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B709: An Evaluation of the Potential for Maine Raised Oysters

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AN EVALUATION OF THE POTENTIAL FOR MAINE RAISED OYSTERS

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Wallace C. Dunham and Munden M. Bray[1]

INTRODUCTION

Historic and Geographic Overview

Only a few of the more than one hundred species of oysters are currently of commercial importance. Oysters, common in the warmer, shallower waters of all oceans, are encountered along the temperate and tropical coasts of all continents. Although some species live in depths of several thousand feet, most are found between tidal levels or in the shallow brackish waters of estuaries.

Oysters are among the oldest of foods of mankind. This is substantiated by the great mounds of shells located in many archaeological findings. Oysters figured prominently in the acounts of the great feasts of ancient Rome. One of the earliest known instances of aquacultural production of oysters occurred over 2,000 years ago when one Sergius Orata turned Lake Avernus, in Italy, into an oyster bed.[2]

In 1620 when the Pilgrims landed on the shores of what is now Massachusetts, they discovered, as had the Indians before them, that the oyster beds of North America could provide a valuable food resource.[3] During the 1700's, oysters were quite plentiful from Maine to the Delaware capes. Today a few are still found about the northern coast of New England, in the Sheepscot River of Maine, and the Oyster River and Great Bay of New Hampshire. However, they are not in sufficient numbers to support a viable industry. In fact, the northern coast of New England has not been able to support an oyster industry since the early 1800's.[4]

In the census of 1890, the eastern coast of North America produced as much as the rest of the world combined. During that period the world oyster industry was located in the United States, Great Britain, France, Canada, the Netherlands, and Italy. The total annual catch of the United

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[1]Associate Professor and former Graduate Assistant respectively, Department of Agricultural and Resource Economics.

[2]Ruge, John G., "The Oyster and Oyster-Beds of Florida" (Paper presented at the National Fishery Congress, 1897), Published in the *Bulletin of the United States Fish Commission*, Document No.561, Vol. XVII, 1897, p. 289.

[3]Ibid., p9. 290

[4]Ibid.

States at that time was estimated to be 5.5 billion oysters, while the total catch for all of Europe was only 2.3 billion oysters.[5] Since the turn of the century, Europe has fallen behind the United States in oyster production. In more recent years, the United States' share of the world production has been declining because other nations, particularly Asian countries, have entered the business. On a world basis, the United States production has fallen to less than 45 percent of the total catch. Japan now ranks second and accounts for about one-third of the world's production. As may be observed from Table 1, the leading countries in oyster production today are the United States, Japan, Mexico, France, and the Republic of Korea.

Table 1

Oyster Catches by Major Producing Countries, 1964-1969

Country	1964	1965	1966	1967	1968	1969
	thousand metric tons					
Canada	6.9	6.7	7.3	5.7	4.7	5.5
Cuba	2.4	2.7	2.8	3.2	2.3	2.6
Mexico	24.0	29.6	25.1	28.4	35.5	42.4
United States	414.5	350.9	356.4	415.3	388.7	355.4
China (Taiwan)	8.5	8.9	10.3	11.7	12.6	11.7
Japan	240.6	210.6	221.1	232.2	267.4	245.5
Korea, Republic of	42.6	45.9	51.7	44.4	38.2	33.2
France	62.2	65.8	62.3	69.5	44.7	39.5
Portugal	10.2	0.2	0.3	4.8	9.6	9.1
Spain	1.1	0.9	0.7	0.9	1.0	1.7
Australia	5.8	6.6	6.8	7.3	7.6	7.5
New Zealand	7.7	9.9	12.9	13.2	11.9	5.6

Source: *Adapted from F.A.O. Yearbook of Fishery Statistics–Catches and Landings, 1970*, Table B5-3

According to F.A.O. statistics, all of the Japanese production originates from aquacultural production. In the Republic of Korea, aquacultural production has varied from 76 to 97 percent during recent years. Aquacultural production represents a minor part of total production for the other countries.

The United States trails France, Japan, and China in the per capita consumption of fishery products, but leads these nations in the total consumption of oysters. The middle Atlantic area of the United States consumes more oysters than any other part of this country. New England consumes a smaller amount per capita than any other region.[6]

[5] Ruge, op. cit., p. 290

[6] *Maine Coastal Resources Renewal*, State Planning Office, Executive Department, Augusta, Maine, July, 1971, p. 26.

There are six regions in the United States where oysters are produced. In descending order of landings, they are, the Chesapeake Bay, Gulf of Mexico, Pacific Coast, Middle Atlantic, South Atlantic, and New England. Most of the New England landings are taken off the coast of Connecticut from the Long Island Sound. Although the Long Island Sound produces a relatively small part of the U.S. total, its product is of higher value on a per pound basis. This is because approximately 60 percent of the production from this area goes to the more exclusive half-shell trade.[7] Recent comparative prices received for oysters are shown in Table 2.

Four distinct species account for all commercial landings and practically all domestic consumption of oysters in the United States. *Crassostrea virginica* (American, or Eastern oyster) accounts for approximately ninety percent of current production; *Crassostrea gigas* (Pacific, or Japanese oyster) accounts for approximately nine percent of current production; *Ostrea lurida* (Olympia, or Pacific Coast native oyster) and *Ostrea edulis* (European oyster) each account for less than one percent of current production.[8]

Table 2

Gross Return to Oyster Producers,
by Producing Area, 1967

Oyster Producing Area	Average Price per Pound of Oyster Meat—1967
New England and New York State[1]	$2.52
Middle Atlantic	.88
Chesapeake Bay	.68
South Atlantic	.43
Pacific	.41
Gulf	.39

[1]Principally Long Island Sound.

Source: *Historical Fishery Statistics*, United States Department of the Interior, Bureau of Commercial Fisheries, 1921-67.

[7]Nelson, J. Richards, President of Long Island Oyster Farms, personal correspondence, August 3, 1972.

[8]Matthiessen, George C., *A Review of Oyster Culture and the Oyster Industry in North*

The Problem

At the present time the value of oyster production in Maine is minimal[9] because the native species, *Crassostrea virginica*, will not survive, in economic numbers, through the larval stage in Maine's cold waters. There is some indication that *Ostrea edulis* (the European oyster) can withstand colder temperatures and may, in fact, thrive in Maine's cold waters, offering an alternative for coastal economic growth. This species is raised on a scale and under continuous culture from juvenile to marketable size in other parts of the world. These factors all favor the establishment of a fishery for *Ostrea edulis* in Maine by adapting the proven hatchery, rearing, and mariculture techniques for this species to Maine's cold water environment. As other scientists began examining the biological and engineering aspects of raising oysters in Maine, it became necessary to consider the marketing aspects of such a venture.

The primary purpose of the study reported here was to investigate the feasibility of developing profitable markets for Maine raised *Ostrea edulis*. More specifically the objectives were to:

1. Evaluate trends in oyster supplies, including landings, imports, and exports in the United States, Canada, and France.
2. Analyze trends in oyster consumption in the United States, Canada, and France and develop a predictive equation based on factors influencing consumption in each of these areas.
3. Evaluate the economic feasibility of developing a half-shell oyster market for Maine raised oysters.

