

COMMERCIAL FISHERIES REVIEW

May 1959

Washington 25, D.C.

Vol. 21, No. 5

THE ROLE OF HOLDING POUNDS IN THE MAINE LOBSTER INDUSTRY

By Robert L. Dow,* Donald M. Harriman,** and Leslie W. Scattergood***

CONTENTS

	Page		Page
Introduction	1	History of Tidal Pounds	5
Yearly and Seasonal Trends of the Fishery	1	Description of Pound Operation	7
Locations and Capacities of Lobster-Holding Facilities	4	Problems to be Solved	12
		Literature Cited	14

INTRODUCTION

The American lobster (*Homarus americanus*) is one of the most valuable resources of the western North Atlantic. This species is caught in commercial quantities between New Jersey and Newfoundland, and the total catch in recent years (1953-1957) has averaged about 76,000,000 pounds, worth \$27,000,000 to the fishermen. Since most of these crustaceans are sold alive, industry has had to develop means of storing the lobsters from the time they are caught by the fishermen until they enter the retail trade. It is the purpose of this paper to discuss the important role that lobster holding pounds play in these storage activities.

YEARLY AND SEASONAL TRENDS OF THE FISHERY

The need for storing large quantities of lobsters is apparent when the yearly and particularly the seasonal fluctuations in the landings are demonstrated. Scattergood and McKown (1951) showed that lobster production had been increasing in the western North Atlantic between 1921 and 1949. It is evident from figure 1 and table 1 that this upward trend has continued. Because Maine is by far the principal United States producer of lobsters, we are omitting other states from our discussion.

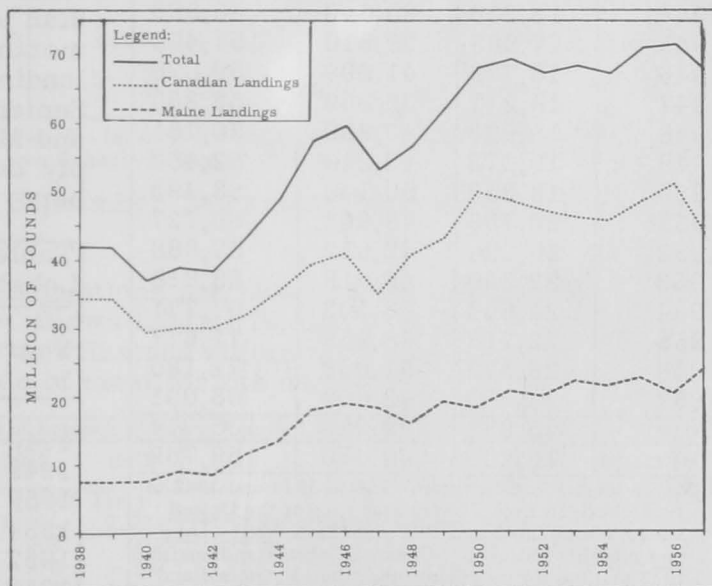


Fig. 1 - Landings of lobsters in Maine and Canada, 1938-1957.

The United States remains the principal market for Canadian lobsters (figure 2 and table 2). It is not now possible to determine accurately the percentage of Canadian lobster landings that are exported to the United States, however, from the data

* Director of Marine Research, Maine Department of Sea and Shore Fisheries, Augusta, Me.

** Marine Resources Scientist, Maine Department of Sea and Shore Fisheries, Newagen, Me.

*** Director, Fishery Biological Laboratory, Division of Biological Research, U. S. Bureau of Commercial Fisheries, Boothbay Harbor, Me.

in tables 1 and 2, it appears that between 59 and 71 percent were shipped into the States during the last 10-year period. This is a minimum figure, because fresh or frozen lobster meat is included with live whole lobsters in the import classification "lobsters, not canned." During the seasons when Canadian lobsters are imported, a pound of lobster meat represents about four pounds of live lobsters. To state that between 65 to 80 percent of all Canadian lobsters are destined for export to the United States would not be an extravagant estimate.

Of particular interest to the economy of the fishery are the marked seasonal landing fluctuations. Figure 3,

Year	Maine	Canadian	Total
	(1,000 Lbs.)		
1938	7,659	34,324	41,983
1939	7,571	34,223	41,794
1940	7,643	29,479	37,122
1941	8,937	30,181	39,118
1942	8,404	30,162	38,566
1943	11,468	32,009	43,477
1944	13,250	35,643	48,893
1945	17,988	39,510	57,498
1946	18,779	41,099	59,878
1947	18,277	35,059	53,336
1948	15,923	40,858	56,781
1949	19,273	43,210	62,483
1950	18,353	50,140	68,493
1951	20,759	48,968	69,727
1952	20,036	47,652	67,688
1953	22,300	46,518	68,818
1954	21,668	46,103	67,771
1955	22,718	48,959	71,677
1956	20,572	51,608	72,180
1957	24,403	43,688	68,091
Total	325,981	809,393	1,135,374
Average	16,299	40,470	56,769

^{1/}Maine lobster landings from 1938 to 1940 and 1942 to 1956 obtained from Fishery Statistics of the United States; Maine 1941 and 1957 data from Maine Landings monthly bulletins. Canadian lobster landings from 1938 to 1946 for provinces other than Newfoundland obtained from the Annual Fisheries Statistics of Canada and those for 1947 taken from the Monthly Review of Canadian Fisheries Statistics. The 1948 landings taken from Monthly Report of Eastern Fisheries Division, Halifax, N. S. 1949 to 1951 data taken from Monthly Review of Canadian Fisheries Statistics, Dominion Bureau of Statistics. 1952-1957 taken from Annual Report of the Federal Department of Fisheries. Newfoundland statistics for 1938-1939 obtained from Templeman 1941, Newfoundland Government Research Bulletin No. 11 (Fisheries), and figures for 1940 to 1948 taken from Annual Reports of Newfoundland Fisheries Board. The 1949 to 1957 figures are taken from the Annual Reports of the Federal Department of Fisheries.

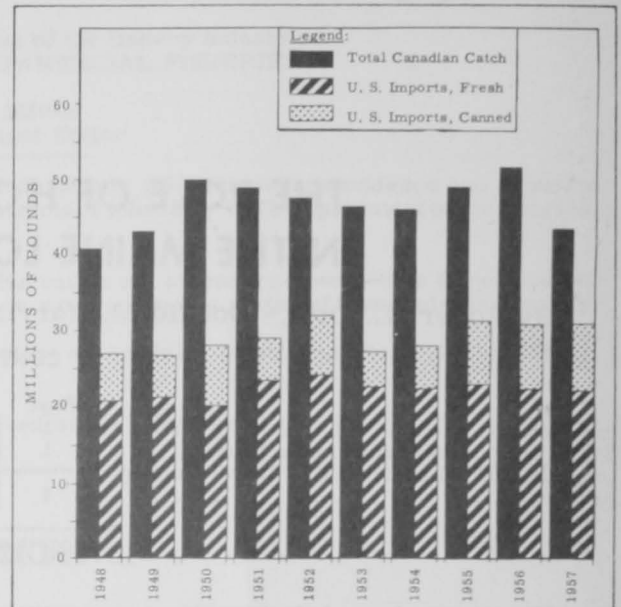


Fig. 2 - Canadian lobster landings and United States imports of fresh or frozen and canned (hermetically sealed) Canadian lobsters, 1948-1957.

table 3 and 4 show that most of the Canadian lobsters are imported during the months of May and June, while the Maine landings are principally in August and September. Together, Canadian imports and Maine landings result in a peak supply during the period May to September.

