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# SOME FACTORS INFLUENCING MAINE LOBSTER LANDINGS

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ABSTRACT

In this four-part article, some of the factors influencing lobster landings are examined.

Part I describes experiments carried on to measure the value of extended lobster fishing time. Concurrently information on the validity of catch-per-unit-of-gear as an index of lobster population abundance was obtained. Results indicate that during the last quarter (spring) of the lobster year when the legal-size population has been reduced to a minimum, extended-period fishing may be economically more efficient than short-period trapping. For reasons of extreme variability in the length of the fishing year, catch-per-unit-of-gear cannot be used as a valid index of lobster abundance.

Part II shows that analysis of data on the Maine lobster fishery during recent years indicates a measurable causal relationship between spring sea water temperature and summer landings. The magnitude of summer landings determines the price paid fishermen during the period and influences fishing intensity and landings during the following winter and spring.

Part III points out that available data on the Maine lobster fishery during the period 1939-1947, when landings increased nearly 200 percent above the average of the two preceding decades, indicate that an increase in landed value was the principal causative factor.

Part IV indicates that major long-term fluctuations in Maine lobster landings are the result of variations in fishing effort and that the number of traps fished is the most consistent index of that effort.

## Part I - Length of Fishing Time and Catch-Per-Unit-of-Gear in the Maine Lobster Fishery

### BACKGROUND

Maine commercial lobster fishermen generally believe that their catches are increased by set-over fishing except during the peak post-moult fishing period of the late summer and early fall when greater catches sometimes compel them to empty their traps daily or, on occasion, even more frequently.

The period of such extension beyond one day may range to a week or more when weather conditions are sufficiently unfavorable, but generally does not exceed 72 hours.

Belief in the efficiency of extended period fishing is based on the assumption that prolonged exposure of lobsters to undisturbed baited traps will increase the net catch. The assumption presupposes concurrent escapement will be less than the continuing level of catch.

Experimental traps fished under the direction of research personnel of the Maine Department of Sea and Shore Fisheries by commercial lobster fishermen in three rather widely

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scattered areas of the central Maine coast provide information on this assumption as well as on the validity of catch-per-unit-of-gear as an index of the magnitude of lobster populations.

In this report the following terms are used: "trap haul," the act of checking a trap for catch by lifting or hauling it aboard the fishing vessel; "daily," on successive days; "set-over," on non-successive days; and "length of fishing time," the duration of time during which a trap is unchecked for catch.

Fig. 1 - A small harbor in eastern Maine showing lobster boats and traps.

## MATERIALS

Three groups of 12 to 15 traps were built to the specifications of each of three commercial fishermen who had volunteered to fish them and to maintain catch records during the period of the experiments.

## METHODS

A trap built by the Department and one built by the fisherman concerned were fished in pairs for control purposes. This procedure conforms to the practice of fishing two or more traps on a single line in those areas where the type of bottom, tidal currents, water depth, and other related factors are believed to cause high losses when traps are operated singly.

Catch records without regard for legal or non-legal lobsters were maintained on forms prepared and furnished by the Department.

Fishing was carried on during the following months:

Area #1--August, September, October, December, January, March, April, and May.

Area #2--October, November, February, March, April, May, June, October, and November.

Area #3--December, January, February, April, and May.

To reduce individual trap design and location as factors of fishing efficiency, traps were randomly checked for catch and reset on both a daily and set-over basis.

## RESULTS

The period of the experiments covered approximately one year; only in July were no traps fished (table 1). Seventy-one days of 807 daily trap hauls averaging 11.4 traps per haul-day produced 2,005 lobsters, or an average of 2.55 lobsters per trap haul. A total of 198 days of 2,505 set-over trap hauls averaging 12.6 traps per haul-day produced 6,323 lobsters, or an average of 2.52 lobsters per trap haul.