Procedure

Data on landings, imports and exports were collected for the United States, Canada, and France on the most recent years for which reliable data were available. The annual data used were obtained from statistical data in the F.A.O. Yearbooks of Fishery Statistics. These were analyzed to determine if significant trends and cyclical changes were present. The significance of annual trends was based on the Spearman Rank Correlation Coefficient. The significance in cyclical patterns was tested by the Chi-Square Statistic. Through use of a multiple linear regression technique, predictive equations for the demand for oysters in the United States, Canada, and France were estimated. Secondary data were utilized for this phase of the study.

Six purposive samples were chosen to obtain information on volumes of supply of half-shell oysters in Boston, Montreal, and Paris.

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[9]Maine produces a very insignificant amount of oysters. Recent years have seen Maine's production of oysters fluctuate between 900 and 4,100 pounds per annum valued betwen $799 and $4,972 (Historical Fishery Statistics).

These samples represented shellfish wholesalers, brokers, and restaurants in these cities. The basis for selecting each sample was the likelihood, in the opinion of the researcher, that they handled half-shell oysters.

Questionnaires and personal interviews were conducted with four trucking companies and with officials at the Bangor International Airport and Logan Airport in Boston. The information thus obtained provided the basis for the analysis of marketing costs and returns to would-be Maine producers of half-shell oysters.

This study was severely hampered by a lack of relevant historical information. Data on oysters were not partitioned into the various market classifications. Data on the half-shell trade were practically non-existent. Nevertheless, the study provides a relevant overall analysis for oysters in the United States, Canada, and France, and a starting point in evaluating the half-shell sector.

OYSTER SUPPLIES IN SELECTED COUNTRIES

The United States, Canada, and France experience many similar supply problems. Pollution, predation, disease, lack of technical innovation, antiquated laws governing the use of the resource, competition from imports, acts of nature, and the disorganized state of the industry apply to the oyster industry in each of these countries.

The following is an analysis of the patterns of supply of domestic landings, imports, and exports in each of the national markets. The overall effect of the aforementioned problems is used to ascertain the significance of trends and cycles for the most recent years for which reliable data are available. Two statistical tests, one for trends and one for cyclical patterns, were used to test the null hypothesis that each series of annual observations was random.

Trend Analysis

As may be observed in Figure 1, the domestic landings of oysters in the United States exhibited a gradual downward trend from 1956-1969 with upturns in landings from the immediately preceding year experienced in five of the 14 years cited (1961, 1963, 1964, 1966, 1967).

The Spearman Rank Correlation Coefficient was used to test for a statistically significant trend in landings. The null hypothesis of a random time series was tested against the alternate hypothesis of a definite trend in landings. The rank correlation coefficient was calculated to be -.7033 and found to be statistically significant at the .005 level of probability. Essentially, this means that the probability was only one in 200 that the declining trend in domestic oyster landings in the United States between 1956-1969 was due strictly to a random occurrence.

As may be observed from Figure 2, oysters imported into the United States from 1956-1970 showed a definite upward trend. In only three of the 15 years during this time series did imports decrease from the previous year (1964, 1968, 1970). The rank correlation coefficient of total oyster imports during this 15 year period was calculated to be .9321 and found to be statistically significant at the .005 level of probability. This means that the probability was one in 200 that the increasing trend in oyster imports in the United States between 1956-1970 was random in nature. The probability was 199 out of 200 that the trend was caused by some phenomenon other than chance.

FIGURE 1

DOMESTIC LANDINGS OF OYSTERS FOR THE UNITED STATES, 1956-1969

Referring again to Figure 2 it can be seen that the export of oysters from the United States has decreased over the period from 1956-1970. The rank correlation coefficient of total oyster exports from the United States for this period was calculated to be -.9339 and found to be statistically significant at the .005 level of probability. Thus, the probability was 199 out of 200 that the decreasing trend in exports into the United States from 1956-1970 was caused by some phenomenon other than chance.

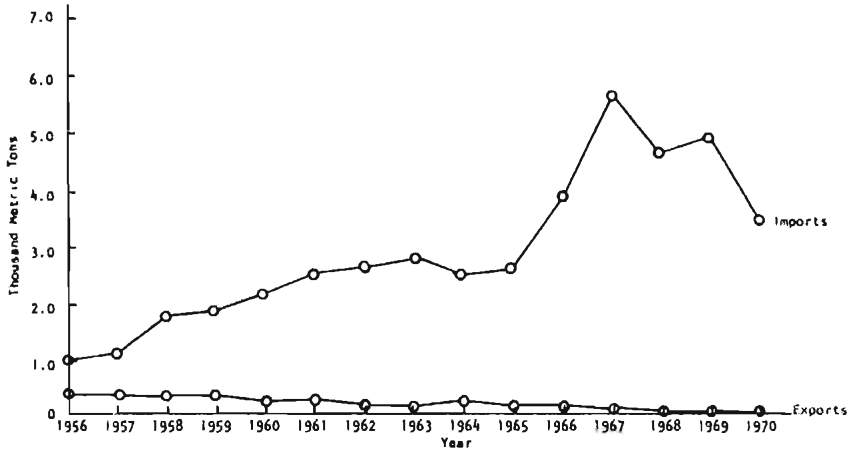

FIGURE 2

IMPORTS AND EXPORTS OF OYSTERS FOR THE UNITED STATES, 1956-1970

Data on landings, imports, and exports for Canada and France are illustrated in Figures 3 and 4. Trend analyses, similar to those performed for the United States, were also conducted for these countries. The results of the analyses for all three countries are presented in Table 3.

Table 3

Summary of Analyses of Trends in Oyster Landings, Imports, and Exports for the United States, Canada, and France

Years	Supply	R_s*	Significance Level
United States			
1956-1969	Landings	-.7033	.005
1956-1970	Imports	.9321	.005
1956-1970	Exports	-.9339	.005
Canada			
1956-1969	Landings	.5648	.010
1956-1970	Imports	-.2786	N.S.
1956-1970	Exports	-.5946	.005
France			
1956-1969	Landings	.1099	N.S.
1963-1970**	Imports	-.2976	N.S.
1956-1970	Exports	----------Negligible----------	

*Spearman Rank Correlation Coefficient

**Not an adequate number of observations.

N.S.—Non-significant at the .100 level of probability.

Source: Computed from data in Appendix Tables 1, 2 and 3.