Year	Canned Changed to ^{2/} Live Weight	Fresh or Frozen ^{3/}	Total
	(1,000 Lbs.)		
1948	6,164	20,850	27,014
1949	5,483	21,323	26,806
1950	8,038	22,046	30,084
1951	5,994	23,558	29,552
1952	7,929	23,197	31,126
1953	4,743	22,611	27,354
1954	5,758	22,468	28,226
1955	8,455	22,962	31,417
1956	8,555	22,484	31,039
1957	8,815	22,218	31,033

^{1/}Data from U. S. Bureau of the Census, United States Imports of Merchandise for Consumption, FT110 Reports.

^{2/}These figures are obtained by multiplying the import canned meat data by a factor of 4.0, which is the estimated number of pounds of live lobsters that yield one pound of canned (hermetically-sealed) meat.

^{3/}This includes lobster meat that is not in hermetically-sealed cans.

Figure 4, tables 4 and 5 indicate that the seasonal volume of imports from Canada has a trend somewhat similar to that for Canadian landings. Delayed shipments of lobsters that have been held in live storage in Canada are responsible for the instances where the imports exceed the landings, for example, during July and November to April. There are several reasons why the May Canadian landings markedly exceed the United States imports: some of the lobsters are processed into canned or frozen meat; some are put into live storage; and a time lag exists between the landings of the lobsters in Canada and their shipment to the United States.

The seasonal variation in the supply of lobsters is an important factor in the price of lobsters. Figure 5 and table 6 show the mean monthly prices for landed Maine lobsters. It is apparent that average prices are usually highest during the months January to April, which is the period when Canadian and United States lobster landings are at the lowest. In the remainder of the year, the price drops as Canadian lobsters begin to be imported and remains low while the Maine fishery is at its peak. The summer tourist season provides a large market for live lobsters and, when that season has ended in September, the prices increase slowly as the catches diminish.

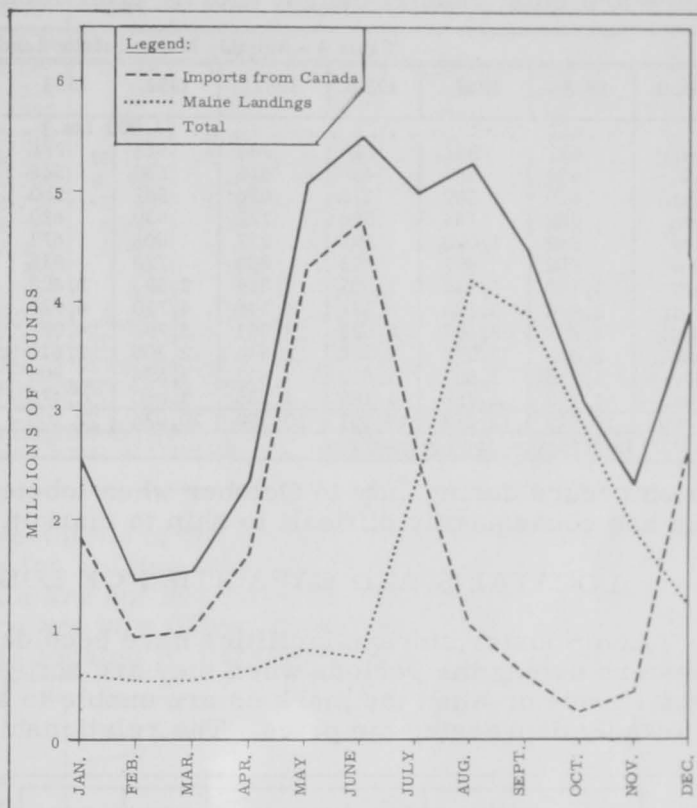


Fig. 3 - Monthly Maine lobster landings and imports of fresh and frozen Canadian lobsters, 1948-1957.

The reasons for the seasonal fluctuations are based on several factors. Canada has a system of closed seasons that allows lobster fishing principally during those months when live lobsters are able to withstand shipment to distant markets and the cooked lobsters produce a good yield of meat for the canneries. This means that

Table 3 - U. S. Imports of Lobsters (Fresh or Frozen) 1948-1957^{1/}

Month	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	10-Year Average
	(1,000 Lbs.)										
Jan.	1,617	1,676	1,909	1,706	2,023	2,214	1,777	1,832	1,731	2,308	8.4
Feb.	668	743	762	1,355	903	952	1,078	1,026	1,190	892	4.3
Mar.	645	869	619	1,320	978	880	1,039	827	666	1,264	4.2
Apr.	2,237	1,854	1,325	2,050	1,937	1,661	1,688	1,704	1,308	1,551	7.7
May	3,571	4,352	4,149	4,892	3,980	4,614	4,284	4,898	4,741	3,800	19.3
June	5,056	4,430	5,181	3,983	4,772	4,329	4,987	5,198	5,356	4,418	21.3
July	2,626	2,181	2,482	2,334	2,339	2,790	2,844	2,856	3,003	3,031	11.8
Aug.	834	1,069	1,287	1,104	960	1,065	1,115	1,243	1,084	1,380	5.0
Sept.	507	650	659	678	731	436	517	557	474	830	2.7
Oct.	231	318	335	391	289	169	185	212	232	190	1.1
Nov.	432	379	386	500	701	698	397	286	250	246	1.9
Dec.	2,426	2,802	2,951	3,245	3,584	2,802	2,557	2,323	2,449	2,308	12.3
Total	20,850	21,323	22,045	23,558	23,197	22,610	22,468	22,962	22,484	22,218	100.0

^{1/}From customs information available at Bureau of Census office, New York City, N. Y.

hard-shelled, rather than newly-moulted or thin-shelled, lobsters are desired. Lobster fishing is prohibited in most of the Canadian areas during the summer-autumn moulting season. The lobster season is also closed during the winter months in

many Canadian regions which are normally ice-bound. Along the Nova Scotia coast, where ice is no problem, a winter fishery is allowed.

