

# MAINE STATE LEGISLATURE

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**MAINE PUBLIC DOCUMENTS  
1948-1950**

**(in three volumes)**

**VOLUME II**

State of Maine  
16TH BIENNIAL REPORT

Department of  
Sea and Shore Fisheries



For Period  
July 1, 1948 to June 30, 1950

Vickery Hill Building

Augusta, Me.



State of Maine

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*(Cover picture shows department's research-patrol boat, EXPLORER,  
underway)*

STATE OF MAINE

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BIENNIAL REPORT OF  
DEPARTMENT OF SEA AND SHORE FISHERIES

Augusta, Me.

To the Honorable Governor and Executive Council:

Sirs:

I herewith transmit, in compliance with the law, the report of the Department of Sea and Shore Fisheries, for the two years ending June 30, 1950, together with statistics and other pertinent data.

RICHARD E. REED,

*Commissioner*

## COMMISSIONER'S REPORT

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This report covers activities of the department for the biennium commencing July 1, 1948 and ending June 30, 1950.

We have included pertinent information on expenditures and income, licenses, violations, statistics, the several departmental divisions and other matters in an effort to give a general over-all picture of the operations of the department. Detailed reports on economic and industry data as well as numerous surveys and research projects that are not included, because of lack of space, may be obtained by contacting our Augusta headquarters.

Due to much progressive legislation promulgated at the 1947 and 1949 sessions we have been able to reorganize the department and put it on a basis to render a more comprehensive service to the industry and the general public.

We feel that our progress has been steady but that we must continue to build and keep alert to changes and needs of the industry at all times. Mistakes have been made and rectified when possible. We are still a long way from arriving at a perfect formula for management of our great fisheries resources despite a persistent and conscientious effort.

A statement of income on another page shows that the industry is now contributing approximately \$70,000 a year to the General Fund of the state and to the Shellfish Fund, through license fees. It was because of this added industry participation that we were able to obtain adequate appropriations to launch a progressive program and to obtain suitable working equipment. Prior to 1947 the income from fees had varied from \$6,500 to \$10,000 a year.

Income decreased about \$10,000 a year for the biennium. This was chiefly due to changes in requirements for the retail seafood dealer and interstate shellfish transportation licenses. There was also a drastic decline in the number of commercial shellfish licenses issued. Income from fines and fees was off nearly fifty per cent.

We wish to congratulate the industry for its willingness to continue paying the higher license fees. Although the additional revenue had made the difference between progress and the lack of it, I wish to point out that the total far from defrays the cost of operating expenses. In fact it does not even foot the bill for the salaries and expenses of our comparatively small 26 man warden force. The remainder, or close to 60% of our total expenditures, comes from the general taxpayer.

Despite the many changes in the fisheries laws which have taken place during the past two sessions of Legislature, there is still much work to be done. We hope to eventually have a simple, sound set of conservation regulations, with the existing confusion, contradictions and duplications eliminated.

We will have numerous recommendations for the 1951 Legislature which we hope will bring us at least some nearer to the simplification which we believe to be necessary and desirable. Once this is achieved the job of running the department will be much more enjoyable and all personnel will have more time to devote to constructive work instead of to legal arguments and controversies.

The table of violations and arrests shows considerable improvement over the record for the previous biennium but still appears to be much higher than necessary. Possession of short clams and digging in closed areas were the principal causes of trouble. Lobster violations were fewer and there is evidence of growing sentiment among the fishermen and dealers to further the conservation of this important species.

As usual our wardens have been instructed to be fair and impartial at all times and to exercise good judgment in enforcing the conservation laws. We believe that our men are sincerely trying to follow such a policy. Their job is not an easy one. We feel that mutual cooperation between the officers and the industry will eventually result in a minimum of arrests and are continuously working towards that end.

Revocation of licenses is a difficult problem to handle and therefore we believe that the Commissioner should be given more discretion, at least on the first and second offenses. We are planning to ask Legislature for such discretion and to do away with virtually all mandatory revocations on the first two offenses.

The department offices have now been in Augusta for four years and we firmly believe that it is more advantageous to have the department at the seat of government instead of in the comparative obscurity of a coastal location.