Table 1 - Comparison of Maine Lobster Catches by Daily and Set-Over Trap Hauls

| Month | Total Daily Trap Hauls | Avg. No. Lobsters Caught Per Trap | Total Set-Over Trap Hauls | Avg. No. Lobsters Caught Per Trap |
|---|---|---|---|---|
| August | 104 | 3.16 | 110 | 3.03 |
| September | 85 | 3.58 | 397 | 2.95 |
| October | 52 | 2.35 | 244 | 2.78 |
| November | 76 | 2.96 | 198 | 3.55 |
| December | 240 | 2.42 | 260 | 2.28 |
| January | - | - | 172 | 1.90 |
| February | 54 | 3.56 | 174 | 2.48 |
| March | 16 | 1.75 | 180 | 2.34 |
| April | 72 | 1.51 | 274 | 1.79 |
| May | 108 | 1.53 | 416 | 2.32 |
| June | - | - | - | - |
| Total | 807 | - | 2,505 | - |
| Avg. no. of lobsters caught per trap | - | 2.55 | - | 2.52 |
| Avg. no. of traps hauled per day | 11.4 | - | 12.6 | - |

## DISCUSSION

LENGTH OF FISHING TIME: Set-over haul fishing was carried on in all months except July. Daily haul fishing was carried on in all months except January, June, and July. Since the same traps were used for both types of fishing, individual trap bias was not a problem.

Set-over haul catches were greater in October, November, March, April, and May; while daily haul catches were greater in August, September, December, and February.

There is evidence to support the belief of commercial fishermen that during the peak post-moult (September) availability of lobsters, daily haul catches are somewhat higher (3.58 per trap) than those made by set-over (2.95 per trap) fishing. The high average trap catch at this season, with consequent crowding of the lobsters in the trap, competition for entry, more rapid deterioration of bait because of high water temperature, and subsequent escapement during the set-over time may serve to reduce the set-over catch in comparison with daily haul fishing.

Fig. 2 - Maine fisherman repairing lobster trap.

Conversely, less crowded conditions toward the end of the lobster year (June) when the available legal population has been reduced by eight months of fishing may make set-over fishing economically more attractive. Re-

sults of the experiments indicate that during the last third of the lobster year (March-June) the average catch for set-over fishing is 35 percent higher than for daily fishing.

The most intense fishing activity occurs during the period from July through September. When late moulting delays the appearance of the annual recruitment significantly into this period, most of the fishing effort has not been effectual in reducing the recruited population, and a larger population survives to the winter and spring fisheries. The reduced intensity of fishing--set-over fishing--may permit a greater carry-over abundance to last through the winter and spring fisheries. The net affect on annual landings is likely to be small because the fishing effort expended prior to the delayed summer recruitment actively diminished annual landings by the yield of an equivalent effort applied at the end of the lobster year--May and June--when its productivity would be least.

Fig. 3 - Oared boats have been largely replaced in the Maine fishery by outboard and inboard powered boats.

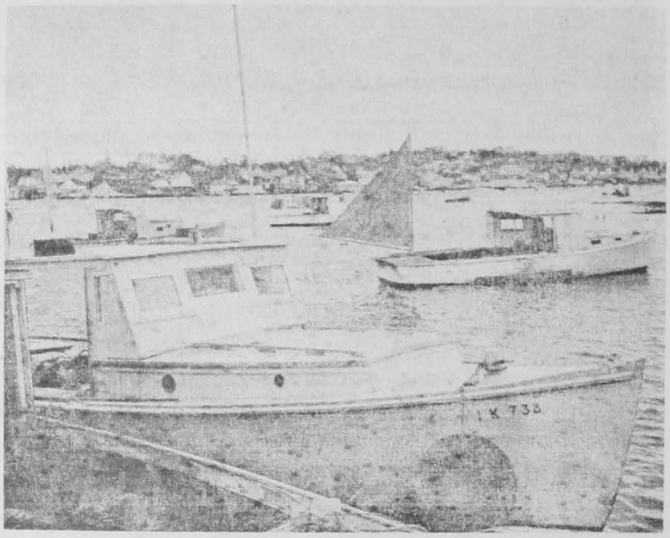

Fig. 4 - Typical Maine lobster boats.