In Maine, there are no closed seasons, except for around Monhegan Island. Lobsters are most readily caught shortly after moulting; as a result, most of Maine's

Month	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	10-Year Average
	(1,000 Lbs.)										
Jan.	472	561	724	944	823	788	667	785	527	534	3.3
Feb.	433	461	457	616	630	548	561	476	430	507	2.5
Mar.	426	509	378	626	567	560	573	573	369	602	2.5
Apr.	669	761	586	772	630	630	578	595	489	652	3.1
May	982	1,008	991	927	803	673	568	666	750	949	4.0
June	862	807	723	883	729	915	623	650	587	816	3.7
July	1,193	1,949	1,885	2,819	2,393	3,402	2,877	2,931	1,315	2,984	11.5
Aug.	2,446	3,384	3,597	4,348	4,720	4,726	5,257	5,417	3,767	4,786	20.6
Sept.	2,883	3,697	3,635	3,361	3,792	4,062	4,138	4,761	4,509	4,489	19.1
Oct.	2,441	3,072	2,542	2,614	2,305	2,616	2,876	2,830	4,113	3,959	14.3
Nov.	1,956	1,807	1,650	1,611	1,594	1,905	1,889	1,888	2,307	2,556	9.3
Dec.	1,160	1,256	1,185	1,238	1,050	1,475	1,061	1,146	1,409	1,569	6.1
Total	15,923	19,272	18,353	20,759	20,036	22,300	21,668	22,718	20,572	24,403	100.0

^{1/}Data from Maine Monthly Landings.

catch occurs during July to October when lobsters are not particularly hard-shelled and are consequently difficult to ship to market.

LOCATIONS AND CAPACITIES OF LOBSTER-HOLDING FACILITIES

Live-lobster storage facilities have been devised to provide means of holding lobsters during the periods when they are soft-shelled and difficult to ship to the retail trade or when the markets are unable to absorb greater quantities without markedly depressing the price. The relationship between the seasonal values and volume of lobster landings would be much more marked, if means of storing lobsters were not available.

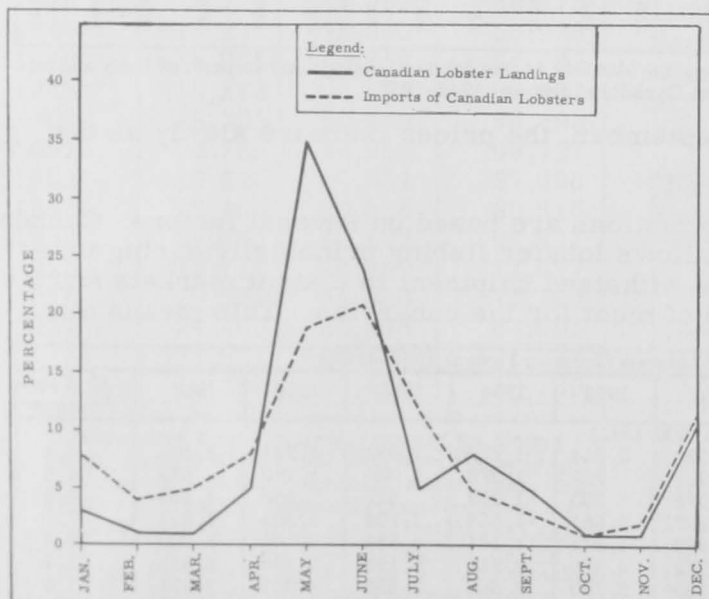


Fig. 4 - Monthly Canadian lobster landings and United States imports of fresh and frozen lobsters, 1948-1957.

Live-lobster storage facilities are in operation along the coast from Kittery to Eastport (table 7). Three methods of live lobster storage are currently in use: (1) tidal pounds for long-term (up to several months) storage (fig. 6); (2) circulating sea-water holding-tanks for preparation of daily shipments to market or for temporary short-term storage (fig. 7); (3) cars and crates anchored near docks, floats, or other installations for auxiliary and short-term storage (fig. 8). Wet-well smacks are also employed for temporary storage of live lobsters at the buying site.

The western Maine coastal area from the Piscataqua River to Cape Elisabeth, with its lack of highly indented coast line and protective islands, relatively low production, and proximity to markets is not suited to the construction and use of tidal pounds. All tidal pounds except one are located between eastern Casco Bay and Jonesport with concentrations being generally located in the Boothbay-Bristol area,

the Friendship-St. George area, Vinalhaven, Stoningotn, Hancock-Sorrento, and the Steuben-Beals area (fig. 9).

Table 5 - Monthly Canadian Lobster Landings 1948-1957^{1/}

Month	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	10-Year Average
	(1,000 Lbs.)										
Jan.	1,010	1,090	1,576	1,941	1,087	1,936	1,718	1,642	1,117	885	3.0
Feb.	194	189	340	509	311	367	290	235	577	509	.8
Mar.	514	653	256	1,153	780	814	642	356	461	740	1.4
Apr.	2,614	2,418	1,856	2,246	2,629	2,227	2,485	2,766	2,139	1,620	4.9
May	12,966	14,261	18,346	16,881	15,358	16,778	16,177	18,079	17,884	14,841	34.5
June	11,095	10,054	11,424	10,606	11,504	10,329	11,460	10,976	12,685	11,208	23.8
July	2,371	1,949	2,038	1,674	2,757	2,189	2,386	1,922	2,007	1,996	4.6
Aug.	3,197	3,631	4,211	4,149	4,121	3,762	2,769	4,087	5,331	3,484	8.3
Sept.	1,944	2,809	3,039	2,984	2,483	1,878	2,140	2,780	2,581	3,734	5.6
Oct.	234	397	424	205	308	40	295	481	464	380	.7
Nov.	531	466	472	587	732	857	773	807	723	699	1.4
Dec.	4,188	5,293	6,158	6,033	5,582	5,341	4,968	4,828	5,639	3,592	11.0
Total	40,858	43,210	50,140	48,968	47,652	46,518	46,103	48,959	51,608	43,688	100.0

^{1/}Newfoundland 1948 data from Annual Report of the Newfoundland Fisheries Board and General Review of the Fisheries; 1949-1957 data from Annual Report of the Federal Department of Fisheries; 1948-1952 monthly figures are calculated on basis of monthly percentages of period 1953-1957. Nova Scotia, New Brunswick, Prince Edward Island, and Quebec: 1948 data from Monthly Report of Eastern Fisheries Division, Halifax, N. S.; 1949-1951 data from Monthly Review of Canadian Fisheries Statistics, Dominion Bureau of Statistics; 1952-1957 data from Annual Report of the Federal Department of Fisheries.

Tidal pounds represent over two-thirds of the Maine live-lobster storage facilities and are the best means to date for holding lobsters for several months without large mortalities. Complete data are not available for the storage capacities in Canada, except for the pounds. There are now fifteen pounds which will hold about 2,325,000 pounds of lobsters. One is located in Yarmouth, Nova Scotia; the other fourteen in Charlotte County, New Brunswick. Nine of these pounds have been built since 1950 and have more than doubled the pre-1950 pound storage capacity.

Circulating sea-water holding tanks for temporary and wholesale-retail trade storage are used extensively in western coastal Maine as far east as western Penobscot Bay. Cars, crates and other floating storage devices are used primarily in conjunction with pounds and follow the same coast distribution pattern as pounds.

