the return on investment for old vessels. An actual anticipated value for equity capital should be substituted by a prospective vessel operator.

C. Crew Earnings

We calculated the individual crew share for each settlement by dividing the crew share of net proceeds (gross revenue minus trip expenses) by the average number of crewmen (to the nearest whole man) on the vessel during the period covered by the settlement.

1. Fleet Averages from 1963 to 1967

We calculated the average crewman's earnings in the fleet for each year by multiplying the average individual crew share per settlement (above) by the average number of settlements per vessel during the year (Table 11). The average crew earnings did not increase during the period, but the real earnings (actual earnings adjusted by consumer price index) decreased 9.2 percent during the period.

2. Vessel Variation in Crew Earnings

The average crewman's annual earnings for each vessel during 1963 through the first quarter of 1968 were calculated in the same manner described earlier and are presented in Table 12. In accordance with the wishes of the vessel owners, the estimates are not identified as to vessel. Figure 8 presents the frequency distribution of the estimates in 500 dollar intervals. The variation in crew earnings has two major components--namely, (1) the variation in the crewman's share per settlement and (2) the variation in the number of settlements per year. The latter variation is not amenable to analysis, because it is determined (1) by different response to labor disputes by management, (2) by different tie-up periods for gear and vessel modification and repairs, and (3) by different fishing success, but the factors affecting crewman's share per settlement, the other source of variation, are examined later in the section concerned with predicting earnings.

D. Employment

The size of crew on the vessels (Table 13) as well as the number of vessels in the fleet decreased during 1963 to 1967. The combined effect of these two factors

Table 11.--Average crewman's earnings in San Pedro wetfish boat fleet, 1963 to 1968

Year	Average crewman's share per settlement	Average settlements per vessel	Average crewman's earnings per year	Average crewman's real earnings for year	Sample size	
					Settlements	Vessels
	Dollars	Number	Dollars	Dollars	Number	Number
1963	438	9.44	4134	4134	168	18
1964	440	9.11	4008	3953	159	18
1965	445	8.22	3658	3551	171	21
1966	493	8.90	4388	4140	191	22
1967	480	8.52	4090	3752	177	22
1968 (1st $\frac{1}{4}$)	324	2.36	--	--	50	22

Note 1: The average crewman's earnings per year includes nontaxable provisions, which averaged $585 per crewman in 1967.

Note 2: The average crewman's real earnings for the year was adjusted to the 1963 level with consumer price index (Long, 1969).

Table 12.--Average crewman's earnings for San Pedro wetfish boats, 1963 to 1968 (1st ¼)

Vessel Number	Average crewman's share per settlement	Average settlements per year	Average crewman's earnings for year
	Dollars	Number	Dollars
1	353	6.29	2,219
2	358	6.67	2,387
3	292	9.53	2,781
4	322	10.48	3,374
5	352	9.67	3,402
6	366	9.53	3,486
7	414	8.57	3,549
8	400	8.95	3,582
9	359	10.29	3,692
10	420	8.95	3,761
11	392	9.72	3,809
12	467	8.57	4,004
13	472	8.57	4,047
14	467	8.76	4,171
15	457	9.14	4,179
16	537	8.57	4,601
17	486	9.91	4,814
18	534	9.53	5,086
19	582	8.95	5,211
20	580	10.27	5,957
21	735	8.95	6,581
22	591	11.36	6,716
Grand average	453	9.15	4,164

Note: These figures are based on settlement data. For vessels entering the sample after 1963, the crewman's earnings for the year was adjusted to the 1963 level with the consumer price index (Long, 1969).

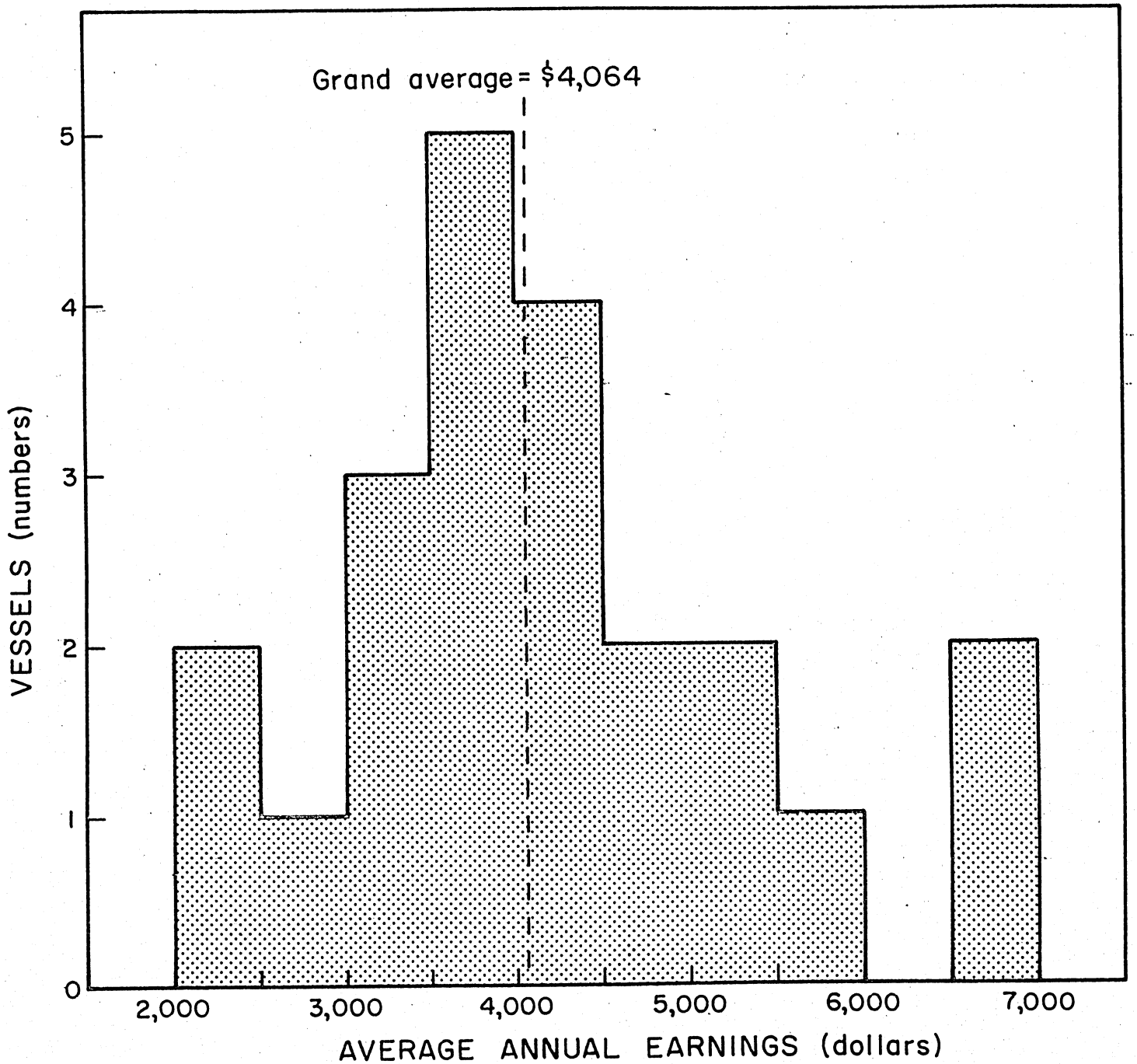

Figure 8.--Frequency distribution of crewman's average annual earnings, 1963 to 1967. The graph is based on settlement data.

Table 13.--Average size of crew in the San Pedro wetfish-boat fleet, 1963 to 1968

Year	Men in crew
	Number
1963	10.29
1964	10.28
1965	9.94
1966	9.65
1967	9.74
1968 (1st ¼)	9.52

Note: These figures are based on settlement data.

was a 30-percent decrease in the number of fulltime jobs (Figure 9) from about 381 jobs in 1963 to 238 jobs in 1968. These estimated totals do not include employment in other phases of the wetfish industry such as processing, maintenance of vessels, and supply.

II. COSTS AND EARNINGS MODEL

Having looked into the financial condition of the fleet, we turn now to our second topic--namely, our costs and earnings model. In so doing, we first analyze costs and then predict earnings.

A. Analysis of Costs

Average total costs per vessel (operating costs or "trip expense" and owner's costs; crew's share not deducted) reached a high in 1966 (Table 14) and then decreased in 1967. The ratio of costs to value (total costs divided by the value of the catch) increased to a high in 1965 and then decreased coincidentally with the advent of the anchovy fishery to below the 1963 level.

Operating costs and owner's costs are discussed separately in the following section, and a submodel is developed for each cost category.

1. Operating Costs

Operating costs or "trip expenses" (described under Share-out procedures above) are shared by the owner and the crew. Two major items are the cost of fuel and of airplane spotting services. The price of diesel fuel in 1968 was 14.5 cents per gallon. When airplane spotting is used, 5 percent of the value of the catch

Table 14.--Average/costs per vessel (operating costs + owner's costs exclusive of the payments to the crew on "crew's share") for San Pedro wetfish boats--1963 to 1967

Year	Total costs	Ratio of cost to value of catch
	Dollars	
1963	31,547	0.432
1964	31,549	0.432
1965	31,022	0.544
1966	37,394	0.534
1967	32,882	0.422

Note: These figures are based on settlement data and annual financial data.

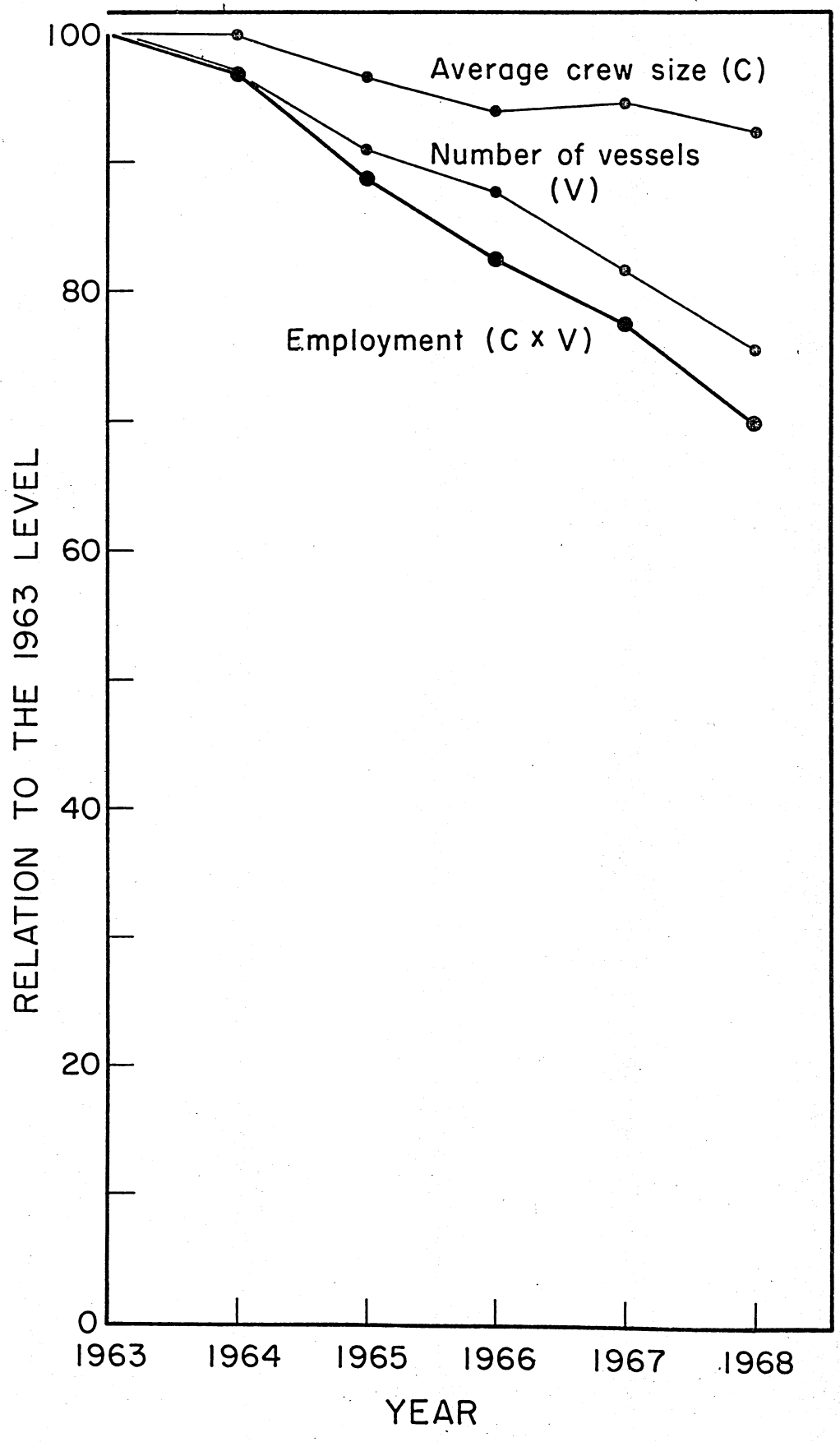

Figure 9. --Combined effect of decreasing size of fleet and decreasing size of crew on employment in the San Pedro wetfish boat fleet, 1963 to 1968.

goes to the spotter. Welfare and other fund contributions are calculated as a percentage of gross revenue or as a charge per ton of fish landed. Other costs are related to the time spent at sea and to the size of the main engine. Still others include expenses that are incurred sporadically and that have no relation either to the time spent at sea or to the proceeds from fishing.