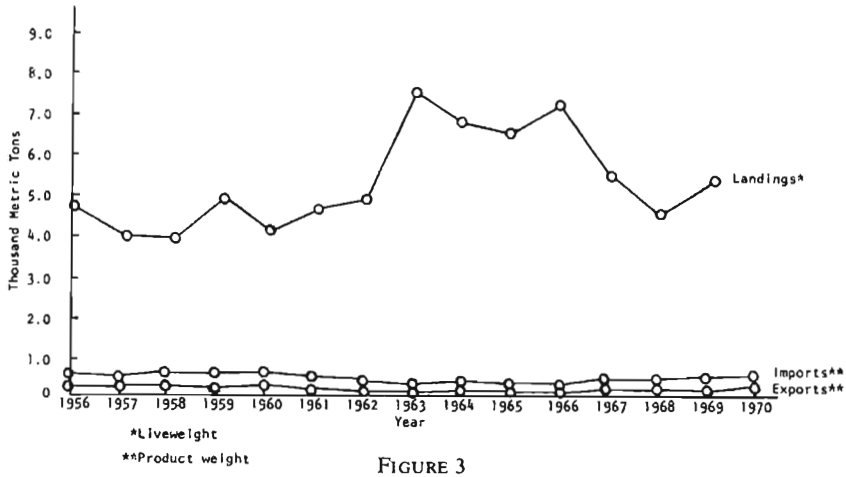

FIGURE 3

DOMESTIC LANDINGS, 1956-1969, IMPORTS, 1956-1970, EXPORTS 1956-1970, OF OYSTERS FOR CANADA

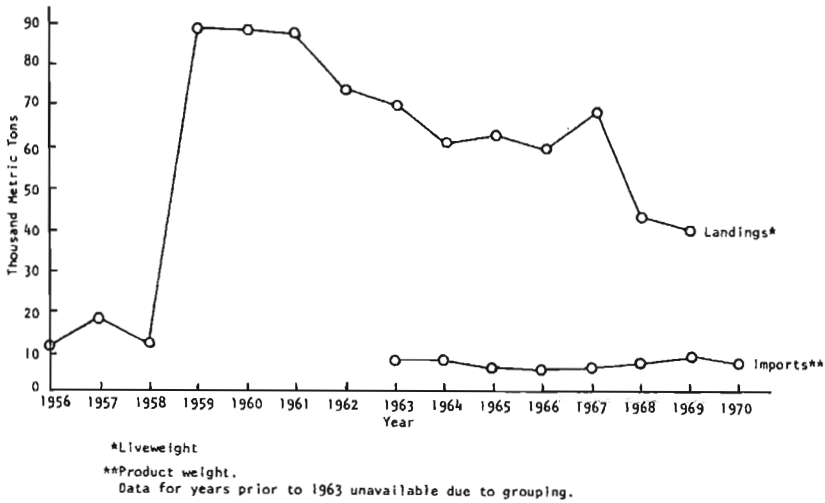

FIGURE 4

DOMESTIC LANDINGS 1956-1969 AND IMPORTS OF OYSTERS FOR FRANCE (INCLUDING PORTUGUESE OYSTERS)

Cyclical Analysis

The chi-square statistic was employed to test for the significance of cyclical patterns in domestic landings of oysters in the United States for the time series 1956-1969. The test compared the actual number of turning points in the data with the expected number of turning points in a random series of data of equal length. The number of expected turning points for 14 observations was eight, as compared to six actual turning

points. The computed chi-square statistic of 1.167 was not found to be significant. Thus, the null hypothesis of random cyclical movements was accepted. However, this does not rule out cyclical movements if a longer period of time were included in the analysis. These 14 observations simply may not have been long enough to define a cycle.

The chi-square statistic, to test for the significance of cyclical patterns in imports of oysters into the United States for the time series 1956-1970 yielded a value of 3.674 and was found to be statistically significant only at the 0.10 level of probability. Thus, the null hypothesis of random cyclical movements was rejected.

The chi-square statistic, employed to test for the significance of cyclical patterns in exports of oysters from the United States for the time series 1956-1970, yielded a value of 12.146 and was therefore found to be highly significant at the .005 level of probability. In this case the null hypothesis of random cyclical movements was also rejected. This means that the probability was only one in 200 that the cyclical patterns in exports were due to random influences.

Similar analyses of cyclical patterns in oyster landings, imports, and exports were conducted for Canada and France. The results are contained in Table 4.

Table 4

Summary of Analyses of Cyclical Patterns in Oyster Landings, Imports, and Exports for the United States, Canada, and France

Years	Supply	x^2	Significance Level
United States			
1956-1969	Landings	1.167	N.S.
1956-1970	Imports	3.674	.100
1956-1970	Exports	12.146	.005
Canada			
1956-1969	Landings	0.292	N.S.
1956-1970	Imports	20.526	.005
1956-1970	Exports	20.526	.005
France			
1956-1969	Landings	1.167	N.S.
1963-1970*	Imports	0.500	N.S.
—	Exports	----------Negligible----------	

*Not an adequate number of observations.
N.S.—Non-significant at the .100 level of probability.
Source: Computed from data in Appendix Tables 1, 2, and 3.

Summary

From the preceding analyses it can be concluded that domestic landings of oysters in both the United States and Canada showed significant trends from 1956-1969. For the United States, this trend was downward, while for Canada it was upward. The results for France were nonsignificant. From the number of observations used in the analyses, no cyclical patterns were statistically discernible for any of the countries.

The analysis of imports revealed a significant upward trend for the United States only. The cyclical pattern of oysters imported into Canada during this period was found to be significant at the .005 level of probability. Imports into the United States were significant at the .10 level of probability.

The analysis of the exportation of oysters revealed significant downward trends for both the United States and Canada. Data obtained through FAO statistics indicated that France did not export significant quantities of oysters during the period under review. Cyclical patterns of oyster exports also proved highly significant for both the United States and Canada.

ANALYSIS OF DEMAND

From 1950 to 1971, per capita oyster consumption in the United States exhibited a marked downward trend (Figure 5). Deflated retail price showed a definite upward trend from 1950 to 1967 when deflated prices rose from $0.89 to $1.88 per pound (edible weight). From 1967 to 1971 prices leveled-off, fluctuating between $1.64 to $1.69 per pound (Figure 6).

Economic theory suggests that the consumption of a commodity is influenced by the price of the commodity, income, prices of substitute goods, and prices of complementary goods. This can be expressed in algebraic terms as follows:

$$Q=f(P, Y, P_s, P_c)$$

where: Q = consumption
P = price of commodity in question
P_s = prices of substitute goods
P_c = prices of complementary goods

Secondary time-series data (1950-1971) on prices, consumption, and consumer income were used to quantify the demand for oysters in the United States.

A linear demand function was estimated for oysters in the United States. Per capita consumption of oysters was hypothesized to be a

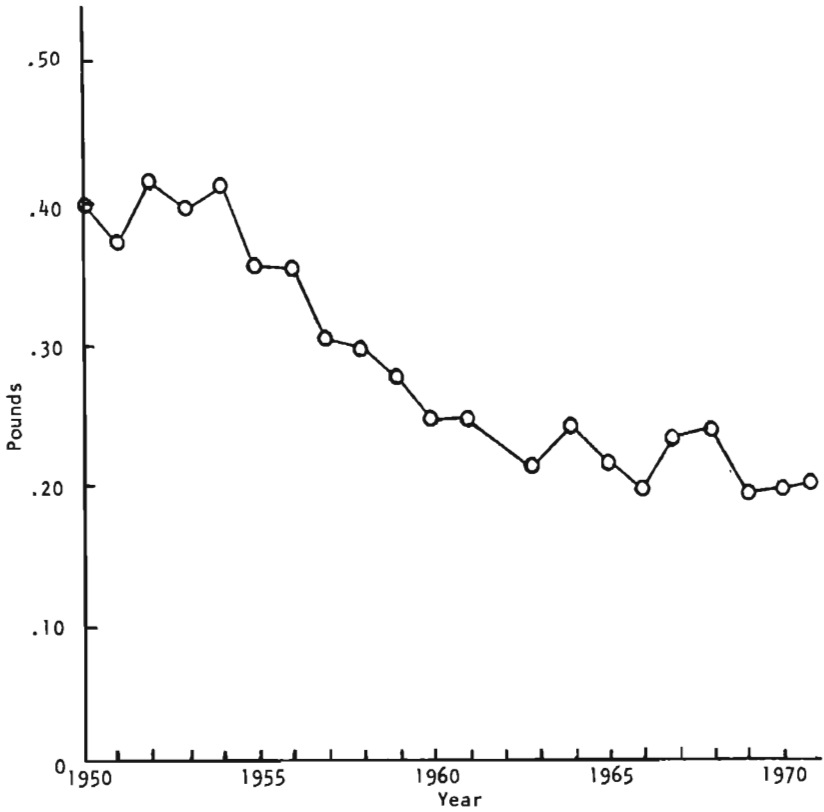

FIGURE 5

PER CAPITA CONSUMPTION OF OYSTERS
IN THE UNITED STATES, 1950-1971

function of deflated price of oysters, deflated per capita disposable personal income, deflated price of shrimp, and deflated price of crab,[10] that is:

$$Q = a+b_1P_1+b_2Y+b_3P_2+b_4P_3$$

where: Q = the per capita consumption of oysters

P_1 = the retail price of oysters divided by consumer price index,

Y = the per capita disposable personal income divided by the consumer price index,

[10]Shrimp and crab were hypothesized to be substitutes for oysters based on statement by J. Richards Nelson, President Long Island Oyster Farms, personal correspondence August 3, 1972. No complementary goods were discernible.

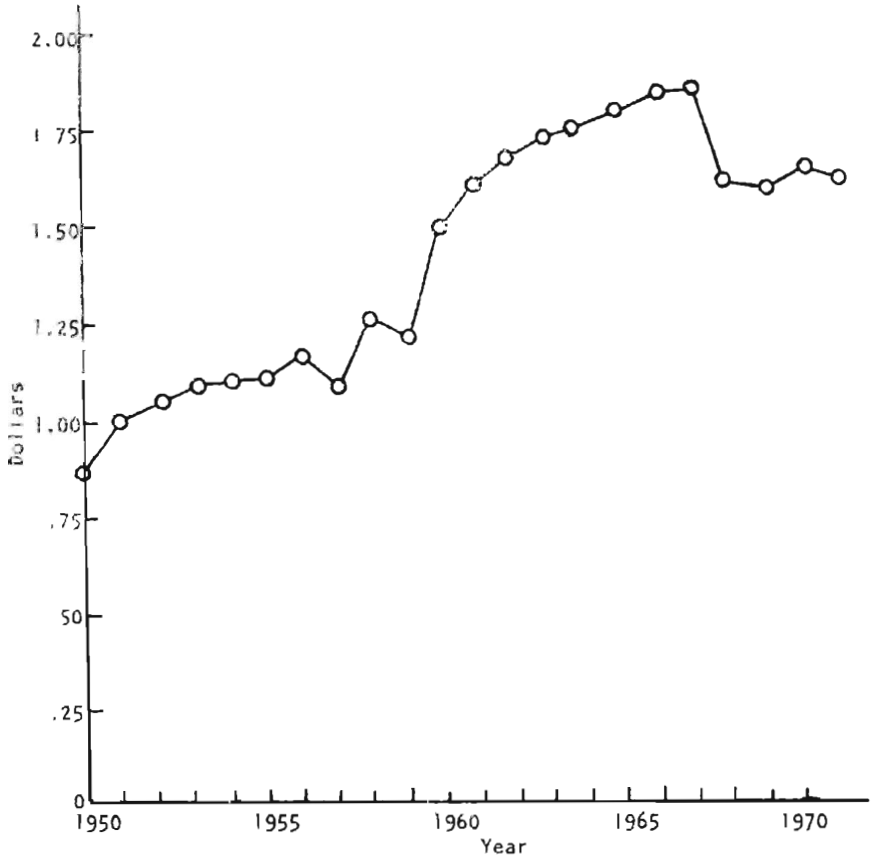

FIGURE 6

DEFLATED RETAIL PRICE PER POUND OF OYSTERS IN THE UNITED STATES, 1950-1971

P_2 = the retail price of shrimp divided by consumer price index, and

P_3 = the ex-vessel price[11] of crab divided by consumer price index.[12]

Economic theory suggests that the expected relationships between a commodity and its price is inverse, a commodity and income is direct,

[11]Ex-vessel price refers to the price received by the fisherman at the dock.

[12]The retail prices of crabs were not available for all species, for all years.

and a commodity and the price of substitute goods is direct. Therefore, the expected signs of the regression coefficients would be $b_1<0$, $b_2>0$, $b_3>0$, $b_4>0$.

Of the four independent variables used, two of them had the anticipated signs for the regression coefficient (price of oysters and price of crab), while income and the price of shrimp had the opposite signs.

The following equation shows the calculated values for the parameters:

$$Q=0.7555-0.1296\ P_1-0.0001\ Y-0.0709\ P_2+0.3774\ P_3$$

The squared multiple correlation coefficient was calculated to be .87 and the equation was found to be significant at the .005 level of probability. Of the four independent variables, only the regression coefficient for the price of oysters was found to be significant at the .05 level of probability.

Data on consumption and prices for Canada and France are illustrated in Figures 7, 8, 9, and 10. Regression analyses, similar to that performed on the data for the United States, were also conducted for Canada and France. The same variables used for the United States were used for Canada. However, for France the per capita consumption of oysters was hypothesized to be a function of deflated price of oysters, per capita disposable personal income, and deflated price of Portuguese oysters.[13] The results of these analyses are contained in Table 5.

Table 5

Estimated Demand Equations and Related Statistical Values for Oysters in the United States, Canada, and France

Country	Years	a	b_1	b_2	b_3	b_4	R^2
United States	1950-1971	0.7555	-0.1296*	-0.0001	-0.0709	0.3774	.87*
			(0.0542)	(0.0001)	(0.0793)	(0.6404)	
Canada	1950-1970	0.1909	-0.0079	0.00001	-0.0002	-0.0013	.07
			(0.0113)	(0.00005)	(0.0042)	(0.0056)	
France	1956-1969	0.8873	-0.3178*	-0.00002	0.1536		.35
			(0.1367)	(0.00006)	(0.4606)		

*Significant at .05 level of probability.

a=intercept.

b_1=regression coefficient for price of oysters.

b_2=regression coefficient for per capita disposable personal income.

b_3=regression coefficient for price of shrimp for the United States and Canada, regression coefficient for price of Portuguese oysters for France.

b_4=regression coefficient for price of crab.

Source: Computed from data in Appendix Tables 4, 5, and 6.

[13]Portuguese oysters (Hûitre portuguaise) was hypothesized to be a substitute for oysters (Hûitre plate).