HISTORY OF TIDAL POUNDS

Lobster pounds have been in existence in Maine for many years. The first pound had been built near Vinalhaven in 1875 (Cobb 1901). This was a successful venture, but other lobster dealers were slow to adopt this method of storage. By 1890, there were three pounds (Counce 1891); in 1895, there were four pounds (Nickerson 1903); and in 1898 there were nine (Cobb op. cit.). These nine were located at Dyer Bay, Sunset on Deer Isle, Vinalhaven, Long Island, South Bristol, Pemaquid Beach, Southport, and House Island in Portland Harbor. By 1902, the number had increased to 23, and in 1903 there were 26 (Nickerson 1905) with a total estimated holding capacity of 1.5 million pounds of lobster.

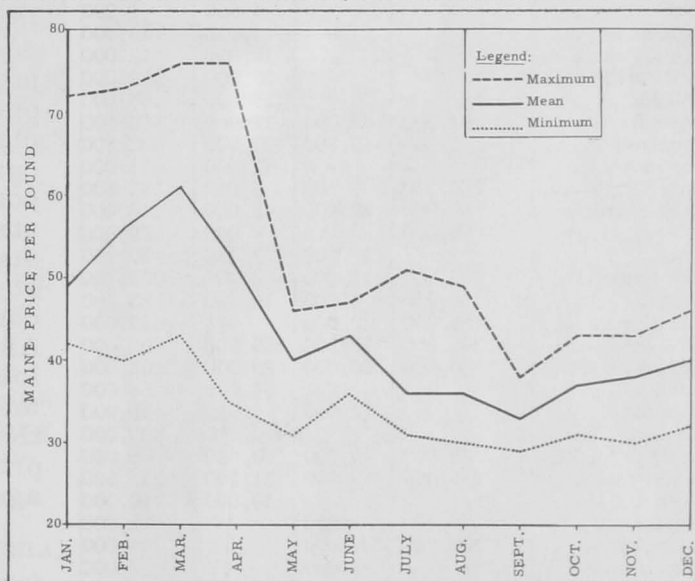


Fig. 5 - Average monthly landed prices of Maine lobsters, 1948-1957.

The great increase in the number of lobster pounds after 1895 was largely the result of the decline in the Maine lobster-canning industry and the increase in the shipping of live lobsters. Cobb (op. cit.) stated that when the Maine supply of lob-

Table 6 - Average Monthly Landed Value (Cents) of Maine Lobsters, 1948-1957

Month	Year										10-Year Average		
	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	Mean	Maximum	Minimum
	(Cents Per Lb.)												
Jan.	42.6	42.7	45.1	41.6	51.0	51.7	44.3	51.3	72.0	47.9	49.0	72.0	41.6
Feb.	44.6	53.3	55.2	40.3	57.9	50.7	56.1	69.1	73.0	60.7	56.1	73.0	40.3
Mar.	52.4	60.8	54.6	42.8	63.3	60.2	61.7	72.8	76.3	60.7	60.6	76.3	42.8
Apr.	45.9	45.8	54.4	35.1	52.2	56.2	62.5	60.7	76.3	46.7	53.6	76.3	35.1
May	36.2	37.6	38.1	31.3	40.6	45.3	42.5	43.5	46.0	43.3	40.4	46.0	31.3
June	39.0	42.9	39.6	35.6	46.2	41.4	42.8	44.1	45.9	46.0	42.4	46.2	35.6
July	35.3	34.8	32.9	31.3	38.6	35.5	36.2	37.8	50.8	36.6	37.0	50.8	31.3
Aug.	39.3	33.2	29.5	32.6	43.6	31.9	32.5	34.3	49.4	33.9	36.0	49.4	29.5
Sept.	37.8	30.5	28.5	29.9	35.5	34.4	30.8	30.9	38.0	33.6	33.0	38.0	28.5
Oct.	43.0	31.4	33.3	40.2	38.5	37.1	37.9	34.6	36.1	30.9	36.3	43.0	30.9
Nov.	42.7	29.8	36.3	38.0	43.3	37.9	37.4	36.3	36.6	30.8	36.9	43.3	29.8
Dec.	40.0	31.6	40.5	37.1	44.9	37.3	40.6	46.3	41.5	44.7	40.5	46.3	31.6

sters began to decrease shortly before 1870, many attributed this decline to the canneries. Laws restricting the activities of the canneries were enacted between 1879 and 1895, and as a result the canneries that formerly could process any size of lobster

Table 7 - Capacity (Weight in Pounds) of Maine Lobster Storage Facilities				
Place	Pounds	Cars	Tanks	Total
Kittery	-	-	35,000	35,000
York	-	-	25,000	25,000
Wells	-	-	6,000	6,000
Kennebunkport	-	7,000	30,000	37,000
Biddeford	-	-	14,500	14,500
Saco	-	-	4,000	4,000
Scarboro	-	-	13,000	13,000
Cape Elizabeth	-	-	12,000	12,000
South Portland	-	-	29,000	29,000
Portland	-	-	135,600	135,600
Harpwell	91,000	63,000	22,000	176,000
Phippsburg	75,000	33,500	23,000	131,500
Georgetown	-	-	11,000	11,000
Southport	250,000	800	2,000	252,800
Boothbay Harbor	40,000	29,400	45,000	114,400
Boothbay	70,000	-	9,000	79,000
Bristol	-	28,000	2,450	30,450
South Bristol	285,000	12,500	4,200	301,700
Bren	60,000	5,000	10,000	75,000
Friendship	465,000	17,000	-	482,000
St. George	285,000	58,000	155,000	498,000
South Thomaston	50,000	26,000	29,000	105,000
Rockland	-	-	54,000	54,000
Matinicus	-	15,000	-	15,000
Rockport	-	-	100,000	100,000
Muscle Ridge Pl.	55,000	10,000	30,000	95,000
Vinalhaven	235,000	45,000	31,500	311,500
Belfast	-	-	10,000	10,000
Deer Isle	50,000	22,000	-	72,000
Stonington	200,000	104,000	-	304,000
Swans Island	-	23,000	-	23,000
Brooklin	-	3,000	-	3,000
Tremont	-	42,000	-	42,000
Southwest Harbor	-	43,000	-	43,000
Cranberry Isles	-	34,000	-	34,000
Long Id. Pl.	-	14,000	-	14,000
Hancock	710,000	6,000	-	716,000
Sorrento	100,000	-	-	100,000
Winter Harbor	-	85,000	-	85,000
Gouldsboro	135,000	17,000	-	152,000
Steuben	304,000	37,500	-	341,500
Milbridge	150,000	24,000	-	174,000
Addison	140,000	15,000	-	155,000
Jonesport	120,000	100,000	-	220,000
Beals	340,000	15,000	-	355,000
Cutler	-	33,600	-	33,600
Eastport	80,000	-	4,000	84,000
Total	4,290,000	968,300	846,250	6,104,550

ster during the entire year were finally restricted by 1895 to canning lobsters of 10½ inches total length during a few weeks in the spring only. According to the Commissioner of Sea and Shore Fisheries, this brought about the death of the canning industry. In the 1880's the lobster-canning industry began moving to the Canadian provinces and by 1895 there was only one Maine lobster cannery, which closed shortly after the 1895 law became effective. Nickerson (1903) reported that prior to 1895 no live lobsters were shipped west of New York State, but a few years later live lobsters were being carried "all over the country" in refrigerator railroad cars. As great numbers were sold to the live lobster market instead of canneries, there was a need for increased facilities for holding the catch, and pounds provided an excellent means of storage.