CATCH-PER-UNIT-OF-GEAR: Although average catch per trap per day was slightly lower (0.03) for set-over fishing than it was for daily fishing, total catch for the year was 2.8 times greater because of the greater number of fishing days. In these experiments typical of fishing practices and conditions, the set-over fishing year contained 198 haul days during which each trap produced an average of 500 lobsters. The daily haul fishing year, less attractive economically toward the end of the lobster year because of the sharply reduced available population of lobsters, contained only 71 haul days during which each trap produced an average of 181 lobsters.

Since annual catch-per-unit-of-gear is based on the total annual catch per trap, the more days of fishing the greater will be the total catch and the yield per unit of gear.

For reasons of demonstrated wide variability in the length of the actual fishing year of any given number of traps, catch-per-unit-of-gear in the lobster fishery has no validity as an index of abundance. It does serve as an imprecise measure of response on the part of fishermen to meteorological and economic pressures.

## CONCLUSIONS

1. On an annual basis, set-over fishing is not more efficient nor will it produce greater landings than daily haul fishing. There is evidence that as the available population declines toward the end of the lobster year, set-over fishing may become economically more efficient.

2. Catch-per-unit-of-gear is not a valid index of lobster abundance.

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## Part II - Influence of Economic and Biological Factors in the Maine Lobster Fishery as Measured by the Sequential Relationship of Sea Water Temperature to Landings to Price to Fishing Intensity

Two divergent explanations to account for the magnitude of fluctuations in Maine lobster, Homarus americanus, landings have been discussed in previous reports. Dow and Trott (1956) attributed fluctuations in annual landings to economic influences while Taylor, Bigelow and Graham (1957) associated a correlation of 0.85 between lobster landings and corresponding mean sea water surface temperature for the months October through April during the period 1939-1949 with the probability of more optimum conditions contributing to the survival of a greater number of lobsters to catchable size.

That both biological (meteorological) and economic factors influence lobster landings has been suggested by these studies. How these factors are related and the extent to which each effects landings is indicated by a study of the fishery in recent years.

Fig. 5 - Ocean perch racks (what is left of fish after filleting) are used extensively in Maine for lobster bait.

(1) Measurable relationships between April-May subsurface sea water temperature (thermograph records, 1952-1960) and July-August post-moult lobster landings representing one-third of the average annual catch, (2) between July-August landings and average landed price, and (3) between average July-August price and landings during the first six months of the following year representing one-sixth of the average annual catch, are suggested for the period 1952-1960 by correlations[1/] of 0.96 between the first two series attributable to the association between water temperature and recruitment of previously sub-legal lobsters through expansion or contraction of the moulting period, -0.98 between the second two series attributable to market response, and of 0.72 between the third two series attributable to fishing intensity.

Table 2 - Relation of April-May Water Temperature to July-August Maine Lobster Landings to Landed Price to Winter-Spring Landings

| Year | a<br>April-May Water Temperature Above 40° F. | b<br>July-Aug. Post-Moult Lobster Landings | c<br>July-Aug. Avg. Landed Price | d<br>Lobster Landings the Following January-June |
|---|---|---|---|---|
| | ° F. | Million Lbs. | ¢ 1 Lb. | Millions Lbs. |
| 1960 | 6.6 | 6.5 | 44 | 4.3 |
| 1959 | 4.8 | 5.3 | 51 | 4.5 |
| 1958 | 5.8 | 6.0 | 50 | 4.4 |
| 1957 | 8.0 | 7.8 | 35 | 4.4 |
| 1956 | 5.0 | 5.1 | 50 | 4.1 |
| 1955 | 8.6 | 8.3 | 32 | 3.2 |
| 1954 | 8.5 | 8.1 | 34 | 3.8 |
| 1953 | 10.0 | 8.1 | 33 | 3.6 |
| 1952 | 7.6 | 7.1 | 42 | 4.1 |