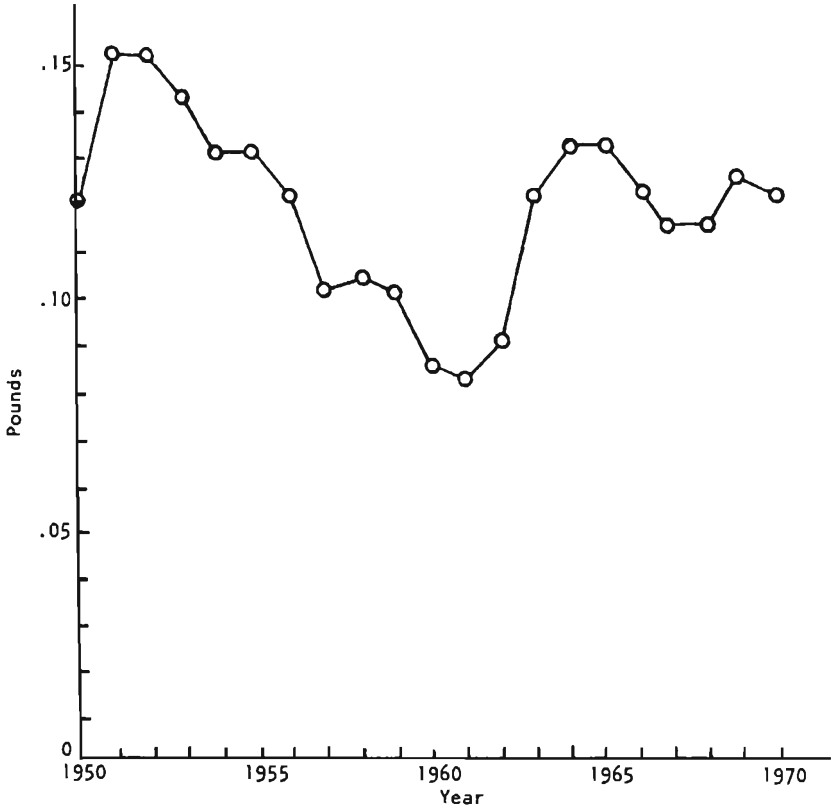

FIGURE 7

PER CAPITA CONSUMPTION OF OYSTERS
IN CANADA, 1950-1970

Since the regression coefficients for price of oysters in the United States and France proved significant at the .05 level of probability, price elasticities were calculated for these countries. Using mean values for the price of oysters and the consumption of oysters in the United States for the period 1950 to 1971, and the regression coefficient for price of oysters, which was previously found significant at the .05 level of probability, the price elasticity for oysters was calculated to be:

$$E_p = \frac{\partial Q}{\partial P} X \frac{\bar{P}}{\bar{Q}}$$

$$= -0.1296 \text{ X } \frac{1.44}{.28}$$

$$= -0.66$$

FIGURE 8

DEFLATED EX-VESSEL PRICE OF OYSTERS
IN CANADA, 1950-1970

The demand for oysters appears to be relatively inelastic and, as anticipated, the sign is negative. From 1950 to 1971, as the retail price of oysters rose, the per capita consumption of oysters was declining.

Using a similar procedure for the data from France, the price elasticity of demand for oysters was calculated to be -0.95. This indicates that the price elasticity of oysters is only slightly inelastic. During the years 1956 to 1969, as the ex-vessel price [14] of oysters rose, the per capita consumption of oysters declined.

[14]Ex-vessel prices were used because retail prices were unobtainable.

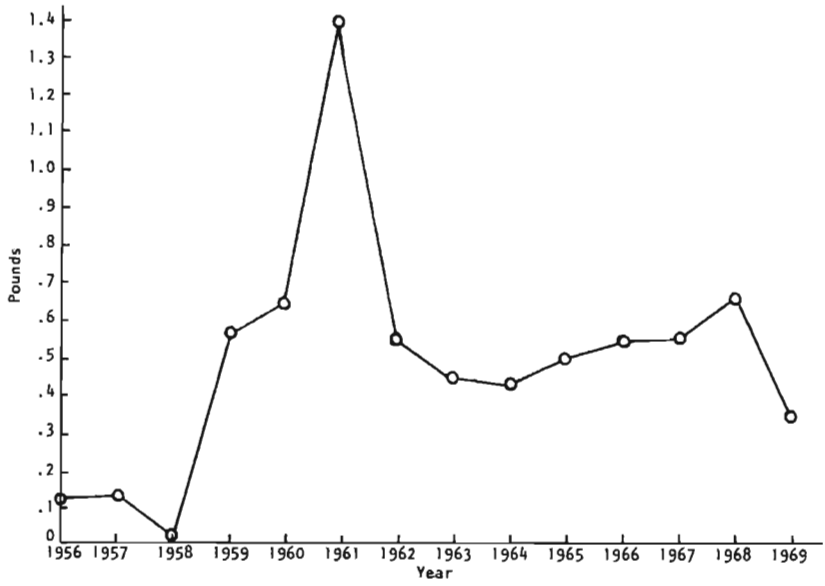

FIGURE 9

APPARENT PER CAPITA CONSUMPTION OF OYSTERS IN FRANCE
1956-1969

FIGURE 10

APPARENT DEFLATED EX-VESSEL PRICE PER POUND
OF OYSTERS IN FRANCE 1956-1969

An interesting result obtained from the demand analyses showed an inverse relationship between the per capita consumption of oysters and per capita disposable personal income for both the United States and France. It is generally believed that most shellfish are normal goods,[15] that is, that income elasticities are positive.

If this assumption is accepted, the shift in the oyster demand curve can be explained by either:

1. A positive income effect and an offsetting negative shift in consumer preference or
2. A positive income effect and an inability of people to obtain oysters because of diminishing supplies to market.

Either of these explanations would have caused a forced negative correlation between consumption of oysters and income. On the other hand, if it is assumed that consumer preference did not change during the periods under review and that supplies of oysters were readily available, there is an indication that oysters represent an inferior good.[16] Neither of the income regression coefficients for the United States or France, however, proved to be statistically different from zero using the two-tailed test at the .05 percent level of probability.

In the case of those shellfish that were hypothesized to be substitute goods for oysters, it was found that many of the cross-price coefficients had signs contrary to expectations, but none was statistically significant. Therefore, based on the data used, none proved to be substitutes for oysters in either the United States, Canada, or France.

Summary

The estimated demand equation for the United States proved to be highly significant. However, the only regression coefficient found to be statistically significant at the .05 level of probability was the price of oysters.

In view of the poor results obtained concerning the demand analysis of oysters for Canada, an attempt was made to explain further the fluctuations of per capita consumption of oysters for the period 1950 to 1970 by introducing other variables into the equation. Prices of clams and quahaugs, prices of lobsters, and prices of scallops were all included. The results of this analysis, however, did not differ significantly from the results obtained in the original analysis (See Table 6). On the basis of these results, it appears that the consumption of oysters in Canada is almost totally unrelated to own-price, disposable income and

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[15]A normal good is one for which the income effect is positive. Quantity demanded always varies inversely with price.

[16]An inferior good is one in which the income effect is negative.

Table 6

Revised Estimate Demand Equations and Related Statistical Values for Oysters in Canada and France

Country	Years	a	b_1	b_2	b_3	b_4	b_5	b_6	b_7	R^2
Canada	1950-1970	0.2095	-0.0067 (0.0128)	-0.00006 (0.0002)	0.0122 (0.0248)	-0.0011 (0.0099)	0.0003 (0.0044)	0.0004 (0.0011)	-0.0007 (0.0051)	.15
France	1956-1969	0.9697	-0.3065* (0.1231)							.34

*Significant at the .05 level of probability.
a=intercept.
b_1=regression coefficient for price of oysters.
b_2=regression coefficient for per capita disposable personal income.
b_3=regression coefficient for price of clams and quahaugs.
b_4=regression coefficient for price of crabs.
b_5=regression coefficient for price of lobsters.
b_6=regression coefficient for price of scallops.
b_7=regression coefficient for price of shrimp.
Source: Computed from data in Appendix Tables 5 and 6.

the prices of other shellfish. Further analysis would be necessary to isolate those variables that do influence the consumption of oysters in Canada.