During the first decade following the enactment of the larger minimum size (1895-1904), 23 pounds were built in Maine coastal waters, the largest number ever constructed in so short a period (tables 8 and 9). Aside from the impetus provided by legislation unfavorable to lobster canning, there is not much evidence to indicate what other influences were necessary to encourage the construction of tidal pounds. The magnitude of the summer-fall catch does not appear to be a controlling criterion. During the de-

pression of the 1930s, lobster production remained at or near a record minimum, averaging approximately six and one-half million pounds a year, yet in the eight-year period 1933-1940, thirteen new pounds were constructed, the second most rapid rate of pound construction in the history of the industry. By contrast, in the seventeen-year period, 1941-1958, when landings had increased nearly 300 percent above the depression level, only eleven pounds were built. The doubling of Canadian pound capacity during the 1950s would reduce somewhat the need for more Maine lobster pounds in recent years.

DESCRIPTION OF POUND OPERATION

The term "lobster pound" has two distinct usages. Certain retail outlets, particularly those equipped with tanks, advertise themselves as lobster pounds. The industry itself, however, defines a lobster pound as an enclosed area, flushed by tide water, in which lobsters may be stored. The most common method of building a pound is to place a dam across

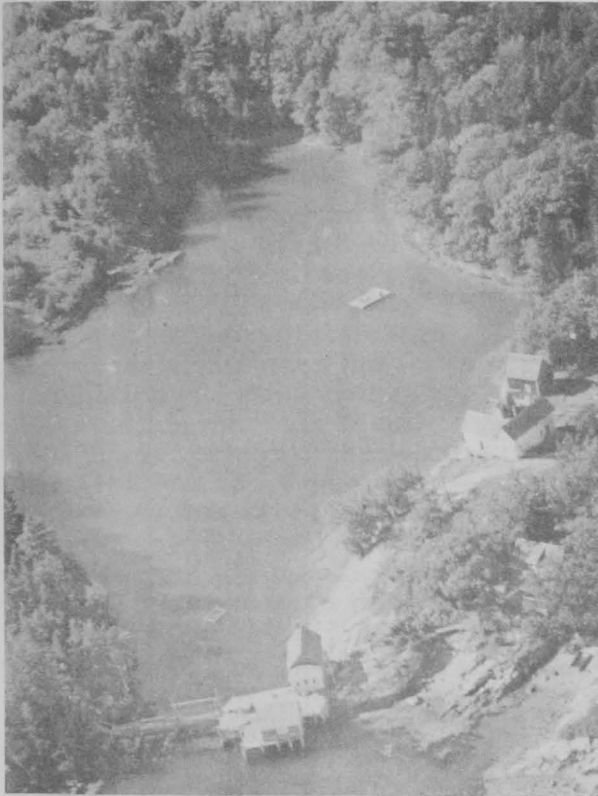


Fig. 6 - Lobster pound at Pig Cove, Southport, Me., capacity 100,000 pounds, built in 1888.

the mouth of a small cove (figure 6). Some pounds have two dams connecting an island with the mainland, and a few have a dam from the shore forming three sides of the pound. The top of the dam is usually several feet below high water level, and the water flushing over the dam provides the needed circulation.

To remove lobsters from the pound, seines or modified beam trawls are dragged along the bottom. Most pounds are designed to permit complete drainage on low spring tides when the last of the lobsters may be collected.

The use of lobster pounds is based upon seasonal variations in abundance and price of lobsters, and upon the difficulties of handling new-shell lobsters in the summer. A pound will be filled with hard-shell lobsters when lobsters first become active in the spring and when Canadian imports are at their peak. Care must then be taken that the lobsters are taken out before the summer moulting time, for most captive lobsters that shed their shells



Fig. 7 - Weighing and packing lobsters for shipment. Indoor tank system in operation.