Average operating costs per vessel remained almost constant during 1963 to 1967 (Table 15). Costs per pound of fish landed increased to a high in 1965 and then decreased when anchovies entered the landings.

The multi-species makeup of the catch of the San Pedro wetfish fleet demands that operating costs be examined for varying compositions of catch. This requirement becomes even more important when we recognize that a future expanded wetfish fleet will perhaps have to depend more on low-priced fish--that is, on anchovies--and less on high-priced fish--that is, on tuna--than does the present fleet. Because two or more species are usually landed by each vessel during any given settlement period, operating costs could not be related directly to species. A multiple regression analysis based on monthly settlement data for 1967, however, indicated that a significant linear correlation exists between the amount of operating expenses (dependent variable), and landings of mackerel, tuna, bonito, and anchovies (independent variables). The regression is of the form:

$$\hat{Y} = 914 + 0.00103X_1 + 0.00519X_2 + 0.00399X_3 + 0.00038X_4$$

where $\hat{Y}$ = operating costs, in dollars

X_1 = pounds of mackerel (jack and Pacific) landed

Table 15.--Average operating costs per vessel and per pound of fish landed by the San Pedro wetfish-boat fleet

Year	Operating costs	
	Dollars	Cents per pound of fish landed
1963	10,317	0.363
1964	10,597	0.378
1965	9,990	0.499
1966	10,341	0.412
1967	10,027	0.396

Note: These figures are based on settlement data.

X_2 = pounds of tuna (bluefin, albacore, and skipjack) landed

X_3 = pounds of bonito landed

X_4 = pounds of anchovies landed

(t_b, in order, = 4.63, 3.33, 11.91, 3.78; $p < 0.001$, $R^2 = 0.75$).

The differences in operating costs coefficients between species reflect species differences in schooling behavior and in geographical distribution. Tuna are caught a few tons at a time, but a vessel may be loaded with anchovies in two sets of the net. Jack mackerel are often fished 50 to 100 miles offshore, but anchovies are fished usually within 10 miles of port.

A statistically significant and positive relation was found between operating costs and the horsepower of the main engine (in the range of 150 to 335 horsepower), but the maximum effect onpredicted costs at 150,000 dollars gross revenue for the present fleet was only 132 dollars; consequently, the variable was dropped from the equation. Capacity of the vessel was found to be of low significance ($t_b = 1.67$), therefore that variable was also dropped from the regression.

Figure 10 shows the fit of predicted annual operating costs to actual operating costs for 15 vessels in 1967. To obtain the annual estimates, we multiplied the Y-intercept of the regression equation times the number of settlements made during 1967 and multiplied the coefficients time the landings of the four species.[3]

---

[3]The landings data were furnished by the California Department of Fish and Game.

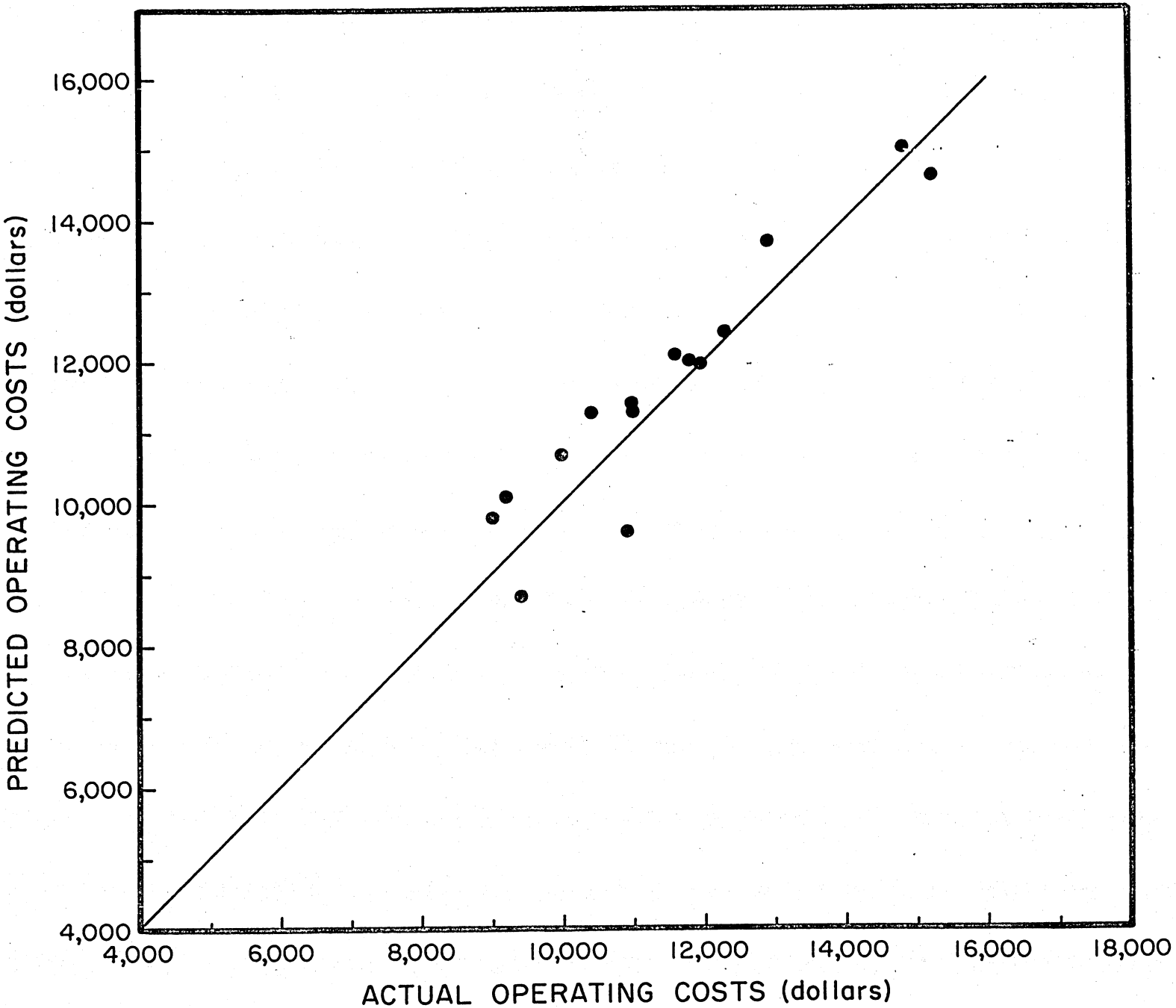

Figure 10.--Fit of operating costs model to actual operating costs. The line is a 45° (slope = 1, correlation coefficient = 1) along which the points would lie if the model were a perfect fit.

Using the levels of the prices of fish in 1967, we can rewrite the operating costs relation in terms of cost per dollars worth of fish landed annually:

$$\hat{Y} = 8,052 + 0.0275X_1 + 0.0419X_2 + 0.0939X_3 + 0.0380X_4 \qquad \text{(Equation 1)}$$

where $\hat{Y}$ = predicted annual operati ıg costs, in dollars

X_1 = value of mackerel landings, in dollars

X_2 = value of tuna landings, in dollars

X_3 = value of bonito landings, in dollars

X_4 = value of anchovy landings, in dollars

We obtained the value 8,052 dollars by multiplying the Y-intercept for the monthly operations cost regression times 8.81, the average number of settlements per year for the fleet during 1963 to 1967. If no strikes, lay-ups for repairs, or very slack fishing months are anticipated, the value 10,968 dollars (12 months multiplied by 914 dollars per month, the Y-intercept for the monthly operating costs regression) should be used as the constant. According to this relation, the maximum predicted effect of species composition of landings on annual operating costs at a gross-revenue level of 150,000 dollars (arbitrarily chosen) is the difference between the predicted cost for an all-mackerel catch and that for an all-bonito catch, or 9,960 dollars.

2. Owner Costs

Owner costs are those costs that are deducted from the owner's share of the net proceeds and are categorized here under (a) parts and repairs, (b) netting and supplies, (c) insurance, (d) payroll taxes, (e) interest on loan, (f) moorage, (g) State and county taxes, (h) depreciation, and (i) a miscellaneous category "office expenses and other costs."

Table 16 presents average values for these costs for the fleet for each year from 1963 to 1967. New engines and anchovy nets were purchased for many of the vessels in 1966, which accounts for the high values for that year. As a measure of dispersion, the coefficient of variation is included. Methods of estimating owner costs are outlined below. Where appropriate, different means of estimation are used for predicting costs for existing vessels of the type now in the fleet and for hypothetical newly constructed vessels.

a. Parts and repairs.--Included in parts and repairs are expenditures for repairs and maintenance, including parts, of the vessel, the seine skiff, and the gear exclusive of the net. Labor for repairs to the net is furnished by the crew, and the cost of webbing is included under "Netting and supplies."

(1) Existing vessels.--The vessels are put into drydock once a year on a regular basis for maintenance and insurance inspection. No relation was found between size of vessel, or capacity, and cost of repairs. The great variation in cost of repairs for vessels of similar size is explainable by two factors pointed out

Table 16.--Average annual owners costs per vessel, 1963 to 1967.

Source of cost	Costs in:						Coefficient of variation
	1963	1964	1965	1966	1967	1963-1967	
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Percent
1. Parts and repairs	4,664	5,118	4,167	5,398	4,891	4,855	45.6
2. Netting and supplies	3,158	2,007	2,720	3,842	2,456	2,847	63.1
3. Insurance	4,472	4,261	4,827	4,971	4,692	4,645	24.8
4. Payroll taxes	2,954	2,923	2,996	4,329	3,246	3,270	29.7
5. Interest on loan	463	251	436	790	420	504	121.6
6. Moorage	513	438	464	431	438	465	30.5
7. State and county taxes	773	666	607	614	750	688	41.0
8. Depreciation	2,614	3,004	3,075	4,496	4,410	3,604	61.3
9. Office expenses and other costs	1,619	2,284	1,740	2,182	1,552	1,873	47.6
Total	21,230	20,952	21,032	27,053	22,855	22,751	19.4

Note: These data were derived from statements of profit and loss.

by Green and Broadhead (1965) in their study of costs and earnings of tuna seiners. Some owners, especially those of vessels that do relatively poorly on the fishing grounds, habitually postpone upkeep and renovation, and they make only those repairs that are absolutely needed to keep the vessel in operation. Also, some owners with mechanical skills may take care of many of the repairs themselves and may thereby save on labor costs.

A significant relation was found between owner's share in net proceeds and repair costs, perhaps a reflection of the factors mentioned above. The estimating equation is of the form:

$$\hat{Y} = 24 + 0.0787X_2 + 0.0552X_3 \qquad \text{(Equation 2)}$$

where $\hat{Y}$ = the costs of repairs in Year t, in dollars

X_2 = the owner's share in the net proceeds in Year t, in dollars

X_3 = the owner's share in the net proceeds in Year (t - 1), in dollars

(t_b, in order, = 3.92, 2.36; F = 18.96 with (2, 41)DF; R^2 = 0.48).