During the past two years we have completely eliminated the lobster rearing program at Boothbay Harbor. Exhaustive studies proved without doubt that this type of activity was much too costly for the results obtained. The rearing plant has been converted into a research and experimental station for the purpose of conducting projects that should be highly beneficial to the industry in the long run.

Lobster pounds at Pemaquid and Schoodic which were used for research and storage of egg bearing lobsters have been turned back to their owners, the U. S. Fish and Wildlife Service and the National Park Service respectively. We have also terminated an agreement



with the University of Maine for a cooperative research program. Although we enjoy friendly and favorable relations with the University it was impossible to finance the program with the funds we have available.

We continued our accelerated program of buying and releasing egg bearing lobsters from the pounds and have spent approximately \$12,000 a year for this purpose. The egg bearing females are purchased under the direction of our supervisors and released as fairly as possible all along the coast.

Your Commissioner has been active in the formulation and ratification of the Northwest Atlantic Fisheries treaty which is designed to conserve and protect the great fishing areas from Cape Cod to Iceland. I was invited to attend the 11 nation sessions in Washington as an official adviser and have been elected vice-chairman of the industry advisory committee which helps to formulate the policies of the U. S. Commissioners.

Recently the Massachusetts legislature passed a law to increase the legal length of lobsters at the rate of 1/16 of an inch a year for two years. This measure will go into effect on July 1, 1951. It appears that the Maine legislature will have to consider similar action. The department hopes to be able to obtain pertinent information which will help the lawmakers in their deliberations. This is a big issue that will require the soundest of judgment on the part of those in the industry.

We recently received word that Congress had appropriated the sum of \$75,000 for a survey of the possibilities of developing a large commercial tuna fishery in the Gulf of Maine. This project was instigated by your department in cooperation with several sardine canners who are seeking ways and means of keeping their plants operating during the winter months. The money will be expended under the direction of the U. S. Fish and Wildlife Service and the project will be based at Boothbay Harbor. An attempt will be made to locate large schools of small Bluefin tuna and to devise economical ways of catching them.

With the death of our Chief Warden Daniel Malloy, the State of Maine and the causes of good government and conservation lost a real friend and booster. Malloy came with Sea and Shore on loan from Inland Fisheries and Game. He was of inestimable help to us in reorganizing the department and especially the warden force. His passing was a deep personal loss for all who had been privileged to know him and to work with him.

During the past two years the Maine fishing industry has been enjoying more than normal prosperity and it appears that when official figures for 1950 are compiled the landings of fish and shellfish and the income of fishermen will reach an all-time high. Preliminary estimates

indicate that the total catch will exceed 350,000,000 pounds for which the fishermen have received more than \$16,000,000. It is further estimated that when these products reach the ultimate consumer, after handling, processing and marketing, they will have brought at least \$60,000,000 in new money into this state. Although these figures are impressive it should be realized that rising costs have severely diminished individual profits.

The outlook for the next two years is reasonably good. Our producers and processors have the finest equipment available and have rapidly adopted the most modern methods and devices.

Unrestricted foreign competition on both fish and shellfish is rapidly getting to be a greater threat to our domestic industry. Relief from the effect of these imports can be given only by the Federal government and the department will urge such action through other agencies and the Maine Congressional delegation.

Our fisheries resources are one of our greatest economic assets and they should be fully and wisely exploited, but never destroyed. We believe that this department has a solemn responsibility to maintain the conservation and propagation practices that are best for the resource and to do everything possible to help develop and promote the industry.

We have endeavored to participate, and to lead when the occasion was proper, in regional and national meetings of officials and organizations seeking to protect the interests of the fishing industry. We have consistently sought the best available information and advice. The department is more than a law enforcement agency.

In closing I wish to thank officials of the U. S. Fish and Wildlife Service, the Atlantic States Marine Fisheries Commission, the Canadian Fisheries departments and others for their cooperation and assistance. Our thanks and appreciation also go to Governor Payne, who with his Executive Council, has been most helpful and considerate of our problems.

RICHARD E. REED,

*Commissioner*

## ADMINISTRATION

Department offices are maintained in the state owned Vickery-Hill Building on Chapel Street, Augusta. We lack room for storage and to provide pleasant working conditions for our staff but are unable to obtain additional quarters.