Table 8 - Maine Lobster Pounds, Year Built and Location

Year Built	Location	County	Name of Pound	Capacity in Pounds	Operating in 1958
1875	Vinalhaven	Knox	Johnson and Young	300,000	No
1888	Southport, Ebenecook Harbor	Lincoln	Atwood	150,000	Yes
1888	Southport, Pig Cove	Lincoln	Robinson	100,000	Yes
1895 ^{1/}	-	-	-	-	-
1898	Steuben, Dyer Bay	Washington	-	-	No
1898	Deer Isle, Sunset	Hancock	-	-	No
1898	South Bristol, High Id.	Lincoln	High Island	50,000	No
1898	Bristol, Pemaquid Beach	Lincoln	-	-	No
1898	Portland, House Island	Cumberland	-	-	No
1898	Friendship, Long Island	Knox	Sim's	350,000	Yes
1899	Friendship, Forest Lake	Knox	Lowry	50,000	Yes
1899	South Bristol	Lincoln	-	-	No
1900	Bristol, Back Cove	Lincoln	Trefethen	75,000	No
1900	Unknown	Cumberland	-	-	No
1900 ^{3/}	Steuben, Dyer Bay	Washington	Wyman	54,000	Yes
1900 ^{4/}	Steuben, Dyer Bay	Washington	N. I. Beal	20,000	No
1901	Unknown	Lincoln	-	-	No
1902	Unknown	Hancock	-	-	No
1902 ^{5/}	Milbridge, Smith Cove	Washington	Stewart	150,000	Yes
1902	Unknown	Washington	-	-	No
1902	Unknown	Washington	-	-	No
1902	Unknown	Washington	-	-	No
1903	Unknown	Washington	-	-	No
1903	Unknown	Washington	-	-	No
1903	Unknown	Hancock	-	-	No
1904	Hancock, Skillings River	Hancock	Consolidated #1	450,000	Yes
1904	Muscle Ridges, Hewell Id.	Knox	Hewell Island	55,000	Yes
1905 ^{6/}	Friendship, Little Morse Id.	Knox	Post	65,000	Yes
1906 ^{7/}	Boothbay Harbor, East Side	Lincoln	Higgins	40,000	Yes
1909	Bristol, Johns Bay	Lincoln	Riverview	50,000	No
1913 ^{8/}	Beals, Robert Ray Cove	Washington	Robert Ray Cove	40,000	Yes
1914	Hancock, Skillings River	Hancock	Consolidated #2	90,000	Yes
1914	Hancock, Skillings River	Hancock	Consolidated #3	90,000	Yes
1918 ^{9/}	Gouldsboro, Bunkers Harbor	Hancock	American Lobster Co. #1	40,000	Yes
1918 ^{9/}	Gouldsboro, Bunkers Harbor	Hancock	American Lobster Co. #2	50,000	Yes
1918	Vinalhaven, Green Island	Knox	Green Island	80,000	Yes
1921	Harpwell, Cundy's Harbor	Cumberland	Watson #2	14,000	Yes
1923	Winter Harbor, Schoodic Point	Hancock	Schoodic Point	70,000	No
1924	Hancock, Skillings River	Hancock	Consolidated #4	30,000	Yes
1924	Steuben, Dyer Bay	Washington	Mitchell	100,000	Yes
1926 ^{2/}	Jonesport, W. Jonesport	Washington	Kirby and Look	100,000	Yes
1926	Harpwell, Cundy's Harbor	Cumberland	Watson #1	65,000	Yes
1933	Bremen, Keene Neck	Lincoln	Zahn	60,000	Yes
1936	Addison, S. Addison	Washington	Look	140,000	Yes
1936	Eastport, Harris Cove	Washington	Emery and Frankland	80,000	Yes
1936	Deer Isle, Sunshine	Hancock	Heansler	50,000	Yes
1936	Stonington, Causeway	Hancock	Barter	100,000	No
1938	Stonington, Moose Id.	Hancock	Colwell	50,000	Yes
1938	Corea	Hancock	Corea Seafoods	45,000	Yes
1938 ^{10/}	Beals, Great Wass Id.	Washington	Deep Cove	300,000	Yes
1938	St. George, Long Cove	Knox	Wild Cat	120,000	Yes
1939 ^{8/}	St. George, Marshall Point	Knox	Marshall Point	40,000	Yes
1940	Stonington, Green Head	Hancock	Cortesi	150,000	Yes
1940 ^{6/}	Somento, Oak Point	Hancock	Creamer	100,000	Yes
1940	Jonesport	Washington	Look	20,000	Yes
1943	St. George, Port Clyde	Knox	Horse Point	125,000	Yes
1943	Vinalhaven, Norton's Point	Knox	Norton's Point	45,000	Yes
1945	Vinalhaven, Indian Creek	Knox	Indian Creek #1	65,000	Yes
1946 ^{11/}	South Bristol, Christmas Cove	Lincoln	Hook	205,000	Yes
1947	Boothbay, Farnum's Cove	Lincoln	Eagle	70,000	Yes
1947 ^{10/}	South Thomaston, Spruce Head	Knox	Spruce Head	30,000	Yes
1949	Vinalhaven, Indian Creek	Knox	Indian Creek #2	45,000	Yes
1949	Phippsburg, Hermit Id.	Sagadahoc	Hermit Island	75,000	Yes
1951 ^{12/}	Cushing, Pleasant Point	Knox	Associated	16,500	No
1953	Hancock, Tidal Falls	Hancock	Tidal Falls	50,000	Yes
1955	Harpwell, Yarmouth Id.	Cumberland	Yarmouth Island	12,000	Yes
1957	Steuben, Goose Cove	Washington	Francis	150,000	Yes

1/ One of the six pounds listed as built in 1898 was actually built in 1895.

2/ Rebuilt in 1958.

3/ Rebuilt in 1943.

4/ Rebuilt in 1941, after being unused since 1920. Being reconditioned in 1958.

5/ Rebuilt in 1945.

6/ Rebuilt in 1957.

7/ Rebuilt in 1939.

8/ Rebuilt in 1952.

9/ Rebuilt in 1938, two pounds.

10/ Rebuilt in 1955.

11/ Rebuilt in 1951.

12/ Never completed.

are eaten by their companions. Pounding delays the moult by several weeks by which time they command a premium over the newly-shed lobsters that are being caught. After the hard-shelled lobsters have been removed, the softer, newly-moulted lobsters from the landings are released in the pound. These lobsters harden as the summer progresses, and withstand the rigors of shipment better. During the summer, a pound may be almost continuously stocked and emptied, depending upon sales, landings, and condition of the lobsters.

In anticipation of the high prices prevailing in mid-winter when landings fall to a very low point, lobster pounds are stocked to capacity in late summer or early fall when the combination of peak landings and dwindling markets result in the lowest prices of the year. Occasionally a lapse in production results in a short period of high prices in late fall, at which time some pounds may be emptied to be refilled when the price drops again. Generally such a sharp fluctuation is caused by a stormy period which prevents fishing.



Fig. 8 - Weighing lobster crate on a lobster car.

The pound capacities as shown in table 7 represent the total poundage that could be held at any one time. In actual practice, many pounds during the year handle more than their capacity because of seasonal filling and emptying. Data were obtained from ten pounds that have been in operation during recent years. Fall and spring were the important storage seasons. These pounds, whose total capacity was 980,000

Table 9 - Maine Lobster Pound Chronology, by Decades

Decade	Number Built	Number in Operation in 1958	Capacity of Those Built Lbs.	Average Annual Lobsters Landings ^{1/} Millions of Lbs.
1870-1879	1	-	300,000	Unknown
1880-1889	2	2	250,000	21.1 (5)
1890-1899	8	2	^{2/} 400,000	12.1 (3)
1900-1909	18	6	^{3/} 421,000	14.6 (10)
1910-1919	6	6	470,000	13.1 (3)
1920-1929	6	5	729,000	6.4 (3)
1930-1939	10	9	985,000	6.5 (10)
1940-1949	11	11	^{4/} 1,010,000	14.1 (10)
1950-1958	4	3	228,500	21.4 (8)
Total	66	44		

^{1/}Numbers in parentheses in the last column refer to number of years when censuses were made.
^{2/}Four pounds not included.
^{3/}Ten pounds not included.
^{4/}One pound of 16,500 number capacity not completed.

pounds, held an average of about 1,365,000 pounds during the years when they were filled and an average of about 1,190,000 pounds for all the periods. Using the latter average and applying it to the capacities shown in table 7, we find that an average of about 5,165,000 pounds would be stored, of which 3,120,000 pounds would be during the fall, 1,960,000 pounds in the spring, and 85,000 pounds during the summer.



Fig. 9 - Locations of Maine lobster pounds in operation in 1958.

In addition to an apparent rise in lobster abundance after 1943 (Taylor, Bigelow, and Graham 1957), it has been shown that economic factors were important in determining the size of the annual Maine landings during the economically-depressed period 1919-1940 and the more highly profitable 1940s and marginally-profitable 1950s (Dow and Trott, 1956). However, the lobster fishery is a seasonal fishery, for seventy percent or more of the annual catch is made in the first four months of the July-June lobster year, and a portion of the fishing season (July-August) coincides with a high demand summer tourist trade.

During the two-month period of this coincidence, average landed value (prices paid to the fishermen is in inverse relation to the size of landings (table 10 and figure 10) on an annual basis for the last forty years (Dow and Trott, *op. cit.*). The need for and the attractiveness of pound-storing Maine-caught lobsters for winter-marketing varies within the range of this inverse seasonal relation.