(2) New vessels.--Presumably, owners of new seiners will possess adequate working capital and will want to keep their vessels in top condition. We therefore used comparable data on new steel shrimp trawlers, based in ports on the Gulf of Mexico, to estimate the maintenance and repair costs of new wetfish seiners. The sample consisted of 17 shrimp vessels, ranging from 61 to 85 feet registered length (the average was 72 feet). The actual costs for 1967 or 1968 were increased by 20 percent, to account for possible additional maintenance costs on wetfish seiners (such as for power block and refrigeration).

The estimating equation is of the form:

$$\hat{Y} = -17,619 + 341.15X \qquad \text{(Equation 3)}$$

where $\hat{Y}$ = the maintenance and repair costs, in dollars

X = the registered length of the vessel, in feet;

($t_b = 3.12$, $p < 0.01$, $r^2 = 0.39$)

b. Netting and supplies.--Netting and supplies include expenditures for net webbing, seine cables, line, hardware, tools, and miscellaneous supply items. Seine cables are replaced about once a year, at a cost of about 500 dollars. Worn webbing is replaced every other year on a routine basis, also at a cost of about 500 dollars, in addition to that replaced to repair the net when it is torn.

A linear correlation was found between these costs and the quantity of fish landed. The least squares regression based on data for 1967 is of the following form:

$$\hat{Y} = -240 + 2X \qquad \text{(Equation 4)}$$

where $\hat{Y}$ = costs in dollars

X = tons of fish landed;

($t_b = 3.77$, $p < 0.005$, $r^2 = 0.53$).

This regression indicates that the costs of nets and supplies increase by 2 dollars per ton of fish caught. The addition of the owner's share in proceeds, as a second possible variable in the regression, is not significant statistically.

c. Insurance.--Insurance is a major expense. Three types of coverage are carried by all boat owners. Hull and machinery insurance covers total loss of the vessel as well as damage caused by fire, stranding, and collision, with a usual deductible amount of 500 dollars per accident. The amount of the insurance is in the amount of the market value of the vessel. The seine skiff is covered under this insurance. Net insurance covers full value of the net (depreciated straight line over 5 years, with renovation added to the value) against loss or damage, with a 500 dollar deductible amount for fire only. Protection and indemnity insurance covers illness and injuries of crew members and a broad range of possible liability to other parties. The usual practice is to insure to 100,000 dollars for a single claim, with a 1,000 dollar deductible amount for property liability. Premiums are based on a complex formula that varies with the insurance company and that has to do with such factors as size of crew, age of vessel, and size of vessel. The premiums are about 2,000 dollars per year for a vessel with a crew of 10.

(1) Existing vessels.--Analysis of costs categorized under "insurance" in the financial reports examined in the present study revealed a variability too great to allow us to estimate insurance costs empirically. This variation is due to differences in coverage and in premium-payment schedules. For purposes of cost prediction, hull and machinery premiums were computed at 6.75 percent of the market value, net insurance premiums were computed at 5 percent of the value

of the nets, and protection and liability premiums were computed at 200 dollars per crewman. In 1968, these premiums provided the coverage described above. Values of vessels and nets are discussed below in the section ondepreciation (h).

The equation for insurance costs for existing vessels is as follows:

$$\hat{Y} = 0.0675X_1 + 0.0500X_2 + 200X_3 \qquad \text{(Equation 5)}$$

where $\hat{Y}$ = the estimated insurance costs

X_1 = the market value of the vessel, in dollars

X_2 = the market value of the nets, in dollars

X_3 = the maximum size of the crew.

(2) New vessels.--For new vessels, the cost of hull and machinery insurance is lower than for old vessels. The estimating equation therefore becomes:

$$\hat{Y} = 0.0375X_1 + 0.0500X_2 + 200X_3 \qquad \text{(Equation 6)}$$

where $\hat{Y}$ = the estimated insurance costs

X_1 = the market value of the vessel, in dollars

X_2 = the market value of the nets, in dollars

X_3 = the maximum size of the crew.

d. Payroll taxes.--Social Security taxes are computed as a percentage of a maximum annual amount of wages for each crew member. If the membership of the crew changes during the year, the taxes paid by the owner are higher than during a year in which the crew is stable. The following least-squares regression accounts for 77 percent of the variance for 58 observations:

$$\hat{Y} = 1,073 + 0.057X \qquad \text{(Equation 7)}$$

where Y = estimated annual payroll taxes, in dollars

X = annual crew wages, in dollars;

($t_b = 13.72$, $p < 0.001$, $r^2 = 0.77$).

e. Interest on loans.--The amounts paid by various corporations for interest on loans range from a few dollars to more than 2,000 dollars in a given year. The dispersion of payments by any corporation over the years is also very high. In many profit-and-loss statements, no interest payments are shown, although a substantial loan is indicated in the balance sheet. The amounts shown in Table 2 therefore may not reflect the real situation. The grand average value (504 dollars) will be used below for predicting costs for old vessels; but, for the purpose of estimation for new vessels, the interest cost should be calculated from assumed loans. The rate used for predicting purposes below is 7.5 percent.

f. Moorage.--The moorage fee is computed by the Harbor Department on the basis of the length and of the type vessel. Out of 22 vessels analyzed, 16 (50 to 79 feet long, 60-tons to 110-tons capacity) paid 450 dollars per year, and 6 (80 feet and over, 110-tons to 150-tons capacity) paid 540 dollars per year.

g. State and county taxes.--In 1968, the California State income tax rate for corporations was 7 percent, with a minimum of 100 dollars. This rate is used for predicting purposes below. The companies, being small corporations, pay no Federal corporate income tax. Taxable income is reported in the personal returns of the shareholders.

The modal value for county property taxes was about 450 dollars. Under a new law (effective 1968), commercial fishing vessels registered in Los Angeles County are assessed at 1 percent of their market value. The current tax rate is about 10 dollars per hundred dollars assessed valuation, making the effective tax rate about 0.1 percent of market value per year.

In terms of an equation:

$$\hat{Y} = 0.001X_1 + 0.07X_2 \qquad \text{(Equation 8)}$$

where $\hat{Y}$ = the estimated county and state taxes, in dollars

X_1 = the market value of the vessel, in dollars

X_2 = the taxable income during previous year, in dollars.

$0.07X_2$ $100

h. Depreciation.--Considered here is the depreciation both for vessels and for nets.

(1) Existing vessels.--The straight-line method and the declining-balance method of computing depreciation are alternatively applied to the various component parts of the vessels (for example, vessel, engine, and skiff) and equipment (for example, power block, electronics, and netting). The vessels are old (all are more than 20 years old, and about half of the fleet is more than 30 years old), which explains why the cost of depreciation is rather low on the average (Table 16). The vessels ranged in 1968 from 25,000 dollars to 60,000 dollars in market value, the average value being 41,530 dollars and the modal value being 45,000 dollars. (Note: The modal value is used below for predicting insurance

costs for existing vessels in sample calculations.) The depreciation claimed in 1967 does not show a significant linear relation with market value, the reason being that most of the depreciation claimed is on the items of nets, skiffs, electronics, refrigeration, and other vessel improvements, which retain a high market value beyond the span of their short book lives. The grand average value of depreciation for 1963-1967 (Table 16) is used below for predicting purposes.

(2) New vessels.--Depreciation is estimated for new vessels and skiffs at straight line for 15 years of 85 percent of the unsubsidized portion of new construction costs. Table 17 contains estimated costs of new-vessel construction for 12 steel vessels of various lengths, capacities, and horsepower. The total cost of a new net is depreciated straight line over 5 years. A new seine costs about 12,000 dollars. Most vessel operators own two seines--one for mackerel and one with a smaller mesh for anchovies. In equation form:

$$\hat{Y} = 0.057X_1 + 0.2X_2 \qquad \text{(Equation 9)}$$

where $\hat{Y}$ = estimated depreciation, n dollars

X_1 = value of vessel and gear exclusive of nets, in dollars

(for 1st year, = 85 percent of new construction cost of full amount of unsubsidized cost for subsidized vessel)

X_2 = value of nets, in dollars.

Table 17.--Estimated costs of new vessel construction (steel)

Vessel data										Skiff data			
Vessel number	Length	Bean	Depth	Fish capacity	Size of motor	Speed		Cost	Remarks	Length	Beam	Size of motor	Cost
						light	loaded						
	Feet	Feet	Feet	Short tons	Horse-power	Knots	Knots	Dollars		Feet	Feet	Horse-power	Dollars
1	54.0	16.5	8.0	61	160	9.5-9.8	8.5	120,000	Combination boat. In 1959 cost $80,000 for basic boat, $110,000 fully-equipped for seining and trawling.	16	8	60	8,000
2	58.0	18.0	9.0	66	240	10.2	-	140,000	Seiner.	16-17	9	-	9,000
3	58.0	-	-	60	-	-	-	160,000	Seiner.	-	-	-	-
4	60.0	20.0	-	60	275	10.5	-	140,000	Combination boat.	-	-	-	-
5	66.0	19.5	9.5	110	260	10.2	8.5-9.0	160,000-180,000	Combination boat. In 1968 it cost 230,000 dollars as a fully-equipped crab boat.	20	10	100	11,000
6	70.0	22.0	-	110	365	11.0	-	285,000	Combination boat.	-	-	-	-
7	70.0	-	-	120	-	-	-	200,000	Seiner.	-	-	-	-
8	73.0	21.9	10.5	154	350	10.0-10.5	9.0-9.5	18,000-200,000	Combination boat.	22	-	100	14,000
9	80.0	24.0	-	135	510	12.0	-	400,000	Combination boat.	-	-	-	-
10	80.0	-	-	175	-	-	-	260,000	Seiner.	-	-	-	-
11	83.0	24.0	11.5	210	350-400	11.0	9.5	220,000-240,000	Combination boat. Spray refrigerator would cost about $25,000 more.	22	-	100	14,000
12	90.0	25.0	12.0	264	560	11.5-12.0	10.5	280,000-300,000	Combination boat. In 1968 it cost 350,000 dollars as a crab boat--450,000 dollars as a completely equipped combination boat for trawling, seining, crabbing, scalloping, or salmon hauling, and 400,000 dollars for a crabbing-scalloping combination.	24	12	100	15,000

Note 1: The data on cost is for a vessel fully equipped for seining, except for nets and skiffs; excludes refrigeration. The estimates were obtained in the fall of 1968.

Note 2: These figures are based on data furnished by vessel builders (see Acknowledgments).

i. Office expenses and other costs.--Table 18 shows the main components of office expenses and other costs.

The remainder of these costs consists of items such as licenses, legal fees, promotion expenses, telephone, donations, and "miscellaneous." For predicting purpose below, the average figure of 1,873 dollars for the fleet in 1967, is used.

B. Model for Prediction of Earnings

Now that we have an analysis of costs, we can construct our model for the prediction of earnings. In so doing, we consider first the prediction of revenue and then the prediction of the aspects of earnings that depend on revenue--namely, profits, return on investment, and crew earnings.

1. Revenue

Predicting revenue turned out to be difficult--in fact, impossible at present. In this section, we described the problem and then how we handled it.

a. Problem of predicting earnings.--Revenue proved difficult to predict because little relation was found in the present study between landings or gross revenue and vessel characteristics such as length, capacity, horsepower of the main engine, or age. Three possible causes of this lack of observed relation are (1) the nature of the fishery, (2) an over-riding factor of skill, and (3) insufficient data.

Table 18.--Office expense and other costs

Item	Cost
	Dollars
Accounting	450 to 500
Automobile	400 to 500
Dues	200 to 300

(1) Nature of the fishery.--The vessels are seldom loaded to capacity (the usual load of mackerel is 10 to 50 tons), making differential capacity of minor importance. The exception to this underloading of the vessel occurs in the anchovy fishery, in which the vessels are loaded to capacity on most trips. Because the fishing grounds are within a few hours run from the harbor at most and, in some places, only a few minutes run, the importance of differential horsepower is minimized. Also, the catches of some species are subject to limits set by processors.