Relationship between a and b with a correlation of 0.96 may be expressed as b = 2.1 + (0.67)a.
Relationship between b and c with an inverse correlation of -0.98 may be expressed as c = 13.1 + (-1.5)b.
Relationship between c and d with a correlation of 0.72 may be expressed as d = 2.42 + (0.385)c.
Relationship between a and d with an inverse correlation of -0.69 may be expressed as d = 52.2 + (-0.167)a.

1/ Correlations were calculated by the simple linear method of least squares.

Water temperature is related to the peak time of moulting. After moulting, feeding activity increases and lobsters are more easily trapped. The level of water temperature in April and May is related to the magnitude of the catch in July and August. Catch determines the price paid fishermen during July and August. Summer price appears to influence fishing intensity of the following winter and spring and, in turn, is related to the magnitude of landings for the period.

Based on water temperature only, computed values differed from actual values by ±4.2 percent for July-August landings, by ±6.0 percent for July-August price, and by ±8.3 percent for January-June landings during the period.

Although winter-spring inshore water temperature, closely related to the time of recruitment of newly moulted lobsters, had no measurable effect upon landings of contemporaneous winter and spring fisheries, July-August price factors, determined by post-moult landings, appear to have directly influenced fishing intensity throughout the subsequent January-June period (table 2).

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## Part III - Observations on the Productive Recovery of the Maine Lobster Fishery

### BACKGROUND

Prior to 1939 when a continuous statistical service was established, Maine lobster catch records were based on estimates of the industry, the Department of Sea and Shore Fisheries, and the U. S. Fish and Wildlife Service (or its predecessor agencies).

These data, extant only since 1880, indicate that landings reached a peak of 24.5 million pounds in 1889 but declined to an annual average of 13.5 million for the next 15 years.

In the following decade a gradual increase reached 20.0 million pounds by 1910 but declined thereafter to 10.5 million pounds annually at the beginning of World War I. From 1919 to 1940 production fluctuated only moderately, between 5.0 and 7.75 million, the lowest average in the history of the fishery.

Fig. 6 - Lobster dealer's buying site in eastern Maine.

A rapid increase in landings occurred during World War II and by 1945 total landings exceeded 19 million pounds. Despite annual declines since 1945, a general upward trend has characterized the fishery and during the 1950 decade landings averaged 21.5 million pounds annually.

Production data together with other information suggest that historically as well as otherwise the fishery may be divided into several rather distinct periods (table 3). Until about 1845 little commercial use had been made of the resource. Other than a small seasonal market for live lobsters, the shellfish were used only as bait in some of the groundfish fisheries, for fertilizer on coastal farms, and as food.

Table 3 - Average Annual Maine Lobster Landings by Periods

| Period | Years | Millions of Pounds |
|---|---|---|
| Canning | 1843-1894 | 20.1 |
| First large-scale live storage | 1895-1904 | 13.3 |
| Pre-World War I | 1905-1916 | 15.2 |
| Post-World War I | 1919-1929 | 6.5 |
| Depression | 1930-1938 | 6.5 |
| World War II | 1939-1947 | 12.6 |
| Post-World War II | 1948-1960 | 21.1 |

The development of satisfactory canning methods led to the rapid expansion of the fishery beginning with 1843. For the next 50 years, until an increase in the legal minimum length of lobsters was established in 1895, the principal commercial fishery was for the purpose of supplying canneries.