Data used in this demand analysis of oysters in France were derived from gross F.A.O. statistics and do not take account of changes in inventories, imports, and exports. Therefore, the basis for the conclusions drawn are much weaker than those used in the analysis of demand for the United States and Canada. Referring to Table 5 it appears that the per capita consumption of oysters in France is negatively related to own-price, but is almost totally unrelated to disposable income, and the price of Portuguese oysters. The equation itself was found non-significant at the .05 level of probability. Because of this, another analysis was performed where the only independent variable included was price of oysters. This resulted in an equation that proved significant at the .05 level of probability (See Table 6).

THE HALF-SHELL OYSTER MARKET

The following is an effort to estimate the marketing costs and returns to potential Maine oyster producers in supplying oysters to the half-shell trades of Boston, Montreal, and Paris. Marketing costs considered were import duties, value added tax, and transportation costs.

Marketing Costs

Import duties and value added tax. There are no quantitative restrictions on the importation of oysters into Canada from the United

States or any other country. In the Canadian Customs Tariff Act, there are two tariff items referring to oysters. The first item (12500-1) is for "oysters, shelled, cans containing shelled oysters" and the tariff rate (the one applying to imports from the United States) is free. The second item (12505-1) refers to "oysters, prepared or preserved, oysters in the shell" and the tariff rate is 7.5 percent.[17]

Oysters in the shell (Tariff number 03.03B1, a and b) of the type "European flat oysters weighing not more than 40 grams each" imported into France from the United States enter duty-free. All other types imported into France are charged with an 18 percent *ad valorem* duty on c.i.f. (cost, insurance, and freight) value. In addition, there is a seven percent value added tax assessed on the c.i.f. duty-paid value (if the item enters duty-free, the tax is levied only on the c.i.f. value.[18]

Transportation costs. In estimating transportation costs the following assumptions were made:

1. Oysters in the shell would be shipped by road as refrigerated, bulk shipments from two potential Maine production areas — Jonesport and Rockland.
2. These weekly shipments from Jonesport and Rockland would occur for forty weeks of the year. None would be shipped during the spawning season (June, July, and August).
3. These oysters would be sent by road from Jonesport and Rockland to Bangor, Maine; Boston, Massachusetts; and Montreal, Canada.

One possibility envisioned was to ship oysters by road to Bangor International Airport where they would be transferred to air carriers for shipment to Montreal and Paris.[19] This proved to be infeasible since Bangor International Airport is used predominantly by unscheduled carriers for freight. Therefore, shipment to either of these cities would require the chartering of aircraft or the shipment of oysters as freight on passenger flights from Bangor to Boston.[20] In Boston, the oysters would have to be transferred to other flights for shipments to Montreal and Paris. The amount envisioned to be shipped was much too small to warrant the chartering of a weekly cargo flight and the transportation costs involved in shipping as belly-loads from Bangor to Boston and

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[17]Proulx, A., Manager, Intelligence Services Division, Marketing Services Branch, Fisheries Services, Department of the Environment, Ottawa, Canada. Personal correspondence, August 11, 1972.

[18]Mullelly, E. F., Acting Director, European Regional Affairs and Trade Regulations Staff, Office of International Marketing, U.S Department of Commerce, Bureau of International Commerce, Washington, D.C. Personal correspondence, May 7, 1973.

[19]Shipments to Boston would be made by truck from Rockland and Jonesport.

[20]Ziegelaar, B. W., Assistant Sales Manager, Operations Department, Bangor International Airport. Personal correspondence, March 22, 1973.

Montreal did not prove to be competitive with trucking rates.[21] Therefore, air transportation from Bangor International Airport was disregarded.

Another alternative open for the shipping of oysters to Paris was to ship from production areas in Maine to Boston by truck, there to transfer the oysters onto flights to Paris. However, air transportation costs coupled with the relatively low prices for American oysters in Europe proved to be prohibitive (See Table 7).

Table 7
Estimated Marketing Costs and Returns to Maine Oyster Producers Competing in the Half-Shell Oyster Trades of Boston, Montreal, and Paris

Half-Shell Oyster Market	Oyster Classification	Wholesale Price	Tariff and Value Added Tax	Transportation Costs	Margin to Cover Production Costs and Profit
		cents per oyster			
Boston	½-Shell	6.9	—	1.1	5.8
Montreal	½-Shell	9.6	0.7	1.7	7.2
Paris	American Oysters	12.0	6.4	12.4*	-6.8

*Based on trucking transportation from central production area in Maine to Boston, and from Boston, by air to Paris.

The Boston Half-Shell Market

From the responses contained in the questionnaires, half-shell oysters were found to be available in the Boston trade during the months of September through May with only a limited number available during the summer months. Sources of supply of these oysters were Long Island Sound, Massachusetts, Chesapeake Bay, and New Jersey. A recent wholesale price paid for half-shell oysters in this market was 6.9 cents per oyster.

Respondents in Boston expressed satisfaction with the quality of the oysters that they are currently receiving. They also were satisfied with the uniformity of pack and the availability of the oysters. A few expressed concern over prices, although most respondents seemed satisfied. Prices have remained fairly stable during the previous two years. Nevertheless, the possibility exists that producers might be able to gain higher prices based on quality and service, according to responses of traders in the Boston market. However, if a viable industry were established in Maine, this might be difficult to achieve and maintain over an extended period of time because the oyster business is highly competitive.

[21] Ibid.

Transportation costs were based on trucking costs from two proposed production areas in Maine (Jonesport and Rockland) to Boston. Estimated shipping costs were found to amount to 1.1 cents per oyster. Assuming the validity of the recent wholesale price of 6.9 cents per oyster and the shipping cost of 1.1 cents per oyster, this would leave 5.8 cents per oyster to cover production costs and profit for the Maine producer (See Table 7). Based on the preceding information, if the would-be oyster producers in Maine are able to meet the following criteria, the Boston half-shell restaurant trade offers an economic outlet for their production:

1. Produce oysters and receive a satisfactory return for approximately 5.8 cents per oyster.
2. Compete with the other producing areas on quality of product, uniformity of pack, and consistent availability of oysters from September to May.

The Montreal Half-Shell Market

From the information contained in the questionnaires the oyster consuming season in Montreal begins in September, peaks in December, and virtually ends in May. As with Boston, a limited number of oysters, from the United States, is available all year round.

Oysters in Montreal were found to originate almost exclusively in the Maritime Provinces of Canada and Long Island Sound in the United States. The size, uniformity, grade, and availability of the Long Island oysters were considered to be superior to those from the Maritimes. However, the oysters from the Maritimes were judged to be much better in taste. They were described as being "juicier" and "saltier" in taste than those from Long Island Sound. The taste of Maine-raised oysters is an unknown factor which may well become an important consideration in their acceptance in any of the half-shell markets.