(2) Over-riding skill factor.--Setting a purse seine around a school of fish requires great skill. Schooling behavior varies widely from species to species and even from one school to another within a particular species, and empty hauls ("skunk sets") are common. Differences in the fishing ability of vessel captains may therefore be the major source of variation in landings and revenue.

(3) Insufficient data.--Few data were available for the present study on fishing effort (days at sea, scouting time, and number of net sets) correlated with landings data. The staff of Marine Resources Operations of the California Department of Fish and Game, however, is presently collecting effort data for the fleet. When adjustments can eventually be made for differential fishing effort, we may find that differences in efficiency are correlated with vessel characteristics.

b. Solution to the problem of predicting earnings.--Because of the difficulty of predicting revenue, costs and earnings are predicted in the following section for arbitrary levels of revenue. The range of values used includes levels of revenue attained by vessels in the fleet in recent years (Figures 5 and 6).

2. Profit, Return on Investment, and Crew Earnings

Profit, return on investment, and crew earnings may be predicted for given levels of gross revenue by the use of the cost relations developed earlier. The details are given in the following subsection both for the older vessels of the type now in the fleet and for hypothetical new vessels.

a. Existing vessels.--In this section, we are concerned with sample calculations--that is, with showing the technique we used to calculate our predictions of profit, return on investment, and crew earnings. Table 19 is presented as a guide to illustrate the method used to estimate profit and return on investment. The following example, which is keyed to Table 19 by column numbers, illustrates the details of computation. Sources of the relations or values used in the computations are indicated in parentheses.

Given:	Vessel size	= 100 tons capacity
	Market value	= 45,000 dollars (modal value for fleet; actual market value should be substituted by the prospective vessel operator)
	Gross revenue	= 150,000 dollars
	Catch	= one-half mackerel and one-half anchovies, by value
	Nets	= one for anchovies and one for mackerel, at 12,000 dollars each.

Then:

Column in Table 19

1. Operating costs (by Equation 1) = 8,052 dollars + 0.0275 x value of mackerel landings + 0.0419 x value of tuna landings + 0.0939 x value of bonito landings + 0.0380 x value of anchovy landings =

Table 19. -- Sample calculations of predicted earnings for existing vessels, at gross revenue = $150,000 (continued)

Column 12	Column 13	Column 14	Column 15	Column 16	Column 17	Column 18	Column 19	Column 20	Column 21	Column 22	Column 23	Column 24	Column 25
Owner's share	Parts and repairs	Netting and supplies	Insurance	Payroll taxes	Interest on loans	Moorage	State and county taxes	Depreciation	Office expenses	Total owner's costs	Net profit	Equity capital investment	Return on investment
Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Percent
50,524	6,789	5,480	6,658	5,873	504	450	1,480	3,604	1,873	32,711	17,813	28,162	63.3
52,545	7,060	5,480	6,858	5,758	504	450	1,480	3,604	1,873	33,067	19,478	28,162	69.2
53,218	7,150	5,480	6,858	5,719	504	540	1,480	3,604	1,973	33,208	20,010	28,162	71.2
55,913	7,511	5,480	7,058	5,566	504	540	1,480	3,604	1,873	33,616	22,297	28,162	79.2
51,388	6,905	9,248	6,658	5,955	504	450	1,235	3,604	1,873	36,442	14,946	28,162	53.1
53,444	7,180	9,248	6,858	5,838	504	450	1,235	3,604	1,873	36,790	16,654	28,162	59.1
54,129	7,272	9,248	6,858	5,799	504	540	1,235	3,604	1,873	36,943	17,186	28,162	61.0
56,870	7,639	9,248	7,058	5,642	504	540	1,235	3,604	1,873	37,353	19,517	28,162	69.3
51,093	6,865	15,240	6,658	5,927	504	450	780	3,604	1,873	41,901	9,192	28,162	32.6
53,137	7,139	15,240	6,858	5,810	504	450	780	3,604	1,873	42,258	10,879	28,162	38.6
53,818	7,230	15,240	6,858	5,772	504	540	780	3,604	1,873	42,401	11,417	28,162	40.5
56,543	7,595	15,240	7,058	5,616	504	540	780	3,604	1,873	42,810	13,733	28,162	48.8

Table 19.--Sample calculations of predicted earnings for existing vessels, at gross revenue = $150,000

Catch composition by value	Vessel capacity	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9	Column 10	Column 11
		Operating cost	Mackerel	Tuna	Bonito	Anchovies	Total fish	Trips	Net proceeds	Proportionate crew share	Gross crew share	Individual crew share
	Tons	Dollars	Tons	Tons	Tons	Tons	Tons	Number	Dollars	Percent	Dollars	Dollars
Approximate composition of 1967 fleet landings (Figure 4), i.e., 50 percent mackerel, 10 percent tuna, 25 percent bonito, and 15 percent anchovies	70	15,270	994	60	441	1,125	2,620	38	134,730	62.5	84,206	8,421 to 9,356
	100	15,270	994	60	441	1,125	2,620	27	134,730	61.0	82,185	7,471 to 8,219
	120	15,270	994	60	441	1,125	2,620	22	134,730	60.5	81,512	7,410 to 8,151
	150	15,270	994	60	441	1,125	2,620	18	134,730	58.5	78,817	6,568 to 7,165
50 percent mackerel and 50 percent anchovies	70	12,965	994	0	0	3,750	4,744	68	137,035	62.5	85,647	8,565 to 9,516
	100	12,965	994	0	0	3,750	4,744	48	137,035	61.0	83,591	7,599 to 8,359
	120	12,965	994	0	0	3,750	4,744	40	137,035	60.5	82,906	7,537 to 8,291
	150	12,965	994	0	0	3,750	4,744	32	137,035	58.5	80,165	6,680 to 7,288
100 percent anchovies	70	13,752	0	0	0	7,500	7,500	108	136,248	62.5	85,155	8,516 to 9,462
	100	13,752	0	0	0	7,500	7,500	75	136,248	61.0	83,111	7,556 to 8,311
	120	13,752	0	0	0	7,500	7,500	63	136,248	60.5	82,430	7,494 to 7,971
	150	13,752	0	0	0	7,500	7,500	50	136,248	58.5	79,705	6,642 to 7,246

8,052 dollars + 0.0275 x 75,000 dollars + 0.0380 x 75,000 dollars = 12,965 dollars ---------- [1]

2. Tons of mackerel = value of mackerel landings ÷ price per ton (fron Table 3; the current price should be substituted by the prospective vessel operator) = 75,000 dollars ÷ 75.42 dollars per ton = 994 tons ---------- [2]

3. Tons of anchovies = the value of the anchovy landings ÷ the price per ton (from Table 3; the current price should be substituted by the prospective vessel operator) = 75,000 dollars ÷ 20 dollars per ton = 3,750 tons ---------- [5]

4. Total tons of fish = Column 2 + Column 3 + Column 4 + Column 5 = 4,744 tons ---------- [6]

5. Minimum number of trips, assuming a capacity load each trip = total tons (Column 6) ÷ capacity of vessel = 994 tons + 3,750 tons ÷ 100 tons = 48 trips (= about 1 trip per week) ---------- [7]

6. Net proceeds = gross revenue - operating costs (Column 1) = 150,000 dollars - 12,965 dollars = 137,035 dollars ---------- [8]

7. Percentage to crew (from Table 4) = 61 percent ---------- [9]

8. Gross crew share = percentage to crew (Column 9) x net proceeds (Column 8) ÷ 100 = 61 percent x 137,035 dollars ÷ 100 = 83,591 dollars ---------- [10]

9. Individual crew share = gross crew share (Column 10) ÷ size of crew (from Table 4) = 83, 591 dollars ÷ 11 or 10 = 7, 599 dollars to 8, 359 dollars per individual ---------- [11]

10. Owner's share = net proceeds (Column 8) - gross crew share (Column 10) = 137, 035 dollars - 83, 591 dollars = 53, 444 dollars ---------- [12]

11. Parts and repairs (using Equation 2) = 24 dollars + 0. 0787 x owner's share (Column 12) + 0. 0552 x owner's share in the preceding year (assumed here to be same as for the year 1969) = 24 dollars + 0. 0787 x 53, 444 dollars + 0. 0552 x 53, 444 dollars = 7, 180 dollars ---------- [13]

12. Netting and supplies (using Equation 4) = 240 dollars + 2 dollars per ton x tons of fish landed (Column 6) = 240 dollars + 2 dollars x 4, 744 = 9, 248 dollars ---------- [14]

13. Insurance (using Equation 5) = 0. 0675 x market value of vessel + 0. 05 x value of nets + 200 dollars per crew x maximum crew size (from Table 4) = 0. 0675 x 45, 000 dollars + 0. 0500 x 24, 000 dollars (assuming two new nets at 12, 000 dollars each) + 200 dollars x 11 = 6, 858 dollars ---------- [15]

14. Payroll taxes (using Equation 7) = 1, 073 dollars + 0. 057 x gross crew share of net proceeds (Column 10) = 1, 073 dollars + 0. 057 x 83, 591 dollars = 5, 838 dollars ---------- [16]

15. Interest on loans (using average value for 1967 from Table 16; the prospective vessel operator should substitute his actual estimate = 504 dollars ---------- [17]

16. Moorage (using average paid by vessels under 80 feet long, Moorage section) = 450 dollars ---------- [18]

17. State and county taxes (using Equation 8) = 0. 001 x market value of vessel + 0. 07 x previous year's profit (assumed here to by 17, 000 dollars) with the limitation that this term may not be less than 100 dollars; the prospective vessel operator should substitute 100 dollars as the state tax during his first year of operation; = 0. 001 x 45, 000 dollars + 0. 07 x 17, 000 dollars = 1, 235 dollars-- [19]

18. Depreciation (using average value for 1963-1967 from Table 16; the prospective vessel operator should substitute his actual estimate) = 3, 604 dollars ---------- [20]

19. Office expenses and other costs (using average value for 1967 from Table 16) = 1, 873 dollars ---------- [21]

20. Total owner's costs = parts and repairs (Column 13) + netting and supplies (Column 14) + insurance (Column 15) + payroll taxes (Column 16) + interest on loans (Column 17) + moorage (Column 18) + state and county taxes (Column 19) + depreciation (Column 20) + office expenses and other costs (Column 21 = 7,180 dollars + 9,248 dollars + 6,858 dollars + 5,838 dollars + 504 dollars + 450 dollars + 1,235 dollars + 3,604 dollars + 1,873 dollars = 36,790 dollars ---------- [22]

21. Net profit = owner's share (Column 12) - total owner's cost (Column 22) = 53,444 dollars - 36,790 dollars = 16,654 dollars ------- [23]

22. Equity capital investment (from Capital structure and return on investment section; the actual anticipated capital investment should be substituted by the prospective vessel operator) = 28,162 dollars ------ [24]

23. Return on investment = net profit (Column 23) ÷ capital investment (Column 24) = 16,654 dollars ÷ 28,162 dollars = 59.1 percent ---------- [25]

b. New vessels.--Before predicting profits and return on investment for new vessels, we must hypothesize a capital structure (Table 20).

Table 20. Capital structure for new vessel owners, under various levels of government vessel-construction subsidy.