Year	Landings	Average Price
	Pounds	Cents
1952	7,112,505	41.9
1953	8,128,386	33.3
1954	8,134,331	33.8
1955	8,347,329	32.2
1956	5,081,701	49.7
1957	7,769,962	34.9
1958	5,955,785	50.2

Sea-water temperature appears to be an important factor in the catch during

the July-August period. Table 11 and figure 11 show that there is a close relation between the January-July Boothbay Harbor, Maine water temperature and the size of the July-August catch. Presumably, the contraction or expansion of the moulting period is affected by the average temperatures prevailing in the months preceding the moulting time. Summer production in some years has been economically favorable for pound storage, but in other years, the delayed catches associated with low water temperatures has made summer pound storage speculatively less favorable. When summer market demand has been met, landed prices decline and a supply of surplus lobsters becomes available for storage. During summers of low water temperatures (1956 and 1958), landings may fail to meet summer demand and, consequently, prices remain relatively high. When these conditions occur, pound storage does not become economically feasible until the end of the tourist season brings a decline in demand. The price-production relation during the summers of 1956 and 1958 suggest that between those two years summer demand increased approximately twenty percent. This assumption is supported by a million-pound increase in landings during July and August with no decline (actually an increase from 49.7 to 50.2 cents) in price.

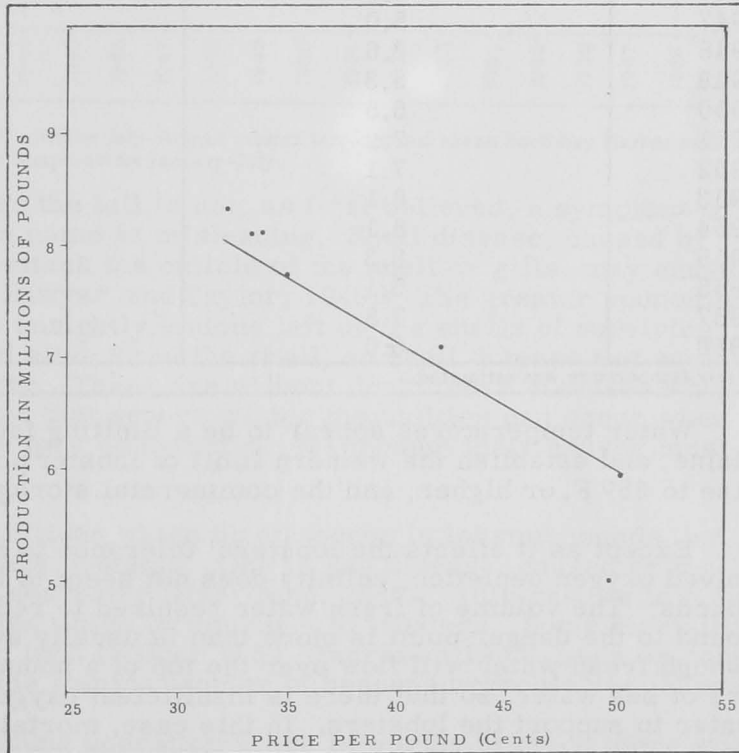


Fig. 10 - Relationship between July-August Maine lobster landings and price per pound, 1952-1958.

the July-August period. Table 11 and figure 11 show that there is a close relation between the January-July Boothbay Harbor, Maine water temperature and the size of the July-August catch. Presumably, the contraction or expansion of the moulting period is affected by the average temperatures prevailing in the months preceding the moulting time. Summer production in some years has been economically favorable for pound storage, but in other years, the delayed catches associated with low water temperatures has made summer pound storage speculatively less favorable. When summer market demand has been met, landed prices decline and a supply of surplus lobsters becomes available for storage. During summers of low water temperatures (1956 and 1958), landings may fail to meet summer demand and, consequently, prices remain relatively high. When these conditions occur, pound storage does not become economically feasible until the end of the tourist season brings a decline in demand. The price-production relation during the summers of 1956 and 1958 suggest that between those two years summer demand increased approximately twenty percent. This assumption is supported by a million-pound increase in landings during July and August with no decline (actually an increase from 49.7 to 50.2 cents) in price.

PROBLEMS TO BE SOLVED

There are a number of factors affecting the survival of lobsters held in pounds. Each of these factors has an optimum (most desirable) value or range of values for the survival of lobsters. Generally any deviation from the optimum results in an increase in mortality. Deviations of two or more factors from their optima appear to be synergistic, that is, the total mortality is greater than would be predicted from the deviation of the factors taken separately.

Many of these factors are recognized. Prevailing water temperatures, salinity fluctuations, degree of mixing of impounded water with outside water, volume of enclosed water, area of bottom, and infection with disease all interact to produce such drastic variations in maximum storage capacity that even the most conservative pound operators have occasional trouble. Although these factors are recognized, their effects cannot be predicted with precision, and even their optimum values are in doubt. Much more work needs to be done to determine the precise interrelationships among these factors.

Table 11 - July-August Maine Lobster Landings and January-July Mean Boothbay Harbor, Maine, Surface Sea-Water Temperatures, 1944-1958

Year	Maine Lobster Landings July-August (Millions of Pounds)	Mean Boothbay Harbor Surface Water Temperatures, January-July (Degrees Fahrenheit)
1944	3.6	43.2
1945	4.5	44.3
1946	4.1	43.6
1947	5.0	44.8
1948	3.6	43.4
1949	5.3	^{1/} 46.5
1950	5.5	46.3
1951	7.2	48.5
1952	7.1	47.5
1953	8.1	49.2
1954	8.1	47.3
1955	8.3	47.7
1956	5.1	44.7
1957	7.8	46.2
1958	6.0	44.9

^{1/}July temperature was estimated.

Water temperatures appear to be a limiting factor in the Casco Bay area in Maine, and establish the western limit of lobster pounding. Here water temperatures rise to 65° F. or higher, and the commercial storage of lobsters becomes difficult.

Except as it affects the lobsters' tolerance to high water temperatures and dissolved oxygen depletion, salinity does not seem to be a major problem in most pounds. The volume of fresh water required to reduce the salinity of the lobster pound to the danger point is more than is usually available. Occasionally, however, enough fresh water will flow over the top of a pound, sweeping away the higher layers of sea water, so that there is insufficient oxygen in the residual layer of sea water to support the lobsters. In this case, mortality is directly due to smothering.

Particularly during low tide, heavily stocked pounds may have marked oxygen depletion at the bottom stratum, even when the upper strata are progressively richer in oxygen. Compressed air has been used to break up such stratification and produce homogeneous oxygen distribution within pounds. Such treatment of fresh ponds has been described by Schmitz and Hasler (1958).

Pounded lobsters are usually fed, although they may go for several months without feeding. Unfed, they lose weight, and cannibalism becomes more troublesome. Redfish (*Sebastes*) racks (the skeletons left after the fish are filleted) and herring are the most popular foods. Trash fish may also be used. The amount of food given can be quite critical. If more is provided than the lobsters can eat, the resulting putrefaction consumes oxygen and may release toxic products. Food requirements vary with season and condition of lobsters; therefore, most poundkeepers provide just enough food so that none is left after twenty-four hours.