The expanding live lobster market which had been the primary reason for a "market" minimum size to replace the "canning" lobster resulted in the construction during the following decade of 23 natural sea water enclosures called "pounds." This was the largest number of such storage facilities ever constructed in Maine in so short a time. (Dow, Harriman & Scattergood 1959.) These 23 pounds provided storage capacity for 3.2 million pounds of lobsters as compared with 44 operational pounds in 1958 with a capacity of nearly 4.5 million pounds. Since 1895 the live market has been the principal outlet for lobsters.

Fig. 7 - A Maine fisherman sells his catch of lobsters.

Production data suggest the probability of cyclic changes in the abundance of lobsters, a concept which is not supported by biological and economic information developed since 1939.

## DISCUSSION

In terms of change, the period of greatest interest is that of World War II when the fishery recovered from two decades of extremely low production. Following World War II annual landings reached the highest catch level in the history of the fishery. There is no evidence to indicate that the higher production of the post-World War II period is anything more than a modification of the factor or factors which made possible the rapid changes of the World War II period.

Average and maximum catch of the post-World War I and depression periods are represented by 1939 and 1940 landings. By 1945 landings had increased 189 percent.

The principal factors likely to have any considerable influence on lobster landings are abundance, sea water temperature, type of bait, number of traps, number of fishermen, and average landed value.

Since standard methods of sampling lobster populations for abundance have produced such imprecise results, fluctuations in abundance can only be inferred. Indications of relative abundance, other than landings, do not suggest any significant change during the period. The average weight of lobsters in the catch remained unchanged after the minimum legal size increase in 1942. During each of the three years preceding the increase in minimum size, average weight had been 1.1 pounds. During each of the six years following the increase average weight was 1.2 pounds. Any significant change in average weight would have been indicative of an inverse increase or decrease in abundance.

Catch-per-unit-of-gear, frequently used as an index of relative abundance, has subsequently been shown to be an invalid measure in the lobster fishery because of variations in fishing effort. (R. L. Dow 1961.) In 1940 at the beginning of the period and in 1947 at the end of the period, catch-per-unit-of-gear in the Maine lobster fishery was the same, 35.4 lobsters per-trap-per-year.

Surface and sub-surface sea water temperatures have been shown to be measurably related to certain seasonal lobster landings but there is no evidence of any relation to annual catch. (Taylor, Bigelow and Graham 1957, and R. L. Dow 1961.)

The development of the ocean perch fishery provided a source of bait which later experiments by the Department of Sea and Shore Fisheries demonstrated to be approximately 25 percent more efficient than other natural baits then in use. Waste from the processing of ocean perch fillets first became available in quantity in 1939. During the next several years landings of this species increased to 40 million pounds. Both the number of fishermen and the number of traps being fished increased greatly during the period as did average landed value.

Coefficients of correlation between each of the several factors and annual lobster landings are of the order of 0.8 to 0.99 (table 4). Although deviations from the year-to-year trend occurred in all series, only that of landed value was limited to one year, 1942, the year in which an increase in the legal size reduced the catch a minimum of 0.7 million pounds, an amount calculated from the size-frequency distribution of lobsters in the catch during the preceding three years. Had these lobsters been available to the fishery, total landings for the year would have been 9.1 million pounds or more.

Table 4 - Comparison of Maine Lobster Landings with Water Temperature, Prices, and Other Significant Factors 1/