The staff consists of an office manager who also serves as secretary to the commissioner, a license clerk, a combination accountant and

bookkeeper, a law enforcement clerk, a typist and a stenographer. Division heads also maintain desks at headquarters.

In addition to his regular duties the commissioner serves as a member of the Maine Development Commission, chairman of the Atlantic Sea Run Salmon Commission, vice-chairman Industry Advisory Committee, Northwest Atlantic Fisheries Treaty and on the executive board of the Atlantic States Marine Fisheries Commission.

All licenses are issued directly from the Augusta office and about 95% of this business is transacted by mail. Lobster measures and clam rings are furnished by the department and sold to the industry at cost.

A file of educational, scientific and industry motion picture films has been set up and these are being continuously loaned and shown to schools, service clubs, groups and organizations within the state and out of state.

The department has prepared numerous bulletins, pamphlets, and circulars on every phase of the industry for free distribution and these are in great demand. We also distribute advertising material such as recipe books, lobster pins, posters, window displays and menu stickers to almost every state in the union.

We are fortunate to have several men in the organization who are able public speakers and barely a week goes by that they do not tell the story of our fishing industry and seafood products to several groups or clubs.

## STATISTICS

The department employs a full time statistician who maintains working quarters in the U. S. Post Office at Rockland. He works in cooperation with a full time statistical expert who is employed by the U. S. Fish and Wildlife Service. These men cover the entire coast each month, gathering pertinent data on the industry which is published monthly and annually and which provides continuous information that is invaluable for all types of fishery management activities.

## SCOLA CASE

In the summer of 1950 we attempted to enforce the non-resident law which provides that one must have been a resident of the state for three years before being eligible to obtain a commercial fishing license. A Massachusetts dragger manned by a non-resident crew defied the law in a whiting operation in Casco Bay. After being arrested twice, the boat owner sought a Federal Court injunction against the department and won his point. A later ruling by a three

man Federal tribunal declared that our law was unconstitutional and the injunction was made permanent.

As a result we are recommending to Legislature that a non-resident commercial fishing license be established and made available to all who want it upon payment of a fee of \$50 for each member of a crew.

## CORMORANT AND GULL CONTROL

For the past four years we have cooperated with the U. S. Fish and Wildlife Service on a program to control the herring gull and cormorant populations along our coast. We have supplied the boats and numerous wardens to assist the Federal men who furnished the egg spraying apparatus and the fluid to go with it. The projects were carried on during May and June to coincide with the egg hatching season.

The program called for visits to many of the most prolific rookeries where thousands of eggs were sprayed with a solution designed to prevent them from hatching. This method is superior to previous practices of destroying the eggs which only resulted in the female laying another set. Under the spraying technique the mother futilely tries to hatch her eggs until the breeding season has passed.

Dozens of islands and ledges were visited from York county to the Canadian line and there is evidence in some sections that the program is beginning to produce good results.

## RECOMMENDATIONS

I wish to submit the following recommendations, covering various phases of the fisheries and departmental operations, to the industry, the Legislature, Maine's Congressional delegation and other interested parties:

Continuation of periodic surveys of closed clam areas for the purpose of opening additional flats to commercial digging. This will require a legislative appropriation of approximately \$10,000 a year;

A full review of the present system of town control of clam flats. In many instances this is workable while in others it tends to prevent full utilization of the resource. This is an extremely important problem;

That the Legislature open for discussion the feasibility of changing the short end lobster measure to coincide with changes recently made by the Massachusetts lawmakers;

That the present system of revocation and suspension of licenses be reviewed to give the department more discretion when such is justified;

Further consideration of legislation to prohibit the shipping of clams in the shell out of state. Such action would offer important conservation and economic possibilities;

Further protection for the lobster industry against increasing shipments of low priced lobster meat into this state from Canada;

Investigation of the feasibility of setting up a state level inspection system for fresh and processed fish and shellfish;

Repeal of all antiquated laws that are neither applicable or justifiable for modern conditions;

Revision of all rules and regulations to bring them up to date and to clarify and simplify their provisions;

Firm demands that the Federal Government take adequate steps to protect the industry against growing and ruinous foreign competition;

Greater representation and consideration for the fisheries in Federal Government;

Federal legislation to outlaw the advertising and selling of African and southern crawfish meat as lobster meat;

Urge the U. S. Public Health Service to review and revamp its present standards for determining the sanitary aspects of shellfish that may be accepted in interstate commerce;

Seek closer cooperation between the department of Sea and Shore Fisheries and the U. S. Fish and Wildlife Service on research and technological projects to assist the fisheries;

Closer cooperation between all phases of the industry so that the fisheries can present a united front on legislative and administrative matters that concern their welfare.