Unlike Boston, prices in Montreal were described by almost all respondents as "too high." There seemed to be a wider range of higher prices than experienced in Boston. One restaurant indicated that it cost from $32-$45 per case (12-17 cents per oyster) of 22 dozen oysters from the Maritimes. However, unlike others, this restaurant expresed satisfaction with the quality of pack and availability of Maritime oysters. This indicates the premium available to oyster producers for superior quality and service in the Montreal market. Another restaurant indicated that the cost per oyster was 11-12 cents after eliminating those oysters that had to be discarded. Oysters were also found to cost the restaurant patrons from 25-35 cents per oyster and many considered this too high a price for an appetizer since six oysters were usually included in a serving.

Transportation costs were based on trucking costs from Jonesport and Rockland, Maine to Montreal. Estimated shipping costs amounted to 1.7 cents per oyster. Assuming the validity of the wholesale price of 9.6 cents, an import duty of 0.7 cents, and transportation costs of 1.7 cents per oyster, this would leave 7.2 cents per oyster to cover production costs and profit for the Maine producers (See Table 7).

Several conditions will determine the economic feasibility of a Montreal market for Maine-raised oysters. They are:

1. Produce oysters with a reasonable return for approximately 7.2 cents each.
2. Compete with the maritime producers on taste, and with the Long Island Sound producers on availibility, size, grade, and quality of pack.

The Paris Half-Shell Market

Half-shell oysters in Paris are available from September to May. Prices are set in August and do not vary during the consuming season.[22] The main source of half-shell oysters is from France with lesser quantities coming from the Netherlands and Ireland.[23] From the responses obtained through the questionnaires, prices were judged to be normally high, and quality of oysters was judged to be excellent with abundant supplies usually available.

A limited number of United States bluepoint oysters has been exported from the United States to Europe during the past few years.[24] Although these oysters are considered to be the same quality as size 4, Zealand, they bring less than half the price (12 cents as compared to 25 cents).[25] Because of this, the 18 percent *ad valorem* import duty, the seven percent value added tax, and the high cost or air transportation, American oysters appear to be uneconomical for exportation from the United States to France (See Table 7). The high cost of air transportation may even preclude the exportation of American-raised European oysters to Paris, particularly if these oysters are discriminated against on price as the American oyster has been in the past. However, if air cargo rates can be negotiated downward, or if other forms of transportation such as sea transportation prove economically and biologically feasible, the Paris market may offer possibilities for Maine producers.

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[22]Syndicat du commerce des huites en gros, du M.I.N. de Paris-Runguis. 63, Allee de Saint-Malo, M.I.N. Runguis (94), France. Personal correspondence, January 29, 1973.

[23]Ibid.

[24]*Representative Wholesale Prices for Fresh Oysters in Selected European Markets*, U.S. Department of Commerce, Washington, D.C.

[25]Ibid.

At the present time American oysters, *Crassostrea virginica,* from Long Island Sound are being shipped to Europe by sea. Thus, it is possible to ship in containers by sea under refrigeration, but the time required makes it almost essential that the stock be conditioned by being put back into pure sea water at the proper salinity for a suitable period before marketing. It is difficult to find such facilities in Europe.[26]

Another difficulty arises when consideration is given to shipping the European oyster, *Ostrea edulis,* from the United States to Europe by sea. There is some indication that they are more fragile than the *Crassostrea virginica* and thus mortality could be a major problem. Research is needed in this area to determine the extent of the problem.

SUMMARY AND CONCLUSIONS

At present, the oyster industry in Maine is almost non-existent. The main retardant to any growth of this industry appears to be the inability of the native species, *Crassostrea virginica* to survive in economic numbers through the larval stage in Maine's cold waters. If this problem can be overcome, or if the introduced species, *Ostrea edulis,* from Europe proves to be successful, there is sufficient evidence that markets are available for Maine's oyster production.

The half-shell oyster market appears to offer the best economic choice to consider if an industry were to develop in the State. The reasons for this are:

1. Half shell oysters command premium prices,
2. No further processing, such as shucking, is required, and
3. Assuming success in the economic cultivation of *Ostrea edulis* in Maine, the superior appearance and uniform shape of this oyster make it a desirable oyster for the half-shell trade.

One uncertainty does exist. This deals with the acceptance, in North America, of the flavor of *Ostrea edulis.* However, this species is well accepted in Europe and there appears to be no serious reason why *Ostrea edulis* would not be accepted here.

Based on an average wholesale price of 9.6 cents per half-shell oyster in Montreal, a margin of 7.2 cents per oyster was found available to cover production costs and profit. If this proves sufficient, the Montreal market appears to be an economic outlet for some of Maine's production. This, however, will depend on the entrepreneurial ability of Maine producers in developing this market and by providing consistently high quality oysters at competitive future prices.

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[26]Nelson, J. Richards, President of Long Island Oyster Farms, personal correspondence, August 16, 1973.

A similar result was found for Boston where 5.8 cents per half-shell oyster was available to cover production costs and profit.

The market in Paris, France does not appear to be a feasible one for Maine producers at the present time. This is due to a number of factors. Among them are the high cost of air transportation of oysters in the shell, a value added tax, an *ad valorem* duty on *Crassostrea virginica* (and *Ostrea edulis* over forty grams), and the relatively low price received for American oysters in Europe. However, if air cargo rates can be negotiated downward, or if other forms of transportation such as sea transportation prove economically as well as biologically feasible, the Paris market may offer possibilities for Maine producers. This is particularly true if Maine-raised oysters grade and are priced as high as premium European oysters.

An analysis of oyster supplies in the United States, Canada, and France revealed statistically significant trends only in domestic landings for the United States and Canada. For the United States this production was downward, while for Canada it was upward. Only the upward trend for the importation of oysters into the United States proved to be statistically significant. Nevertheless, this increasing trend may have little effect on Maine producers since this increase in importation over time is composed almost entirely of canned and processed oysters. Maine's production is envisioned to go primarily to the more exclusive half-shell trade. Both the exporting of oysters from the United States and Canada were statistically significant, both in a downward direction. None of the sources of supply for oysters in France indicated any significant trends. However, these results may have been due to the crudeness of the data available.

The only independent variable that appeared to explain the per capita consumption of oysters in both the United States and France was own-price. For Canada, none of the independent variables proved to be significant. Neither per capita disposable personal income nor the prices of other shellfish appeared to have any effect on the per capita consumption of oysters in any of the three countries. The only data available were for total oyster consumption. If data had been available on half-shell consumption, a different picture might have emerged.

The accuracy of the previous analyses has been hampered by the general crudeness of the data available. Nevertheless, this study does provide a starting point in the overall supply and demand analysis for oysters in the United States, Canada, and France and a beginning step in evaluating the half-shell oyster markets of Boston, Montreal, and Paris. Further biological and economic work is needed, but this analysis says, "let's go further."