| Year | Total Annual Lobster Landings | Mean Surface Temperature | Ocean Perch Landings | No. Lobster Traps | No. Fishermen | Average Ex-Vessel Price |
|---|---|---|---|---|---|---|
| | Million Lbs. | °F. | Millions Lbs. | 1,000 Units | 1,000 | ¢ 1/Lb. |
| 1947 | 18.3 | 48.5 | 40.0 | 516 | 5.3 | 37.3 |
| 1946 | 18.8 | 47.2 | 41.1 | 473 | 6.6 | 38.3 |
| 1945 | 19.1 | 47.0 | 27.8 | 378 | 6.2 | 40.1 |
| 1944 | 14.1 | 46.5 | 24.3 | 252 | 4.9 | 28.8 |
| 1943 | 11.5 | 45.3 | 25.8 | 209 | 4.2 | 25.6 |
| 1942 | 1/ 8.4 | 46.6 | 26.4 | 187 | 3.5 | 21.7 |
| 1941 | 8.9 | 46.0 | 20.7 | 194 | 3.6 | 17.7 |
| 1940 | 7.6 | 44.6 | 7.9 | 222 | 3.7 | 16.6 |
| 1939 | 6.6 | 43.4 | 5.4 | 260 | 3.7 | 15.6 |
| Coefficient of Correlation: r = | | 0.80 | 0.83 | 0.85 | 0.95 | 0.99 |

1/An increase in the minimum legal size in 1942 reduced landings a calculated minimum of 0.7 million pounds.

Moult-classes consisting of 15 percent carapace increment groups were calculated for all lobster landings from July 1939 through June 1952 based on length-frequency and length-weight measurements and moult-frequency observations.

It was observed that lobster-year (July-June) catches varied independently of moult-class catches. When the magnitude of the catch from the first year fishing of newly recruited lobsters suggested a decline in the relative abundance of the previously sub-legal population, subsequent proportionally higher lobster-year catches from this same group as it moved through the legal size range indicated that fluctuations in apparent abundance were not sufficient to influence landings significantly.

Table 5 - Data on Moult-Class Maine Lobster Landings and Average Ex-Vessel Price Per Pound

| Lobster Moult Class | Average Ex-Vessel Price | Moult-Class Landings |
|---|---|---|
| | ¢ 1/Lb. | Million Lbs. |
| 1939-1940 | 15.7 | 7.0 |
| 1940-1941 | 17.2 | 8.0 |
| 1941-1942 | 19.7 | 9.8 |
| 1942-1943 | 25.7 | 11.3 |
| 1943-1944 | 29.5 | 13.4 |
| 1944-1945 | 34.6 | 16.6 |
| 1945-1946 | 40.4 | 18.4 |
| 1946-1947 | 37.5 | 17.1 |
| 1947-1948 | 37.2 | 17.2 |
| 1948-1949 | 39.5 | 17.9 |
| Coefficient of Correlation: r= | 0.99 | |

The average value of moult-class lobsters landed during the 13 lobster and 14 calendar years of the period was determined. Data on moult-class landings and values are listed in table 5.

Data in tables 4 and 5 have been purposely limited to the period 1939 until after World War II because of the behavior of the lobster fishery. Lobster landings in Maine from 1919

to 1940 averaged only 6.6 million pounds per year but rapidly increased through 1945, then declined temporarily for the next three years. My interest has been in trying to account for this phenomenal change. Landings by calendar years, lobster years, and by moult-class years indicate that economic factors were the most important in influencing the recovery of the lobster fishery. Since that time, other factors, including the number of fishermen, the number of traps, water temperatures, the extent of the area fished, and the length of fishing time, appear to have increased considerably in importance. There is some indication that since World War II there has been an inverse correlation between economic factors and landings. That is, fishing effort declines when price declines which in turn leads to increased price with lack of supply. This, in turn, stimulates increased fishing effort and landings go up. For example, in 1948 average ex-vessel price per pound was 40 cents a pound because landings were down to 16 million pounds that year. In 1949 landings increased to 19 million pounds but price declined to 35 cents a pound. Price remained at the same level in 1950 and landings declined to 18 million pounds. In 1952 price went up to 42.5 cents a pound and landings in 1953 increased to 22 million pounds.

## SUMMARY

Indications of relative abundance (landings, average weight, and catch-per-unit-of-gear) fail to support the concept of any significant increase in abundance during the World War II period. Water temperatures are related to the concentration and magnitude of seasonal landings rather than to the magnitude of annual landings.