RICHARD E. REED,

*Commissioner*

## FINANCIAL STATEMENT

### Expenditures

	July 1, 1949 to June 30, 1950	July 1, 1948 to June 30, 1949
Administration.....	\$22,505.25	\$21,579.16
Statistical.....	4,356.79	4,327.11
Warden Service.....	98,830.45	99,004.29
**Research.....	22,471.59	15,314.69
Patrol Boats.....	††12,797.09	†18,367.63
*Propagation of Shellfish.....	11,709.13	14,718.02
Lobster Pound.....	103.28	—
U. of M. Research Project.....	—	3,200.41
xxLaboratory and Workshop.....	3,806.47	4,477.95
Operation of Lobster Rearing Station.....	8,567.74	14,466.10
Total.....	<u>\$185,147.79</u>	<u>\$195,455.36</u>

xSpecial Fund for Restoration and Development of Shellfish Resources..... \$12,189.01 \$10,991.37

\*Includes purchase of seed lobsters.

\*\*Funds provided by percentage of Gasoline Tax Refund

xxIncudes construction of shows, exhibits, and work equipment; also repairs to boats and equipment.

†Includes construction of new 42-foot patrol boat.

††Includes purchase of 28-foot patrol boat.

xMoney provided by license fees paid by the clam industry. Expenditures include salaries, propagation, surveys, and research on clams, mussels, and quahogs.

	July 1, 1949 to June 30, 1950	July 1, 1948 to June 30, 1949
<b>PROSECUTIONS OF VIOLATIONS OF SEA AND SHORE FISHERIES LAWS</b>		
Illegal Fishing.....	34	34
Digging Clams without license.....	18	13
Digging Clams in Closed Areas.....	56	76
Selling Marine Worms without license.....	27	7
Illegal Possession of Lobsters.....	52	82
Illegal Possession of Clams.....	85	138
Illegal Sale of Clams.....	8	7
Illegal Sale of Lobster Meat.....	—	1
Illegal Shucking of Clams.....	—	1
Serving Clams without License.....	—	1
Sale of Fish without License.....	—	1
Illegal Possession of Smelts.....	4	—
Illegal Transportation of Lobsters.....	3	2
Illegal Transportation of Clams.....	1	1
Illegal Transportation of Lobster Meat.....	1	2
Wholesale Trade without License.....	1	—
Failure to Stop.....	8	8
Dumping.....	7	4
Molesting Gear.....	16	11
Obtaining License through Misstatement.....	1	—
Total.....	<u>322</u>	<u>389</u>

## FINANCIAL STATEMENT

### Revenues

	AMOUNT		LICENSES ISSUED	
	January 1, 1950 to December 31, 1950	January 1, 1949 to December 31, 1949	January 1, 1950 to December 31, 1950	January 1, 1949 to December 31, 1949
<b>General Fund Revenues:</b>				
Lobster and Crab Fishing.....	\$25,700.00	\$27,025.00	5,140	5,405
Resident Commercial Fishing.....	936.00	1,674.00	312	558
Resident Sea Moss.....	42.00	108.00	21	54
Retail Sea Food Dealers.....	2,793.00	5,582.00	931	1,135
Shellfish Servers.....	2,684.00	2,704.00	1,342	1,352
Marine Worm.....	1,167.00	1,494.00	389	498
Scallop Fishing.....	1,475.00	1,430.00	295	286
Sea Food Processors.....	1,075.00	1,200.00	43	48
Wholesale Lobster Dealers —Original.....	6,700.00	7,935.00	190	161
—Supp.....	1,365.00	475.00	39	89
Wholesale Sea Food Dealers —Original.....	2,275.00	2,975.00	91	119
—Supp.....	95.00	75.00	19	15
Interstate Lobster Transportation—Original.....	2,200.00	2,225.00	66	66
—Add. Vehicle.....	295.00	220.00	59	44
Lobster Meat.....	850.00	660.00	85	66
Weir Fishing, Fish Trap, and Seine Boat.....	3,552.00	4,034.00	379	408
Duplicate Licenses.....	7.75	7.75	—	—
Fines and Costs.....	4,673.70	8,924.95	—	—
Miscellaneous Receipts.....	3.35	738.69	—	—
<b>TOTAL.....</b>	<b>\$57,888.80</b>	<b>\$69,487.39</b>	<b>9,401</b>	<b>10,304</b>