Appendix Table 1
United States—Domestic Landings,
Imports and Exports of Oysters,
1956-1970

Years	Domestic Landings	Imports	Exports
	thousand metric tons		
1956	467.7	1.0	0.4
1957	443.2	1.2	0.4
1958	426.7	1.9	0.4
1959	418.8	1.9	0.4
1960	397.4	2.2	0.3
1961	402.8	2.6	0.3
1962	364.9	2.7	0.2
1963	395.0	2.8	0.1
1964	414.5	2.6	0.2
1965	350.9	2.7	0.1
1966	356.4	3.8	0.1
1967	415.3	5.7	0.1
1968	388.7	4.6	0.0
1969	355.4	4.9	0.0
1970	N.A.	3.3	0.0

N.A.—Data not available.
Source: *F.A.O.-U. N. Yearbooks of Fishery Statistics.*

Appendix Table 2
Canada—Domestic Landings, Imports
and Exports of Oysters,
1956-1970

Years	Domestic Landings	Imports	Exports
	thousand metric tons		
1956	4.8	0.5	0.4
1957	4.0	0.5	0.3
1958	4.0	0.5	0.2
1959	5.0	0.5	0.1
1960	4.2	0.5	0.1
1961	4.7	0.5	0.1
1962	5.0	0.4	0.1
1963	7.7	0.3	0.1
1964	6.9	0.3	0.1
1965	6.7	0.3	0.1
1966	7.3	0.3	0.1
1967	5.7	0.4	0.1
1968	4.7	0.4	0.2
1969	5.5	0.4	0.2
1970	N.A.	0.5	0.3

N.A.—Data not available.
Source: *F.A.O.-U. N. Yearbooks of Fishery Statistics.*

Appendix Table 3

France—Domestic Landings and Imports of Oysters, 1956-1970

Years	Domestic Landings	Imports
	----------thousand metric tons----------	
1956	12.6	N.A.
1957	18.8	N.A.
1958	13.2	N.A.
1959	88.5	N.A.
1960	87.5	N.A.
1961	87.1	N.A.
1962	76.5	N.A.
1963	70.3	8.5
1964	62.2	8.6
1965	65.8	6.2
1966	62.3	5.4
1967	69.5	6.6
1968	44.7	7.5
1969	39.5	8.2
1970	N.A.	6.1

N.A.—Data not available.
Source: *F.A.O.-U. N. Yearbooks of Fishery Statistics.*

Appendix Table 4
United States—Per Capita Fresh and Frozen Oyster Consumption, Current Prices, Current Per Capita Disposable Personal Income, Consumer Price Index (1967=100), 1950-1971

Years	Per Capita Consumption of Oysters	Current Retail Price of Oysters	Current Per Capita Disposable Personal Income	Current Retail Price of Shrimp	Current Ex-Vessel Price of Crab	Consumer Price Index (1967=100)
	(lbs.)	($/lb.)	($)	($/lb.)	($/lb.)	
1950	.3942	.64	1,364	.79	.0579	72.1
1951	.3723	.78	1,469	.82	.0659	77.8
1952	.4122	.84	1,518	.87	.0669	79.5
1953	.3982	.88	1,583	1.05	.0707	80.1
1954	.4135	.90	1,585	.90	.0690	80.5
1955	.3557	.90	1,666	.88	.0744	80.2
1956	.3543	.96	1,743	1.00	.0817	81.4
1957	.3071	.93	1,801	1.11	.0715	84.3
1958	.2937	1.09	1,831	1.17	.0744	86.6
1959	.2724	1.07	1,905	1.08	.0847	87.3
1960	.2459	1.34	1,938	1.07	.0769	88.7
1961	.2464	1.44	1,984	1.08	.0748	89.6
1962	.2268	1.54	2,066	1.22	.0798	90.6
1963	.2144	1.60	2,139	1.18	.0846	91.7
1964	.2414	1.65	2,284	1.08	.0880	92.9
1965	.2157	1.71	2,436	1.17	.0918	94.5
1966	.1986	1.81	2,605	1.28	.0887	97.2
1967	.2300	1.88	2,751	1.36	.1103	100.0
1968	.2355	1.72	2,946	1.35	.1745	104.2
1969	.1963	1.80	3,130	1.40	.1675	109.8
1970	.1993	1.97	3,358	1.26	.1415	116.3
1971	.2001	2.03	3,590	1.55	.1869	121.3

Source: Data derived from information supplied by N.M.F.S., United States Department of Commerce; Bureau of Labor Statistics, United States Department of Labor; Economic Research Service, United States Department of Agriculture; and Agricultural Experiment Station, University of Maryland.

Appendix Table 5

Canada—Per Capita Oyster Consumption, Current Prices, Current Per Capita Disposable Personal Income, Consumer Price Index (1961=100), 1950-1970

Years	Per Capita Consumption Oysters	Current Ex-Vessel Price of Oysters	Current Per Capita Disposable Personal Income	Current Ex-Vessel Price of Shrimp	Current Ex-Vessel Price of Crab	Consumer Price Index (1961=100)
	(lbs.)	(¢/lb.)	($)	(¢/lb.)	(¢/lb.)	
1950	.1224	4.03	969	17.58	9.09	79.6
1951	.1534	5.27	1,102	20.57	9.48	88.0
1952	.1533	6.19	1,170	17.09	11.11	90.2
1953	.1422	5.61	1,194	13.11	10.74	89.4
1954	.1316	5.24	1,169	14.72	10.96	89.9
1955	.1303	5.13	1,231	16.64	10.37	90.1
1956	.1205	6.39	1,325	16.37	10.34	91.4
1957	.1054	6.57	1,367	16.02	9.83	94.3
1958	.1078	7.25	1,423	15.99	9.12	96.8
1959	.1032	8.12	1,455	16.48	10.13	97.9
1960	.0874	7.90	1,457	17.82	10.16	99.1
1961	.0832	7.87	1,475	16.07	10.21	100.0
1962	.0907	7.58	1,579	16.12	10.90	101.2
1963	.1235	6.53	1,646	15.88	11.89	103.0
1964	.1335	6.84	1,713	15.30	16.07	104.8
1965	.1338	7.74	1,846	16.01	15.76	107.4
1966	.1239	8.54	1,994	17.84	12.96	111.4
1967	.1143	11.12	2,116	17.92	13.49	115.4
1968	.1163	11.27	2,262	16.27	11.49	120.1
1969	.1241	10.35	2,424	23.05	10.41	125.5
1970	.1205	12.35	2,535	20.61	10.52	129.7

Source: Data derived from information supplied by Fisheries Service, Department of the Environment, Ottawa, Canada, and Statistics Canada. Ottawa, Canada.

Appendix Table 6

France—Per Capita Oyster Consumption, Current Prices, Current Per Capita Disposable Personal Income, Consumer Price Index (1953=100), 1956-1969

Years	Per Capita Oyster Consumption	Current Ex-Vessel Price of Oysters	Current Ex-Vessel Price of Portuguese Oysters	Current Per Capita Disposable Personal Income	Consumer Price Index (1953=100)
	(lbs.)	(N.F.F./lb.)	(N.F.F./lb.)	(U.S. $)	
1956	.1307	2.86	.79	899	103
1957	.1442	2.77	.85	992	106
1958	.0098	1.08	.73	920	121
1959	.5701	1.35	1.46	846	129
1960	.6514	1.39	1.78	960	133
1961	1.4040	.74	.83	991	138
1962	.5551	1.54	.95	1,111	138
1963	.4606	2.00	1.25	1,210	145
1964	.4462	2.26	1.20	1,287	149
1965	.5047	2.70	1.32	1,363	154
1966	.5533	3.00	1.55	1,522	158
1967	.5784	2.92	1.53	1,642	162
1968	.6615	2.29	1.23	1,770	170
1969	.3723	3.01	1.45	1,981	180

N.F.F.—New French Franc.

Source: Data derived from information supplied by the United States Department of the Interior, *F.A.O.-U. N. Yearbooks of Fishery Statistics*, and *United Nations Demographic Yearbooks*.