Vessel type (from Table 16)	Capital structure under: No subsidy: Fixed capital: Vessel	Skiff	Refrigeration	Nets	Total	Working capital	Total capital	Borrowed capital	Net worth	40-percent subsidy: Fixed capital: Vessel	Nets	Total	Working capital
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
1	120,000	8,000	19,000	24,000	171,000	8,550	178,550	113,000	65,550	85,000	24,000	112,000	8,550
2	140,000	9,000	19,000	24,000	192,000	9,600	200,600	127,000	73,600	101,000	24,000	125,000	9,600
3	160,000	9,000	19,000	24,000	212,000	10,600	221,600	140,000	81,600	113,000	24,000	137,000	10,600
4	140,000	10,000	21,000	24,000	195,000	9,750	203,750	129,000	74,750	103,000	24,000	127,000	9,750
5	170,000	11,000	21,000	24,000	226,000	11,300	236,300	150,000	86,300	121,000	24,000	145,000	11,300
6	285,000	14,000	23,000	24,000	346,000	17,300	362,300	230,000	132,300	193,000	24,000	217,000	17,300
7	200,000	14,000	23,000	24,000	261,000	13,050	273,050	173,000	100,050	142,000	24,000	166,000	13,050
8	190,000	14,000	23,000	24,000	251,000	12,550	262,550	166,000	96,550	136,000	24,000	160,000	12,550
9	400,000	15,000	25,000	24,000	464,000	23,200	486,200	308,000	178,200	264,000	24,000	288,000	23,200
10	260,000	14,000	25,000	24,000	323,000	16,150	338,150	214,000	124,150	179,000	24,000	203,000	16,150
11	230,000	14,000	25,000	24,000	293,000	14,650	306,650	194,000	112,650	161,000	24,000	185,000	14,650
12	290,000	15,000	25,000	24,000	354,000	17,700	370,700	235,000	135,700	198,000	24,000	222,000	17,700

Note 1: The working capital consists of 5 percent of fixed capital.

Note 2: Borrowed capital consists of 66.6 percent of fixed capital.

Note 3: For subsidized vessels, the fixed capital in the vessel includes the skiff and the refrigeration.

Table 20. Capital structure for new vessel owners, under various levels of government vessel-construction subsidy (continued)

			50-percent subsidy:						
			Fixed capital						
Total capital	Borrowed capital	Net worth	Vessel	Nets	Total	Working capital	Total capital	Borrowed capital	Net worth
Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
120,550	75,000	45,550	73,500	24,000	97,500	8,550	106,050	65,000	41,050
134,600	83,000	51,600	84,000	24,000	108,000	9,600	117,600	72,000	45,600
147,600	91,000	56,600	94,000	24,000	118,000	10,600	128,600	79,000	49,600
136,750	85,000	51,750	86,000	24,000	110,000	9,750	119,750	73,000	46,750
156,300	97,000	59,300	101,000	24,000	125,000	11,300	136,300	83,000	53,300
234,300	145,000	89,300	161,000	24,000	185,000	17,300	202,300	123,000	79,300
179,050	111,000	68,050	118,000	24,000	142,000	13,050	155,050	95,000	60,050
172,550	107,000	65,550	114,000	24,000	138,000	12,550	150,550	92,000	58,550
311,200	192,000	119,200	220,000	24,000	244,000	23,200	267,200	163,000	104,200
219,150	135,000	84,150	150,000	24,000	174,000	16,150	190,150	116,000	74,150
199,650	123,000	76,650	135,000	24,000	159,000	14,650	173,650	106,000	67,650
239,700	148,000	91,700	165,000	24,000	189,000	17,700	206,700	126,000	80,700

Table 21.--Sample calculations of predicted earnings for new vessels, at gross revenue = $150,000 and with no construction subsidy

Catch composition by value	Vessel capacity	Column 1 Operating cost	Column 2 Mackerel	Column 3 Tuna	Column 4 Bonito	Column 5 Anchovies	Column 6 Total fish	Column 7 Trips	Column 8 Net proceeds	Column 9 Proportionate crew share	Column 10 Gross crew share	Column 11 Individual crew share
	Tons	Dollars	Tons	Tons	Tons	Tons	Tons	Number	Dollars	Percent	Dollars	Dollars
Approximate composition of 1967 fleet landings (Figure 4), i.e., 50 percent mackerel, 10 percent tuna, 25 percent bonito, and 15 percent anchovies	66	15,119	1,034	60	452	1,125	2,671	41	134,881	62.5	84,301	8,430 to 9,367
	110	15,119	1,034	60	452	1,125	2,671	25	134,881	60.5	81,603	7,418 to 8,160
	154	15,119	1,034	60	452	1,125	2,671	18	134,881	57.5	77,557	6,463 to 7,051
	210	15,119	1,034	60	452	1,125	2,671	13	134,881	57.5	77,557	6,463 to 7,051
	264	15,119	1,034	60	452	1,125	2,671	11	134,881	57.5	77,557	6,463 to 7,051
50 percent mackerel and 50 percent anchovies	66	12,964	1,034	0	0	3,750	4,784	73	137,036	62.5	85,647	8,565 to 9,516
	110	12,964	1,034	0	0	3,750	4,784	44	137,036	60.5	82,907	7,537 to 8,291
	154	12,964	1,034	0	0	3,750	4,784	31	137,036	57.5	78,796	6,566 to 7,163
	210	12,964	1,034	0	0	3,750	4,784	23	137,036	57.5	78,796	6,566 to 7,163
	264	12,964	1,034	0	0	3,750	4,784	19	137,036	57.5	78,796	6,566 to 7,163
100 percent anchovies	66	13,752	0	0	0	7,500	7,500	114	136,248	62.5	85,155	8,516 to 9,462
	110	13,752	0	0	0	7,500	7,500	69	136,248	60.5	82,430	7,494 to 8,243
	154	13,752	0	0	0	7,500	7,500	49	136,248	57.5	78,343	6,529 to 7,122
	210	13,752	0	0	0	7,500	7,500	36	136,248	57.5	78,343	6,529 to 7,122
	264	13,752	0	0	0	7,500	7,500	29	136,248	57.5	78,343	6,529 to 7,122

Table 21.-- Sample calculations of predicted earnings for new vessels, at gross revenue=$150,000 and with no construction subsidy. (continued)

Column 12	Column 13	Column 14	Column 15	Column 16	Column 17	Column 18	Column 19	Column 20	Column 21	Column 22	Column 23	Column 24	Column 25
Owner's share	Parts and repairs	Netting and supplies	Insurance	Payroll taxes	Interest on loans	Moorage	State and county taxes	Depreciation	Office expenses	Total owner's costs	Net profit	Equity capital investment	Return on investment
Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Percent
50,580	2,168	5,102	9,500	5,878	9,525	450	292	14,376	1,873	49,164	1,416	73,600	1.9
53,278	4,897	5,102	10,975	5,724	11,250	450	226	16,314	1,873	56,811	-3,533	86,300	-4.1
57,324	7,285	5,102	12,112	5,494	12,450	450	251	17,739	1,873	62,756	-5,432	96,550	-5.6
57,324	10,696	5,102	13,688	5,494	14,550	540	293	20,133	1,873	72,369	-15,045	112,650	-13.4
57,324	13,084	5,102	15,975	5,494	17,625	540	354	23,610	1,873	83,657	-26,333	135,700	-19.4
51,389	2,168	9,328	9,500	5,955	9,525	450	192	14,376	1,873	53,367	-1,978	73,600	-2.7
54,129	4,897	9,328	10,975	5,799	11,250	450	226	16,314	1,873	61,112	-6,983	86,300	-8.1
58,240	7,285	9,328	12,112	5,564	12,450	450	251	17,739	1,873	67,052	-8,812	96,550	-9.1
58,240	10,696	9,328	13,688	5,564	14,500	540	293	20,133	1,873	76,665	-18,425	112,650	-16.4
58,240	13,084	9,328	15,975	5,564	17,625	540	354	23,610	1,873	87,953	-29,713	135,700	-21.9
51,093	2,168	14,760	9,500	5,927	9,525	450	192	14,376	1,873	58,771	-7,678	73,600	-10.4
53,818	4,897	14,760	10,975	5,772	11,250	450	226	16,314	1,873	66,517	-12,699	86,300	-14.7
57,905	7,285	14,760	12,112	5,539	12,450	450	251	17,739	1,873	72,459	-14,554	96,550	-15.1
57,905	10,696	14,760	13,688	5,539	14,550	540	293	20,133	1,873	82,072	-24,167	112,650	-21.5
57,905	13,084	14,760	15,975	5,539	17,625	540	354	23,610	1,873	93,360	-35,455	135,700	-26.1

Table 21 illustrates the method used to predict earnings for hypothetical new vessels. The vessel types are selected from Table 17. The following example is keyed to Table 21 by column numbers.

Given:	Vessel size	= 110 tons capacity (vessel-type Number 5 in Table 17)
	Vessel cost (including skiff, two nets, and spray refrigeration)	= 226, 000 dollars (Table 17)
	Gross revenue	= 150, 000 dollars
	Catch	= 1/2 mackerel and 1/2 anchovies, by value.

Then: Column in Table 21

1. Operating costs (using Equation 1) = 8, 052 dollars + 0. 0275 x value of mackerel landings + 0. 0419 x value of tuna landings + 0. 0939 x value of bonito landings + 0. 0380 x value of anchovy landings = 8, 052 dollars + 0. 0275 x 75, 000 dollars + 0. 0380 x 75, 000 dollars = 12, 964 dollars ---------- [1]

2. Tons of mackerel = value of mackerel landings ÷ price per ton for 1967 (from Table 3; the current price should be substituted by the prospective vessel operator) = 75, 000 dollars ÷ 72. 50 dollars per ton = 1, 034 tons ---------- [2]

3. Tons of anchovies = the value of anchovy landings ÷ the price per ton of anchovies (from Table 3; the current price should be substituted by the prospective vessel operator) = 75, 000 dollars ÷ 20 dollars per ton = 3, 750 tons ---------- [5]

4. Total tons of fish = Column 2 + Column 3 = Column 4 + Column 5 = 4, 784 tons ---------- [6]

5. Minimum number of trips, assuming a capacity load each trip = total tons (Column 6) ÷ capacity of the vessel = 4, 784 ÷ 110 tons per trip = 44 trips ---------- [7]

6. Net proceeds = gross revenue - operating costs (Column 1) = 150, 000 dollars - 12, 964 dollars = 137, 036 dollars ---------- [8]

7. Percentage to crew (from Table 4) = 60. 5 percent ---------- [9]

8. Gross crew share = percentage to crew (Column 9) x net proceeds (Column 8) = 60. 5 percent X 137, 036 dollars = 82, 907 dollars ---------- [10]

9. Individual crew share = the gross crew share (Column 10) ÷ the size of the crew (from Table 4) = 83, 768 dollars ÷ 11 to 10 = 7, 537 dollars to 8, 291 dollars ---------- [11]

10. Owner's share = the net proceeds (Column 8) - the gross crew share (Column 10) = 137,036 dollars - 82,907 dollars = 54,129 dollars---- [12]

11. Parts and repairs (using Equation 3) = - 17,619 dollars + 341.15 dollars per foot x length of vessel = 17,619 dollars + 341.15 dollars per foot x 66 feet (from Table 21) = 4,897 dollars--------- [13]

12. Netting and supplies (using Equation 4) = - 240 dollars + 2 dollars per ton x tons of fish landed (Column 6) = 240 dollars + 2 dollars x 4,784 = 9,328 dollars---------- [14]

13. Insurance (using Equation 6) = 0.0375 x value of vessel (including skiff and refrigeration) + 0.05 x value of nets + 200 dollars per crew member x maximum crew size (from Table 4) = 0.0375 x 202,000 dollars + 0.05 x 24,000 dollars + 200 dollars x 11 = 10,975 dollars---------- [15]

14. Payroll taxes (using Equation 7) = 1,073 dollars + 0.057 x gross crew share of net proceeds (Column 9) = 1,073 dollars + 0.057 x 82,907 dollars = 5,799 dollars---------- [16]

15. Interest on loans (7.5 percent of borrowed capital for vessel number 5 in Table 20) = 11,250 dollars---------- [17]

16. Moorage (using average paid by vessels under 80 feet long, Moorage section) = 450 dollars ---------- [18]

17. State and county taxes (using Equation 8) = 0.001 x value of fixed assets (Table 20) + 0.07 x previous years profit (assumed here to be 0 dollars) = 0.001 x 226,000 dollars + 0.07 x 0 dollars = 226.00 dollars ---------- [19]

18. Depreciation (using Equation 9) = 0.057 x value of vessel and gear (unsubsidized portion) exclusive of nets + 0.2 x value of nets = 0.057 x 202,000 dollars + 0.2 x 24,000 dollars = 16,314 dollars ---------- [20]

19. Office expenses and other costs (using the average value for 1967 from Table 16) = 1,973 dollars ---------- [21]

20. Total owner's costs = parts and repairs (Column 13) + netting and supplies (Column 14) + insurance (Column 15) + payroll taxes (Column 16) + interest on loans (Column 17) + moorage (Column 18) + State and county taxes (Column 19) + depreciation (Column 20) + office expenses and other costs (Column 21) = 4,897 dollars + 9,328 dollars + 10,975 dollars, 5,799 dollars + 11,250 dollars + 450 dollars + 226 dollars + 16,314 dollars + 1,873 dollars = 61,112 dollars ---------- [22]

21. Net profit = owner's share (Column 12) - total owner's costs (Column 22) = 54,129 dollars - 61,112 dollars = -6,983 dollars ---- [23]

22. Capital investment (net worth in Table 20) =

86,300 dollars---------- [24]

23. Return on investment = net profit (Column 23) ÷ capital investment (Column 24) = -6,983 dollars ÷ 86,300 dollars

= -8.1 percent---------- [25]

III. ECONOMIC FEASIBILITY OF FLEET EXPANSION AND NEW VESSEL CONSTRUCTION

Now having a model, we can use it to calculate the feasibility of expanding the fleet and of constructing new vessels. We consider first the expansion of the fleet with existing vessels and then consider the addition of new construction.