The known diseases of lobsters are fortunately few and not particularly widespread, but at times they can be quite costly. *Gaffkya homarii*, the worst killer of stored lobsters, is a bacterium which multiplies in the blood stream of the lobster and destroys the blood corpuscles (Snieszko and Taylor, 1947).

This disease is commonly known as "red tail," however, the reddish discoloration sometimes found under the tail is not, as first believed, a symptom of *Gaffkya* infection, so the common name is misleading. Shell disease, caused by shell-consuming bacteria which attack the cuticle of the shell or gills, may cause moderate mortality (Hess 1937, Sawyer and Taylor, 1949). The greater economic damage is done, however, by the unsightly lesions left on the shells of surviving lobsters. Most lobsters are sold alive or, in the shell, so shell disease has an adverse effect on their marketability. There are without doubt other diseases which we do not yet recognize. We know that severe winter mortalities can occur when neither red tail nor shell disease may be detected. At present their causes must remain subject for speculation.

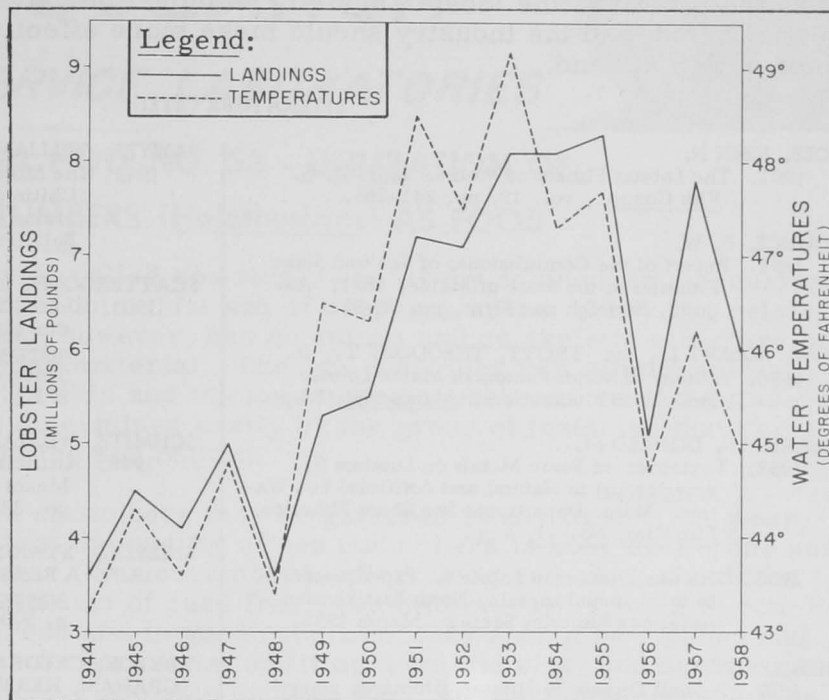


Fig. 11 - Maine July-August lobster landings and mean Boothbay Harbor surface water temperatures January-July.

There are several other conditions which do not occur in lobster pounds, but are lethal to lobsters stored in tank systems. One is gas disease, caused by the compression of air with pumped sea water (Harriman, 1955). This results in a supersaturation of dissolved nitrogen which is injurious to lobsters. Some mortalities result from the presence of toxic ions (Wilder 1952, Harriman 1953), such as copper, or certain insecticides, notably the gamma isomer of benzene hexachloride (Lindane).

The final aspect of lobster pound operation which is worthy of much more work is the role of pounds in conditioning of lobsters. Through most of the summer, large numbers of "shedder" (recently-moulted) lobsters are landed. Such lobsters have thin shells, poor meat, and do not ship well. Many pound operators put such lobsters into the pound until the shell becomes harder. A study of pound practices to promote methods of hardening shell and building meat content simultaneously is needed.

There is an extensive amount of information on the physical and biological limitations of pound operation. In the major lobster-producing areas, Federal and State biologists are available to discuss handling problems and in some cases may be able to diagnose the causes of mortalities. However, a considerable amount of information is either spotty or nonexistent. If biological research is to bring the greatest possible benefit to the lobster industry, a more intensive program of research must be supported, and the industry should make more effective use of the personnel and information at hand.

LITERATURE CITED

- COBB, JOHN N.
1901. The Lobster Fishery of Maine. Bull. U. S. Fish Comm., vol. 19, pp. 241-265.
- COUNCE, B. W.
1891. Report of the Commissioner of Sea and Shore Fisheries of the State of Maine, 1891. Augusta, Burleigh and Flynt, pp. 35-55.
- DOW, ROBERT L., and TROTT, THEODORE T., Jr.
1956. A Study of Major Factors of Maine Lobster Production Fluctuations. Manuscript, 23 pp.
- HARRIMAN, DONALD M.
1953. Toxicities of Some Metals on Lobsters (Homarus americanus) in Natural and Artificial Sea Waters. Maine Department Sea Shore Fisheries, Fish Circ. No. 11, 8 pp.
1955. The Gas Disease in Lobsters. Paper presented to third annual meeting North East Section American Fisheries Society, March 1955.
- HESS, ERNEST
1937. A Shell Disease in Lobsters (Homarus americanus). Jour. Biol. Bd. of Canada, vol. 3, no. 4, pp. 358-362.
- NICKERSON, ALONZO R.
1903. Report of the Commissioner of Sea and Shore Fisheries of the State of Maine 1902. Augusta, Kennebec Journal Print, 66 pp.
1905. Twenty-eighth Report of the Commissioner of Sea and Shore Fisheries of the State of Maine for 1903 and 1904. Augusta, Kennebec Journal Print, 85 pp.
- SAWYER, WILLIAM H., and TAYLOR, CLYDE C.
1949. The Effect of Shell Disease on the Gills and Chitin of the Lobster (Homarus americanus). Maine Department Sea Shore Fisheries, Res. Bull., no. 1, 10 pp.
- SCATTERGOOD, LESLIE W., and MCKOWN, ARTHUR D.
1951. United States Lobster and Spiny Lobster Production (1921-49) and Imports (1920-49). Commercial Fisheries Review, vol. 13, no. 12 (December), pp. 1-11. (Also Separate No. 293.)
- SCHMITZ, WILLIAM R., and HASLER, ARTHUR D.
1948. Artificially Induced Circulation of Lakes by Means of Compressed Air. Science, vol. 128, no. 3331, pp. 1088-1089.
- SNIESZKO, STANISLAS F., and TAYLOR, CLYDE C.
1947. A Bacterial Disease of the Lobster (Homarus americanus). Science, vol. 105, no. 2732, p. 500.
- TAYLOR, CLYDE C.; BIGELOW, HENRY B.; and GRAHAM, HERBERT W.
1957. Climatic Trends and the Distribution of Marine Animals in New England. U. S. Department of the Interior, Fish and Wildlife Service, Fishery Bulletin, vol. 57, no. 115, pp. 293-345.
- WILDER, D. G.
1952. The Relative Toxicity of Certain Metals to Lobsters. Jour. Fish. Res. Bd. Canada, vol. 8, no. 7, pp. 486-487.