**Restoration and Development of  
Shellfish Resources:**

Commercial Shellfish.....	\$6,867.00	\$8,544.00	2,289	2,848
Shellfish Shucking.....	—	141.00	—	47
Shellfish Processor—Original.....	400.00	550.00	8	11
—Supp.....	100.00	100.00	4	4
Res. Shellfish Transportation—Original.....	1,200.00	1,025.00	24	36
—Add. Vehicle.....	75.00	95.00	3	4
Non-Res. Shellfish Transportation—Original.....	—	1,500.00	—	15
—Add. Vehicle.....	—	125.00	—	5
Duplicates.....	2.25	3.25	—	—
<b>TOTAL</b> .....	<u>\$8,644.25</u>	<u>\$12,083.25</u>	<u>2,328</u>	<u>2,970</u>
<b>Department:</b>				
Lobster Tags and Certificates.....	\$ 1.65	\$18.00	—	—
Sale of Supplies.....	932.23	890.49	—	—
Witness Fees.....	5.44	24.88	—	—
Miscellaneous Receipts.....	28.39	36.00	—	—
*Gasoline Tax Refund.....	28,664.41	23,986.88	—	—
<b>TOTAL</b> .....	<u>\$29,632.12</u>	<u>\$24,956.25</u>		
<b>GRAND TOTAL</b> .....	<u>\$96,165.17</u>	<u>\$106,526.89</u>	<u>11,729</u>	<u>13,274</u>

\*This money, which formerly went into the Highway Fund, represents a portion of the gasoline tax not refunded to boat operators and was made available to the Department by the 1947 legislature to finance research, propagation, and development projects. Further details of the activity are given in another part of this report.





LANDINGS AT MAINE PORTS, 1948

By Counties

Species	Cumberland	Hancock	Knox	Lincoln
<i>Fish</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
Cod .....	2,832,639	801,240	1,948,014	92,153
Haddock .....	1,858,212	803,175	3,184,365	21,284
Hake:				
Red .....	59,565	—	440	—
White .....	2,645,701	1,422,522	1,064,467	95,608
Pollock .....	4,133,688	187,425	1,769,272	9,868
Cusk .....	495,501	47,351	288,763	52,243
Halibut .....	7,995	7,714	17,218	395
Mackerel .....	867,980	846,536	109,251	1,559,194
Flounders:				
Gray sole .....	256,486	155,921	330,827	6,351
Lemon sole .....	499	344	7,523	—
Yellowtail .....	3,915	20,191	3,060	—
Blackback .....	10,415	583,643	208,820	32
Dab .....	168,408	71,065	312,142	6,839
Other .....	990	—	—	—
Rosefish .....	19,942,419	1,641,456	25,359,099	2,094,450
Whiting .....	5,732,193	—	204,387	2,246,411
Wolfish (catfish) .....	15,085	53,782	142,368	20
Shark .....	42,814	2,024	2,474	56
Shad .....	2,212	54	80	—
Tuna .....	45,183	—	3,200	6,270
Alewives .....	—	399,000	43,670	345,650
Herring .....	23,131,342	48,051,663	39,877,689	15,925,603
Smelt .....	137,638	229,784	70,120	19,572
Sturgeon .....	196	32	—	—
Swordfish .....	461	—	—	—
Eels .....	—	8,500	—	700
Menhaden .....	—	1,289	—	17,500
Skate wings .....	695	—	—	—
Suckers .....	—	—	—	3,200
Miscellaneous .....	75,524	—	19,827	—
<b>Total .....</b>	<b>62,467,756</b>	<b>55,334,711</b>	<b>74,967,076</b>	<b>22,503,399</b>
<i>Shellfish, etc.</i>				
Crabs .....	242,474	15,866	13,020	68,726
Clams:				
Soft .....	667,529	1,185,315	1,663,613	3,064,068
Hard (quahogs) .....	258,162	—	—	—
Lobsters, Maine .....	2,634,221	4,495,108	4,126,123	1,453,305
Shrimp .....	25	—	2,888	21,667
Scallops, sea .....	3,166	267,113	135,082	—
Mussels, sea .....	124,129	—	—	—
Periwinkles .....	—	—	—	14,727
Sea urchins (sea eggs) .....	122,160	—	—	42,255
Bloodworms .....	56,229	65,931	7,722	438,105
Sandworms .....	8,500	12,072	—	57,299
Sea moss .....	1,050,000	—	—	14,790
Livers .....	1,078,090	131,583	222,666	29,304
Spawn .....	23,161	—	—	1,141
<b>Total .....</b>	<b>6,267,846</b>	<b>6,172,988</b>	<b>6,171,114</b>	<b>5,205,387</b>
<b>Grand total .....</b>	<b>68,735,602</b>	<b>61,507,699</b>	<b>81,138,190</b>	<b>27,708,786</b>