A. Fleet Expansion with Existing Vessels

In this section, we present a table summarizing predicted earnings for old vessels, and then analyze the table and reach a conclusion as to the economic feasibility of fleet expansion with existing surplus vessels from other fisheries.

1. Summary Table

Table 22 summarizes predicted earnings for old vessels under varying condition of gross revenue.

Table 22.--Summary table of predicted annual earnings for existing vessels

Gross revenue	Vessel size (capacity)	Summary of earning data for: 1967 (Figure 4)				Summary of earning data when landings are composed, by value, of: 100 percent mackerel				50 percent mackerel, 50 percent anchovies				100 percent anchovies			
		Landings	1 crew-share	Profit or loss	Return on investment	Landings	1 crew-share	Profit or loss	Return on investment	Landings	1 crew-share	Profit or loss	Return on investment	Landings	1 crew-share	Profit or loss	Return on investment
Dollars	Tons	Tons	Dollars	Dollars	Percent	Tons	Dollars	Dollars	Percent	Tons	Dollars	Dollars	Percent	Tons	Dollars	Dollars	Percent
50,000	70	871	2,745	-4,882	-17.3	663	2,258	-3,187	-11.3	1,561	2,799	-6,037	-21.4	2,500	2,781	-7,934	-28.2
	100	871	2,411	-4,534	-16.1	663	2,204	-2,970	-10.5	1,561	2,459	-5,678	-20.2	2,500	2,443	-7,635	-27.1
	120	871	2,392	-4,442	-15.8	663	2,186	-2,878	-10.2	1,561	2,439	-5,583	-19.8	2,500	2,423	-7,541	-26.8
	150	871	2,102	-3,913	-13.9	663	2,114	-2,343	- 8.3	1,561	2,144	-5,038	-17.9	2,500	2,130	-7,001	-24.9
100,000	70	1,742	6,068	5,828	20.7	1,326	6,080	7,328	26.0	3,122	6,157	4,576	16.2	5,000	6,121	919	3.3
	100	1,742	5,330	6,829	24.2	1,326	5,340	8,341	29.6	3,122	5,408	5,604	19.9	5,000	5,377	1,911	6.8
	120	1,742	5,287	7,142	25.4	1,326	5,297	8,745	31.1	3,122	5,365	5,917	21.0	5,000	5,333	2,200	7.8
	150	1,742	4,647	8,696	30.9	1,326	4,656	10,071	35.8	3,122	4,715	7,361	26.1	5,000	4,688	3,528	12.5
150,000	70	2,620	9,350	17,813	63.3	1,988	9,396	19,188	68.1	4,744	9,516	14,946	53.1	7,500	9,462	9,192	32.6
	100	2,620	8,219	19,478	69.2	1,988	8,254	20,861	74.1	4,744	8,359	16,644	59.1	7,500	8,311	10,879	38.6
	120	2,620	8,151	20,010	71.2	1,988	8,186	22,004	78.1	4,744	8,291	17,186	61.0	7,500	7,971	11,417	40.5
	150	2,620	7,165	22,297	79.2	1,988	7,196	23,694	84.1	4,744	7,288	19,517	69.3	7,500	7,246	13,733	48.8
200,000	70	3,484	12,696	29,035	103.1	2,652	12,719	30,544	108.5	6,244	12,875	24,728	87.8	10,000	12,802	17,324	61.5
	100	3,484	11,152	31,373	111.4	2,652	11,132	32,881	116.8	6,244	11,309	27,037	96.0	10,000	11,245	19,683	69.9
	120	3,484	11,061	32,121	114.1	2,652	11,081	33,629	119.4	6,244	11,217	27,893	99.0	10,000	11,153	20,445	72.6
	150	3,484	9,723	35,353	125.5	2,652	9,740	36,817	130.7	6,244	9,860	31,026	110.1	10,000	9,804	23,431	83.2

(2) Analysis of summary table and conclusions. Within the limits of the summary table (Table 22), the crew share is most affected by the size of the vessel (maximum effect at 200,000 dollars gross revenue = 2,998 dollars) and is little affected by the species composition of the catch (maximum effect at 200,000 dollars gross revenue = 179 dollars). The highest crew share at any level of revenue is achieved on a 70-ton vessel with a half-mackerel, half-anchovy catch, by value. For the vessel operator, profit and return on investment are most affected by the composition of the catch (maximum effect at 200,000 dollars gross revenue = 13,386 dollars, between 100 percent mackerel and 100 percent anchovy catch). A dichotomy of interest exists between the crewman and the vessel owner in that the effect of vessel size on profit and return on investment is opposite to that on crew share (maximum effect at 200,000 dollars = 2,730 dollars). The highest profit and return on investment at any level of revenue is on a 150-ton vessel with an all-mackerel catch. The break-even point for a 150-ton vessel ranges from a gross revenue of about 65,000 dollars for an all-mackerel catch to about 90,000 dollars for an all-anchovy catch. We conclude that, given favorable market conditions, it is economically feasible to expand the wetfish fleet with surplus vessels from other fisheries at present levels of landings and prices.

B. Fleet Expansion and Boat Replacement with New Boats

Using the same approach as with old vessels, we first present our tables summarizing the data and then present our analyses of the tables and our conclusions regarding the economic feasibility of new vessel construction.

1. Summary Tables

Tables 23A, 23B, 23C, and 24 summarize predicted earnings under varying conditions of gross revenue, size of vessel, composition of catch, and construction subsidy. For these computations we assumed an arbitrary 7.5 percent interest rate on borrowed capital, which in turn was set also arbitrarily at 66.6 percent of fixed capital (Table 20). In this way the return to total capital has been split into two parts: return to borrowed capital (in the form of interest paid, as part of fixed costs) and return to equity capital in the form of profits as shown in Tables 23 A, B, and C). The rate of return to equity capital depends then on the assumed interest rate on borrowed capital. Since this interest rate may vary greatly, it is appropriate to calculate the rate of return to total capital as an alternative way of expressing the return on investment. For this purpose the interest costs were added to profits, and the new profit values were then related to total capital from Table 20. These rates of return to total capital are summarized in Table 24.

23A

Table A.—Summary table of predicted annual earnings for new vessels, with no construction subsidy

Gross revenue	Vessel size (capacity)	Summary of earning data for: 1967 (Figure 4)				Summary of earning data when landings are composed by value, of: 100 percent mackerel				50 percent mackerel, 50 percent anchovies				100 percent anchovies			
		Landings	1 crew share	Profit or loss	Return on investment	Landings	1 crew share	Profit or loss	Return on investment	Landings	1 crew share	Profit or loss	Return on investment	Landings	1 crew share	Profit or loss	Return on investment
Dollars	Tons	Tons	Dollars	Dollars	Percent	Tons	Dollars	Dollars	Percent	Tons	Dollars	Dollars	Percent	Tons	Dollars	Dollars	Percent
	66	1,781	6,058	-12,873	-17.5	1,379	6,194	-11,404	-15.5	3,190	6,158	-15,204	-20.7	5,000	6,121	-19,001	-25.8
	110	1,781	5,278	-18,930	-21.9	1,379	5,396	-17,419	-20.2	3,190	5,365	-21,230	-24.6	5,000	5,333	-25,040	-29.0
100,000	154	1,781	4,560	-22,339	-23.1	1,379	4,663	-20,765	-21.5	3,190	4,635	-24,493	-25.5	5,000	4,608	-28,419	-29.4
	210	1,781	4,560	-31,952	-28.4	1,379	4,663	-30,378	-27.0	3,190	4,635	-34,206	-30.4	5,000	4,608	-38,032	-33.8
	264	1,781	4,560	-43,240	31.9	1,379	4,663	-41,666	-30.7	3,190	4,635	-45,494	-33.5	5,000	4,608	-49,320	-36.3
	66	2,671	9,367	1,416	1.9	2,069	9,571	3,476	4.7	4,784	9,516	-1,978	-2.7	7,500	9,462	-7,678	-10.4
	110	2,671	8,160	-3,533	-4.1	2,069	8,338	-1,269	-1.5	4,784	8,291	-6,983	-8.1	7,500	8,243	-12,699	-14.7
150,000	154	2,671	7,051	-5,432	-5.6	2,069	7,204	-3,037	-3.1	4,784	7,163	-8,812	-9.1	7,500	7,122	-14,554	-15.1
	210	2,671	7,051	-15,045	-13.4	2,069	7,204	-12,650	-11.2	4,784	7,163	-18,425	-16.4	7,500	7,122	-24,167	-21.5
	264	2,671	7,051	-26,333	-19.4	2,069	7,204	-23,938	-17.6	4,784	7,163	-29,713	-21,9	7,500	7,122	-35,455	-26.1
	66	3,561	12,676	14,864	-20.2	2,759	12,946	17,609	23.9	6,378	12,874	10,512	14.3	10,000	12,803	3,407	4.6
	110	3,561	11,042	11,088	12.8	2,759	11,280	13,908	16.1	6,378	11,217	5,854	6.8	10,000	11,153	-358	-.4
200,000	154	3,561	9,542	10,724	11.1	2,759	9,745	13,730	14.2	6,378	9,691	6,513	6.7	10,000	9,636	-242	-.3
	210	3,561	9,542	1,740	1.5	2,759	9,745	4,746	4.2	6,378	9,691	-2,644	-2.3	10,000	9,636	-9,855	-8.7
	264	3,561	9,542	-9,426	-6.9	2,759	9,745	-6,210	-4.6	6,378	9,691	-13,932	-10.3	10,000	9,636	-21,143	-15.6
	66	4,452	15,984	28,310	38.5	3,449	16,325	31,743	43.1	7,974	16,233	22,867	31.1	12,500	16,142	13,991	19.0
	110	4,452	13,925	25,475	29.5	3,449	14,222	29,001	33.6	7,974	14,142	20,101	23.3	12,500	14,063	11,200	13.0
250,000	154	4,452	12,031	26,524	27.5	3,449	12,286	30,298	31.4	7,974	12,219	21,258	22.0	12,500	12,151	12,316	12.8
	210	4,452	12,031	17,540	15.6	3,449	12,286	21,314	18.9	7,974	12,219	12,274	10.9	12,500	12,151	3,332	3.0
	264	4,452	12,031	6,991	5.2	3,449	12,286	10,765	7.9	7,974	12,219	1,725	1.3	12,500	12,151	-7,723	-5.7

Table 23B.—Summary table of predicted annual earnings for new vessels, with 40 percent construction subsidy