The more efficient bait, ocean perch, is still not available in many remote fishing areas where landings have shown the same rate of increase. The number of traps is a biological function insofar as traps are agents of food and shelter. Traps also reflect long-term fishing effort and in that respect are of economic significance.

Moult-class catches derived from biological data support the reliability of the high correlation between average landed ex-vessel price and annual landings during the World War II period 1939-1947.

## CONCLUSION

The magnitude of productive recovery of the Maine lobster fishery from the post-World War I and Depression periods is attributable to economic factors of which landed value during the World War II period is the most reliable indicator.

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## Part IV - The Role of Traps in the Maine Lobster Fishery

## BACKGROUND

With respect to the fisherman, the role of traps in the Maine lobster fishery is relatively uncomplicated, limited to the catching of lobsters. In terms of biology and economics, the function of traps may become somewhat more complex.

**An unbaited trap is an agent of shelter, while a baited trap also provides a readily available source of food. The number of traps in operation is indicative of the level of fishing effort.**

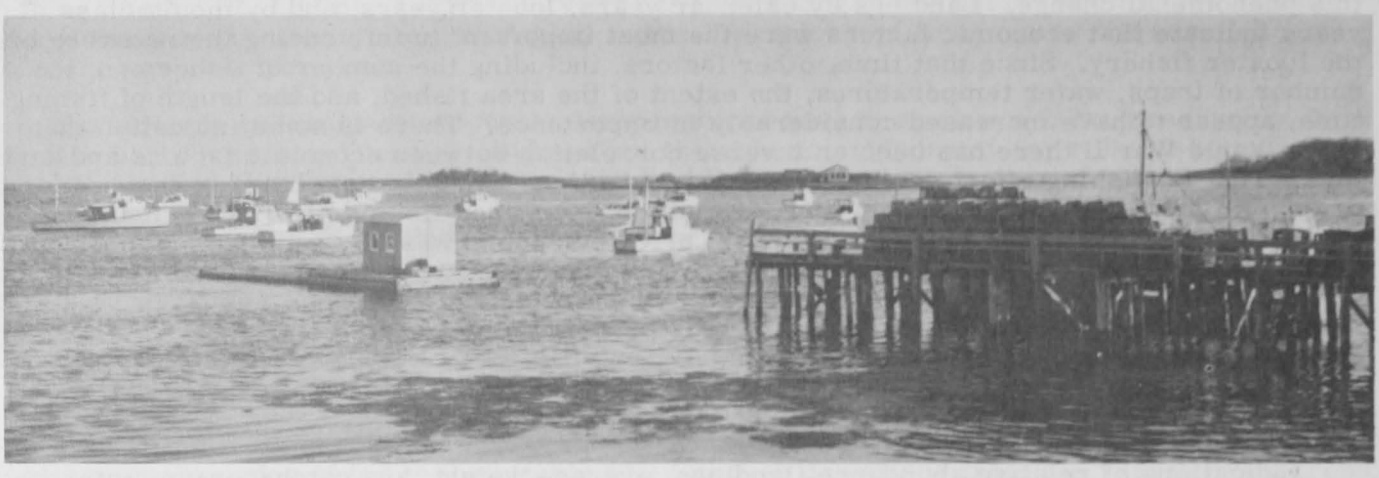

Fig. 8 - A portion of harbor at Cape Porpoise showing lobster "car" (left foreground), boats, and traps stacked on the dock.

Traps are of particular interest in the Maine lobster fishery because records of their number are more consistent and include a longer period of years than those of any other factor likely to influence the magnitude of landings. Trap records are available for 40 of the 63 years since 1897.