LANDINGS AT MAINE PORTS 1948—Continued

By Counties

Species	Sagadahoc	Washington	York	Total 7 Counties	
<i>Fish</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Value</i>
Cod	265,289	378,512	68,573	6,386,420	\$360,405
Haddock	22,646	148,312	13,304	6,051,298	441,991
Hake:					
Red	—	—	—	60,005	2,394
White	250,833	69,495	25,097	5,573,723	231,382
Pollock	6,084	178,765	15,450	6,300,552	209,132
Cusk	120,610	383	9,518	1,014,369	45,834
Halibut	8,887	96	452	42,757	12,598
Mackerel	170,197	—	538,372	4,091,530	191,917
Flounders:					
Gray sole	3,232	455	113	753,385	45,724
Lemon sole	—	—	—	8,366	630
Yellowtail	90,552	—	—	117,718	7,345
Blackback	55,428	11,856	—	870,194	53,123
Dab	5,230	155	30	563,869	18,931
Other	—	—	—	990	20
Rosefish	311	3,675	—	49,041,410	1,711,769
Whiting	471,563	—	—	8,654,554	113,618
Wolfish (cattfish)	4,405	724	258	216,642	8,702
Shark	1,967	—	84	49,419	1,621
Shad	206	—	—	2,552	86
Tuna	167,946	—	6,539	229,138	19,095
Alewives	75,000	1,004,500	—	1,867,820	11,370
Herring	3,073,260	52,302,208	99,190	182,460,955	3,486,455
Smelt	38,130	46,992	—	542,236	137,291
Sturgeon	—	—	—	228	39
Swordfish	—	—	—	461	258
Eels	2,175	8,856	—	20,231	3,534
Menhaden	5,320	—	—	24,109	227
Skate wings	—	—	—	695	35
Suckers	943	—	—	4,143	544
Miscellaneous	3,026	—	—	98,377	3,123
<b>Total</b>	<b>4,843,240</b>	<b>54,154,984</b>	<b>776,980</b>	<b>275,048,146</b>	<b>\$7,119,163</b>
<i>Shellfish, etc.</i>					
Crabs	—	—	—	340,086	\$19,878
Clams:					
Soft	309,912	2,031,549	47,376	8,969,362	1,801,207
Hard (quahogs)	30,515	—	—	288,677	60,348
Lobsters, Maine	335,660	1,539,940	1,338,696	15,973,053	6,439,474
Shrimp	2,745	—	—	27,325	3,122
Scallops, sea	—	48,325	—	453,686	217,662
Mussels, sea	—	—	—	124,129	13,365
Periwinkles	2,094	2,952	—	19,773	6,213
Sea urchins (sea eggs)	15,670	—	—	180,085	4,448
Bloodworms	—	—	—	567,987	305,044
Sandworms	—	—	—	77,871	57,307
Sea moss	243,931	—	175,000	1,483,721	29,675
Livers	24,469	23,162	—	1,509,274	104,993
Spawn	—	—	40	24,342	1,697
<b>Total</b>	<b>964,996</b>	<b>3,645,928</b>	<b>1,561,112</b>	<b>29,989,371</b>	<b>\$9,064,433</b>
<b>Grand total</b>	<b>5,808,236</b>	<b>57,800,912</b>	<b>2,338,092</b>	<b>305,037,517</b>	<b>\$16,183,596</b>