Gross revenue	Vessel size (capacity)	Summary of earning data for: 1967 (Figure 4)				Summary of earning data when landings are composed by value, of: 100 percent mackerel				50 percent mackerel, 50 percent anchovies				100 percent anchovies			
		Landings	1 crew share	Profit or loss	Return on investment	Landings	1 crew share	Profit or loss	Return on investment	Landings	1 crew share	Profit or loss	Return on investment	Landings	1 crew share	Profit or loss	Return on investment
Dollars	Tons	Tons	Dollars	Dollars	Percent	Tons	Dollars	Dollars	Percent	Tons	Dollars	Dollars	Percent	Tons	Dollars	Dollars	Percent
	66	1,781	6,058	-5,754	-11.2	1,379	6,194	-4,285	-8.3	3,190	6,158	-8,085	-15.7	5,000	6,121	-11,882	-23.0
	110	1,781	5,278	-10,338	-17.4	1,379	5,396	-8,827	-14.9	3,190	5,365	-12,638	-21.3	5,000	5,333	-16,448	-27.7
100,000	154	1,781	4,560	-12,727	-19.4	1,379	4,663	-11,153	-17.0	3,190	4,635	-14,981	-22.9	5,000	4,608	-18,807	-28.7
	210	1,781	4,560	-20,471	-26.7	1,379	4,663	-18,897	-24.7	3,190	4,635	-22,725	-29.6	5,000	4,608	-26,551	-34.6
	264	1,781	4,560	-29,191	-31.8	1,379	4,663	-27,617	-30.1	3,190	4,635	-31,445	-34.3	5,000	4,608	-35,271	-38.5
	66	2,671	9,367	8,070	15.6	2,069	9,571	9,722	18.8	4,784	9,516	4,805	9.3	7,500	9,462	-559	-1.1
	110	2,671	8,160	4,728	8.0	2,069	8,338	6,633	11.2	4,784	8,296	1,504	2.5	7,500	8,243	-4,107	-6.9
150,000	154	2,671	7,051	3,907	6.0	2,069	7,204	6,161	9.4	4,784	7,163	700	1.1	7,500	7,122	-4,942	-7.5
	210	2,671	7,051	-3,564	-4.6	2,069	7,204	-1,169	-1.5	4,784	7,163	-6,944	-9.1	7,500	7,122	-12,686	-16.6
	264	2,671	7,051	-12,638	-13.8	2,069	7,204	-9,889	-10.8	4,784	7,163	-15,664	-17.1	7,500	7,122	-21,406	-23.3
	66	3,561	12,676	21,518	41.7	2,759	12,948	23,449	45.4	6,378	12,874	17,165	33.3	10,000	12,803	10,059	19.5
	110	3,561	11,042	19,118	32.2	2,759	11,280	21,515	36.3	6,378	11,217	14,818	25.0	10,000	11,153	7,695	13.0
200,000	154	3,561	9,542	19,708	30.7	2,759	9,745	22,713	34.6	6,378	9,691	15,496	23.6	10,000	9,636	8,339	12.7
	210	3,561	9,542	12,471	16.3	2,759	9,745	15,475	20.2	6,378	9,691	8,258	10.8	10,000	9,636	1,079	1.4
	264	3,561	9,542	4,322	4.7	2,759	9,745	7,326	8.0	6,378	9,691	17	0	10,000	9,636	-7,541	-8.2
	66	4,452	15,984	34,964	67.8	3,449	16,325	37,176	72.0	7,974	16,233	29,520	57.2	12,500	16,142	20,644	40.0
	110	4,452	13,925	33,505	56.5	3,449	14,222	36,397	61.4	7,974	14,142	28,131	47.4	12,500	14,063	19,259	32.5
250,000	154	4,452	12,031	35,508	54.2	3,449	12,286	39,281	59.9	7,974	12,219	32,358	49.4	12,500	12,151	21,299	32.5
	210	4,452	12,031	28,270	36.9	3,449	12,286	32,043	41.8	7,974	12,219	23,004	30.0	12,500	12,151	14,062	18.3
	264	4,452	12,031	20,121	21.9	3,449	12,286	23,894	26.0	7,974	12,219	14,901	16.2	12,500	12,151	5,912	6.4

23C.

Table A —Summary table of predicted annual earnings for new vessels, with 50 percent construction subsidy

Gross revenue	Vessel size (capacity)	Summary of earning data for: 1967 (Figure 4)				Summary of earning data when landings are composed by value, of: 100 percent mackerel				50 percent mackerel, 50 percent anchovies				100 percent anchovies			
		Landings	1 crew share	Profit or loss	Return on investment	Landings	1 crew share	Profit or loss	Return on investment	Landings	1 crew share	Profit or loss	Return on investment	Landings	1 crew share	Profit or loss	Return on investment
Dollars	Tons	Tons	Dollars	Dollars	Percent	Tons	Dollars	Dollars	Percent	Tons	Dollars	Dollars	Percent	Tons	Dollars	Dollars	Percent
	66	1,781	6,058	-3,960	-8.7	1,379	6,194	-2,491	-5.5	3,190	6,158	-6,291	-13.8	5,000	6,121	-10,088	-22.1
	110	1,781	5,278	-8,148	-15.3	1,379	5,396	-6,637	-12.4	3,190	5,365	-10,448	-19.6	5,000	5,333	-14,258	-26.8
100,000	154	1,781	4,560	-10,348	-17.7	1,379	4,663	-8,774	-15.0	3,190	4,635	-12,602	-21.5	5,000	4,608	-16,428	-28.1
	210	1,781	4,560	-17,714	-26.2	1,379	4,663	-16,140	-23.7	3,190	4,635	-19,968	-29.5	5,000	4,608	-23,794	-35.2
	264	1,781	4,560	-25,660	-31.8	1,379	4,663	-24,086	-29.8	3,190	4,635	-27,914	-34.6	5,000	4,608	-31,740	-39.3
	66	2,671	9,367	9,747	21.4	2,069	9,571	11,806	25.9	4,784	9,516	6,481	14.2	7,500	9,462	1,135	2.5
	110	2,671	8,160	6,781	12.7	2,069	8,338	8,891	16.7	4,784	8,296	3,551	6.7	7,500	8,243	-1,917	-3.6
150,000	154	2,671	7,051	6,130	10.5	2,069	7,204	8,368	14.3	4,784	7,163	2,971	5.1	7,500	7,122	-2,563	-4.4
	210	2,671	7,051	-807	-1.2	2,069	7,204	1,484	2.2	4,784	7,163	-4,187	-6.2	7,500	7,122	-9,929	-14.7
	264	2,671	7,051	-8,753	-10.8	2,069	7,204	-6,358	-7.9	4,784	7,163	-12,133	-15.0	7,500	7,122	-17,874	-22.1
	66	3,561	12,676	23,194	50.8	2,759	12,948	25,905	56.8	6,378	12,874	18,842	41.3	10,000	12,803	11,736	25.7
	110	3,561	11,042	21,164	39.7	2,759	11,280	23,984	45.0	6,378	11,217	16,865	31.6	10,000	11,153	9,742	18.3
200,000	154	3,561	9,542	21,931	37.4	2,759	9,745	24,936	42.6	6,378	9,691	17,719	30.3	10,000	9,636	10,562	18.0
	210	3,561	9,542	15,047	22.2	2,759	9,745	18,052	26.7	6,378	9,691	10,835	16.0	10,000	9,636	3,678	5.4
	264	3,561	9,542	7,621	9.4	2,759	9,745	10,626	13.2	6,378	9,691	3,409	4.2	10,000	9,636	-4,008	-5.0
	66	4,452	15,984	36,640	80.4	3,449	16,325	40,005	87.7	7,974	16,233	31,196	68.4	12,500	16,142	22,321	48.9
	110	4,452	13,925	35,551	66.7	3,449	14,222	39,077	73.3	7,974	14,142	30,178	56.6	12,500	14,063	21,276	39.9
250,000	154	4,452	12,031	37,731	64.4	3,449	12,286	41,504	70.9	7,974	12,219	32,465	55.4	12,500	12,151	23,522	40.2
	210	4,452	12,031	30,847	45.6	3,449	12,286	34,620	51.2	7,974	12,219	25,580	37.8	12,500	12,151	16,638	24.6
	264	4,452	12,031	23,421	29.0	3,449	12,286	27,194	33.7	7,974	12,219	18,194	22.5	12,500	12,151	9,212	11.4

Table 24 -- Summary table of predicted returns to capital for new vessels

Gross revenue	Vessel size (capacity)	No construction subsidy				40 percent construction subsidy				50 percent construction subsidy			
		Composition of landings by value:				Composition of landings by value:				Composition of landings by value:			
		As in 1967 (Fig. 4)	100 percent mackerel	50 percent mackerel 50 percent anchovies	100 percent anchovies	As in 1967 (Fig. 4)	100 percent mackerel	50 percent mackerel 50 percent anchovies	100 percent anchovies	As in 1967 (Fig. 4)	100 percent mackerel	50 percent mackerel 50 percent anchovies	100 percent anchovies
Dollars	Tons	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
	66	- 1.7	- 0.9	- 2.8	- 4.7	0.3	1.4	- 1.4	- 4.2	1.2	2.4	- 0.7	- 4.0
	110	- 3.2	- 2.6	- 4.2	- 5.8	- 2.0	- 1.0	- 3.4	- 5.9	- 1.4	- 0.3	- 3.1	- 5.9
100,000	154	- 3.8	- 3.2	- 4.6	- 6.1	- 2.7	- 1.8	- 4.0	- 6.2	- 2.3	- 1.2	- 3.8	- 6.3
	210	- 5.7	- 5.2	- 6.4	- 7.6	- 5.6	- 4.8	- 6.8	- 8.7	- 5.6	- 4.7	- 6.9	- 9.1
	264	- 6.9	- 6.5	- 7.5	- 8.6	- 7.5	- 6.9	- 8.5	-10.1	- 7.8	- 7.1	- 8.9	-10.8
	66	5.5	6.4	3.7	0.9	10.6	11.8	8.1	4.2	12.8	14.6	10.1	5.5
	110	3.3	4.2	1.8	- 0.6	7.6	8.9	5.6	2.0	9.5	11.0	7.1	3.1
150,000	154	2.7	3.6	1.3	- 0.8	6.9	8.2	5.0	1.7	8.6	10.1	6.5	2.8
	210	- 0.2	0.6	- 1.3	- 3.1	2.8	4.0	1.1	- 1.7	4.1	5.4	2.1	- 1.1
	264	- 2.3	- 1.7	- 3.3	- 4.8	- 0.6	0.5	- 1.9	- 4.3	0.3	1.5	- 1.3	- 4.1
	66	12.1	13.5	10.0	6.4	20.6	22.0	17.3	12.0	24.3	26.6	20.6	14.5
	110	9.4	10.6	7.2	4.6	16.8	18.4	14.1	9.5	20.0	22.1	16.9	11.7
200,000	154	8.8	10.0	7.2	4.6	16.0	17.8	13.6	9.4	19.1	21.1	16.3	11.5
	210	5.3	6.3	3.8	1.5	10.8	12.3	8.7	5.1	13.2	14.9	10.8	6.6
	264	2.2	3.0	1.0	- 0.9	6.4	7.6	4.6	1.4	8.2	9.7	6.2	2.6
	66	18.8	20.5	16.1	11.7	30.6	32.2	26.5	19.9	35.7	38.6	31.1	23.5
	110	15.5	17.0	13.2	9.5	26.0	27.9	22.6	16.9	30.6	33.2	26.7	20.1
250,000	154	14.8	16.2	12.8	9.4	25.2	27.4	23.4	16.9	29.6	32.1	26.1	20.2
	210	10.4	11.7	8.7	5.8	18.7	20.6	16.1	11.6	22.3	24.5	19.3	14.1
	264	6.6	7.6	5.2	2.6	13.0	14.6	10.8	7.0	15.9	17.7	13.3	9.(

2. Analysis of Summary Tables and Conclusions

As was found for existing-type vessels (Table 22), the crew share is most affected by the size of the vessel. Profit is also greatly affected by the size of the vessel (maximum effect at 250,000 dollars gross revenue with a 50-percent subsidy = 14,310 dollars). Profit is most affected by the species composition of the catch (maximum effect at 250,000 dollars gross revenue with 50-percent subsidy = 17,982 dollars). The highest profit and return on the investment at the 250,000 dollar level of gross revenue are attained on the 154-ton vessel with an all-mackerel catch. At lower levels of gross revenue, the profit is greatest with the smallest vessel (66 tons capacity). The break-even point for a 66-ton vessel with no subsidy and with an all-mackerel catch is about 140,000 dollars, which is near the upper end of the range of gross revenue for the existing fleet in 1967 (Figure 7). For a new 66-ton vessel landing a catch with the same species composition as that in the 1967 landings of the fleet to achieve the levels of profit obtained by the top boats in the existing fleet in 1967 (30,000 dollars, about a 30-percent return on investment for a new 66-ton vessel), it would have to have a gross revenue of over 250,000 dollars, which is well above the maximum level achieved by the existing fleet in any year. With a 50-percent construction subsidy, the amount of revenue needed drops to about 225,000 dollars, which is still a very high figure relative to the revenue obtained by the fleet in the past. For an all-anchovy catch, the break-even point for a 66-ton vessel with a 50-percent subsidy is about 145,000 dollar gross revenue (7,250 tons of anchovies, or 110 capacity

loads), and the profit at 250,000 dollars gross revenue (12,500 tons of anchovies, or 190 capacity loads--a probably unachievable rate of catch) is only 22,321 dollars, which is less than the profit for the top vessels in the existing fleet in 1967.