Table 6 - Number of Traps and Landings in the Maine Lobster Fishery, 1897-1960

| Year | Traps | Landings |
|---|---|---|
| | No. in 1,000's | Millions of Lbs. |
| 1960 1/ | 745 | 24.0 |
| 1959 | 717 | 22.3 |
| 1958 | 609 | 21.3 |
| 1957 | 565 | 24.4 |
| 1956 | 533 | 20.6 |
| 1955 | 532 | 22.7 |
| 1954 | 488 | 21.7 |
| 1953 | 440 | 22.3 |
| 1952 | 417 | 20.0 |
| 1951 | 383 | 20.8 |
| 1950 | 430 | 18.4 |
| 1949 | 462 | 19.3 |
| 1948 | 459 | 15.9 |
| 1947 | 516 | 18.3 |
| 1946 | 473 | 18.8 |
| 1945 | 378 | 19.1 |
| 1944 | 252 | 14.1 |
| 1943 | 209 | 11.5 |
| 1942 | 187 | 8.4 |
| 1941 | 194 | 8.9 |
| 1940 | 222 | 7.6 |
| 1939 | 260 | 6.6 |
| 1938 | 258 | 7.7 |
| 1937 | 186 | 7.3 |
| 1935 | 185 | 7.7 |
| 1933 | 180 | 5.9 |
| 1932 | 208 | 6.1 |
| 1931 | 168 | 5.4 |
| 1930 | 205 | 7.8 |
| 1928 | 211 | 7.1 |
| 1924 | 154 | 5.5 |
| 1906 | 305 | 15.0 |
| 1905 | 254 | 11.1 |
| 1903 | 268 | 13.1 |
| 1902 | 298 | 14.3 |
| 1901 | 304 | 14.0 |
| 1900 | 327 | 14.4 |
| 1899 | 335 | 12.7 |
| 1898 | 279 | 12.3 |
| 1897 | 234 | 11.2 |

Coefficient of Correlation: r = 0.907.

1/Preliminary estimate.

## DISCUSSION

Within this historic period (table 6), lobster landings have ranged from 5 million to 24 million pounds and the number of traps from 150,000 to nearly 750,000.

Chronologically as well as in terms of the number of traps fished, the fishery falls into three major periods (table 7). From 1897 to 1906 the number of traps fluctuated between 234,000 and 325,000 and landings between 11.1 million and 15.0 million pounds. Data are unavailable again until 1924. From 1924 to 1944 the number of traps ranged from 154,000 to 260,000 and landings from 5.4 million to 14.1 million pounds. During recent years, 1945 to 1960, traps have ranged from 378,000 to 745,000 and landings from 15.9 million to 24.4 million pounds.

Table 7 - Average Number of Traps and Average Annual Landings in Maine Lobster Fishery during Three Major Periods--1897-1906, 1924-1944, and 1945-1960

| Period | Annual Average of Traps Fished | Average Annual Landings | Years in Period |
|---|---|---|---|
| | No. in 1,000's | Millions of Lbs. | No. |
| 1945-1960 | 509 | 20.6 | 16 |
| 1924-1944 | 205 | 7.8 | 15 |
| 1897-1906 | 289 | 13.1 | 9 |

The relation of the number of traps fished to various levels of landings is fur-

ther illustrated when landings are grouped by four-million-pound annual units (table 8).

Table 8 - Relationship Between Number of Traps Fished and Various Levels of Annual Landings

| Range of Annual Landings | Annual Average No. of Traps | No. of Years Considered |
|---|---|---|
| Millions of Lbs. | No. in 1,000's | No. |
| 5- 8 | 203 | 13 |
| 9-12 | 262 | 5 |
| 13-16 | 316 | 7 |
| 17-20 | 449 | 8 |
| 21-24 | 585 | 7 |

The number of traps being fished appears to be determined by the average landed price paid fishermen for their catch. Only since 1939 have consecutive annual data on average landed price been available. Coefficients of correlation for the series; price and current year following; and price and average number of traps of current and year following range from 0.88 to 0.93.

## CONCLUSION

Major long-term fluctuations in Maine lobster landings can be attributed to variations in fishing effort of which the number of traps being fished is the most consistent index.