The predicted unprofitability of new vessels is caused by the high investment base. The lowest cost of a new vessel from Table 20 is 147,000 dollars (vessel with skiff and refrigeration), while the average market value of a vessel in the existing fleet is 45,000 dollars. This difference in value causes an extremely high increase in the following categories of fixed costs: insurance, depreciation, and interest on capital. The increase in fixed costs is partly offset by lower repair costs on new vessels. On two comparable vessels, for example, shown in the sample calculations of foregoing sections, the total owner's costs at a level of 150,000 dollars gross revenue have risen from 36,800 dollars on the old vessel, to 61,112 dollars on the new one. This means a 66 percent increase in owner's cost effected by higher investment costs, while the owner's share in net proceeds from fishing remained on the same level (about 54,000 dollars).

We must conclude that, at present catch rates and fish prices, the construction of new wetfish seiners, even with construction subsidies, for either vessel replacement or fleet expansion is not economically feasible. This situation may change in the future if the efficiency of wetfish seining operations can be improved through technological research or if new markets can be developed that will yield higher prices for wetfish.

SUMMARY

The San Pedro wetfish boat fleet has dwindled to half its size of 10 years ago. Large underexploited stocks of wetfish (jack mackerel and anchovies) exist in the California Current. If these resources are to be harvested, the wetfish fleet must expand through the construction of new vessels or through the acquisition of surplus vessels from other fisheries. The purposes of the study that this paper reports were to describe and document the financial condition of the fleet, to develop a model of wetfish boat costs and earnings, and by means of this model, to examine the economic feasibility of fleet expansion and vessel replacement.

The findings of the study with respect to the financial condition of the fleet are that the fleet is antiquated, corporate profits are low, corporate net worth is low, working capital is inadequate, crew earnings are very low and are not increasing in pace with inflation, and employment in the fleet has decreased by 30 percent in the last 5 years.

Analysis of costs in several categories yielded equations to be used in predicting earnings at various levels of revenue and with various combinations of vessel size and composition of the catch. Their use showed that, of the four principal wetfish species, mackerel cost the least to land (per value), anchovies and tuna cost about the same (more than mackerel) to land, and bonito cost the most to land.

Predicted crew earnings, profit, and return on investment based on the relations developed in the analysis of costs showed that although the expansion of the fleet through recruitment of existing vessels from other fisheries is feasible, fleet expansion or vessel replacement through construction of new vessels is not economically feasible at present rates of catch and prices of fish.

ACKNOWLEDGMENTS

Invaluable cooperation and assistance were provided in the data-gathering phase of this study by the following individuals and organizations: Fishermen's Cooperative Association of San Pedro (Anthony Pisano, Manager); Fishermen's Union, Local 33, I.W.L.U. (John J. Royal, Secretary-Treasurer); Seine and Line Fishermen's Union of San Pedro (Steven J. Hoinski, Business Agent); Robinson, Pettie and Company; Rafalovich and Rafalovich, Public Accountants; Trani Realty; Steve Muskatelo, Public Accountant; Commercial Fishermen's Inter-Insurance Excahnge; Star-Kist Foods, Incorporated; Los Angeles County Assessor's Office; Marine Construction and Design Company; J. M. Martinac Shipbuilding Corporation; Tacoma Boatbuilding Company, Incorporated; Marine Resources Operations, California Department of Fish and Game; and others. James R. Zweifel assisted in data processing. Kenneth S. Raymond drafted the figures. Roger E. Green, Clark E. Blunt, Jr., Frank J. Hester, Frederick W. Bell, James D. Messersmith, David Kramer, Lawrence Van Meir, Richard F. H. Heimann, Ernest W. Carlson, and Adam Sokoloski read the manuscript and made many helpful suggestions.

REFERENCES CITED

Ahlstrom, E. H.

1968. An evaluation of the fishery resources available to California fishermen. In: D. E. Gilbert (ed.) The future of the fishing industry of the United States. University of Washington Publication in Fisheries New Series 4: 65-80.

Biostatistical Section, Marine Resources Operations.

1960a. The marine fish catch of California for the years 1957 and 1958. California Department of Fish and Game, Fish Bulletin 108, 74 p.

1960b. The marine fish catch of California for the year 1959. California Department of Fish and Game, Fish Bulletin 111, 44 p.

1961. The marine fish catch of California for the year 1960. California Department of Fish and Game, Fish Bulletin 117, 45 p.

1963. The California marine fish catch for 1961. California Department of Fish and Game, Fish Bulletin 121: 1-47.

1964. The California marine fish catch for 1962. California Department of Fish and Game, Fish Bulletin 125, 45 p.

1965. The California marine fish catch for 1963. California Department of Fish and Game, Fish Bulletin 129, 45 p.

Croker, R. S.

1938. Historical account of the Los Angeles mackerel fishery. California Department of Fish and Game, Fish Bulletin 52, 62 p.

Green, R. E. and G. C. Broadhead.

1965. Costs and earnings of tropical tuna vessels based in California. Fishery Industrial Research 3(1): 29-45.

Greenhood, E. C.

1965. Statistical report of fresh, canned, cured, and manufactured fishery products for 1964. State of California Department of Fish and Game Circular 39, 16 p.

Greenhood, E. C., and D. J. Mackett.

1965. The California marine fish catch for 1964. California Department of of Fish and Game, Fish Bulletin 132, 45 p.

1967. The California marine fish catch for 1965. California Department of Fish and Game, Fish Bulletin 135: 1-42.

Heimann, R. F. G., and H. W. Frey.

1968a. The California marine fish catch for 1966. California Department of Fish and Game, Fish Bulletin 138: 1-48.

1968b. The California marine fish catch for 1967. California Department of Fish and Game, Fish Bulletin 144, 47 p.

Long, L. H.

1969. The World Almanac and Book of Facts. Doubleday, N.Y., 934 p.

McNeely, R. L.

1961. The purse-seine revolution in tuna fishing. Pacific Fisherman 59(7): 27-58.

Roedel, P. M.

1952. A review of the Pacific mackerel (Pneumatophorus diego) fishery of the Los Angeles region with special reference to the years 1931-1951. California Fish and Game 38(2): 253-273.

Scofield, W. L.

1951. Purse seines and other roundhaul nets in California. California Department of Fish and Game, Fish Bulletin 81, 83 p.

Staff, Bureau of Marine Fisheries.

1949. The commercial fish catch of California for the year 1947 with an historical review 1916-1947. California Division of Fish and Game, Fish Bulletin 74, 267 p.

1951. The commercial fish catch of California for the years 1948-1949 with yield per area of the California sardine fishing grounds 1937-1949. California Division of Fish and Game, Fish Bulletin 80, 87 p.

1952. The commercial fish catch of California for the year 1950 with a description of methods used in collecting and compiling the statistics. California Department of Fish and Game, Fish Bulletin 86, 120 p.

1953. The commercial fish catch of California for the year 1951 with an evaluation of the existing anchovy case pack requirements. California Department of Fish and Game, Fish Bulletin 89, 68 p.

Staff, Marine Fisheries Branch.

1954. The commercial fish catch of California for the year 1952 with proportion of king and silver salmon in California's 1952 landings. California Department of Fish and Game, Fish Bulletin 95, 64 p.

1956. The marine fish catch of California for the years 1953 and 1954 with jack mackerel and sardine yield per area from California waters 1946-47 through 1954-55. California Department of Fish and Game, Fish Bulletin 102, 99 p.

Staff, Marine Resources Operation.

1958. The marine fish catch of California for the years 1955 and 1956 with rockfish review. California Department of Fish and Game, Fish Bulletin 105, 104 p.

United States Bureau of Customs.

1965. Merchant Vessels of the United States 1965. U.S. Government Printing Office, Washington, D.C., 1314 p.

(continued from inside front cover)

14. A Price Incentive Plan for Distressed Fisheries by A. A. Sokoloski and E. W. Carlson.

15. Demand and Prices for Shrimp by D. Cleary.

16. Industry Analysis of Gulf Area Frozen Processed Shrimp and an Estimation of Its Economic Adaptability to Radiation Processing by D. Nash and M. Miller.

17. An Economic Evaluation of Columbia River Anadromous Fish Programs by J. A. Richards.

18. Economic Projections of the World Demand and Supply of Tuna, 1970 - 90 by F. Bell.

19. Economic Feasibility of a Seafood Processing Operation in the Inner City of Milwaukee by D. Cleary.

20. The 1969 Fishing Fleet Improvement Act: Some Advantages of its Passage by the Division of Economic Research.

21. An Economic Analysis of Policy Alternatives for Managing the Georges Bank Haddock Fishery by L. W. Van Meir.

22. Some Analyses of Fish Prices by F. Waugh and V. Norton.

23. Some Economic Characteristics of Pond-Raised Catfish Enterprises by J. E. Greenfield

24. Elements Crucial to the Future of Alaska Commercial Fisheries by D. Nash, A. Sokoloski, and D. Cleary.

25. Effects on the Shrimp Processing Industry of Meeting the Requirements of Wholesome Fishery Products Legislation by D. Nash and M. Miller.

26. Benefit Cost Analysis of a Proposed Trawl Systems Program by M. Miller.

27. An Economic Analysis of Future Problems in Developing the World Tuna Resource: Recommendations for the Future Direction of the BCF Tuna Program by F. Bell.

28. Economic Efficiency in Common Property Natural Resource Use: A Case Study of the Ocean Fishery by D. W. Bromley

29. Costs, Earnings and Borrowing Capacity for Selected U. S. Fisheries, by A. Sokoloski, E. Carlson, and B. Noetzel.

30. Fish Cycles: A harmonic analysis by F. Waugh and M. Miller.

31. Benefit-Cost Analysis as Applied to Commercial Fisheries Programs, by F. Bell.

32. Economic Study of San Pedro Wetfish Boats by W. F. Perrin and B. Noetzel.

33. A Survey of Fish Purchases by Socio-Economic Characteristics - First Quarterly Report - February, May, April, 1969 by Darrel A. Nash.

34. A Survey of Fish Purchases by Socio-Economic Characteristics, Second Quarterly Report - May June July by D. Nash.

35. A Simplified Guide to Benefit-Cost Analysis for BCF Programs by F. Bell.

36. Estimation of the Optimal Number of Vessels in a Fishery: Theoretical and Empirical Basis for Fishery Management by F. Bell.

37. Major Economic Trends in Selected U.S. Master Plan Fisheries: A Graphical Survey by Richard K. Kinoshita and Frederick W. Bell

38. Market Potential for the San Pedro Wetfish Fishery by D. Nash

The goal of the Division of Economic Research is to engage in economic studies which will provide industry and government with costs, production and earnings analyses; furnish projections and forecasts of food fish and industrial fish needs for the U. S.; develop an overall plan to develop each U. S. fishery to its maximum economic potential and serve as an advisory service in evaluating alternative programs within the Bureau of Commercial Fisheries.

In the process of working towards these goals an array of written materials has been generated representing items ranging from interim discussion papers to contract reports. These items are available to interested professionals in limited quantities of offset reproduction. These "Working Papers" are not to be construed as official BCF publications and the analytical techniques used and conclusions reached in no way represent a final policy determination endorsed by the U. S. Bureau of Commercial Fisheries.