LANDINGS AT MAINE PORTS, 1949

By Counties

Species	Cumberland	Hancock	Knox	Lincoln
<i>Fish</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
Cod.....	2,490,717	553,041	1,683,951	180,112
Haddock.....	2,509,101	579,318	3,039,560	29,876
Hake:				
Red.....	184,407	—	1,445	360
White.....	2,119,182	989,810	728,219	328,705
Pollock.....	4,022,775	81,593	1,049,543	23,387
Cusk.....	602,804	13,110	302,649	132,093
Halibut.....	10,044	7,737	23,423	816
Mackerel.....	257,320	465,493	453,251	1,614,031
Flounders:				
Gray sole.....	250,952	118,637	334,976	22,036
Lemon sole.....	1,010	—	—	—
Yellowtail.....	5,463	13,862	—	1,884
Blackback.....	6,785	726,741	59,125	6,000
Dab.....	177,808	59,046	290,044	19,498
Rosefish (ocean perch).....	24,239,095	32,708	30,341,721	872,205
Whiting.....	8,692,302	92	77,862	2,653,754
Wolffish (catfish).....	11,063	77,129	65,229	118
Shark.....	49,061	1,334	2,104	1,406
Shad.....	4,518	290	100	—
Tuna.....	32,685	480	675	10,845
Alewives.....	—	1,260,000	210,000	921,867
Herring.....	18,696,319	20,105,125	31,270,610	13,652,575
Smelt.....	7,116	100,174	27,179	8,901
Sturgeon.....	370	—	—	—
Eels.....	—	22,900	—	—
Suckers.....	—	—	—	—
Salmon.....	—	—	—	—
Menhaden.....	4,771,760	1,340	137,725	110,000
Cusk.....	—	8,298	4,329	—
Butterfish.....	227	—	—	—
Grayfish (dogfish).....	567,000	—	—	18,000
Miscellaneous.....	956,524	—	1,026,254	—
<b>Total.....</b>	<b>70,666,408</b>	<b>25,218,258</b>	<b>71,129,974</b>	<b>20,608,469</b>
<i>Shellfish, etc.</i>				
Crabs.....	379,768	184,221	84,757	64,240
Clams:				
Soft.....	296,090	927,650	1,816,065	1,754,388
Hard (quahogs).....	556,409	—	—	—
Lobsters, Maine.....	3,124,702	5,321,510	5,010,206	1,889,597
Shrimp.....	—	—	—	9,700
Scallops, sea.....	5,293	308,475	146,207	—
Mussels, sea.....	190,935	—	—	—
Periwinkles.....	—	—	—	8,488
Squid.....	7,885	5,620	3,500	470
Sea urchins (sea eggs).....	—	—	—	79,490
Bloodworms.....	129,208	69,275	2,881	196,469
Sandworms.....	500	6,466	—	24,574
Sea moss.....	900,000	—	—	—
Livers.....	1,383,826	47,855	226,653	44,028
Spawn.....	45,561	—	648	971
<b>Total.....</b>	<b>7,020,177</b>	<b>6,871,072</b>	<b>7,290,917</b>	<b>4,072,415</b>
<b>Grand total.....</b>	<b>77,686,585</b>	<b>32,089,330</b>	<b>78,420,891</b>	<b>24,680,884</b>

**LANDINGS AT MAINE PORTS 1949—Continued**  
By Counties

Species	Sagadahoc	Washington	York	Total 7 Counties	
<i>Fish</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Value</i>
Cod.....	181,522	119,708	55,507	5,264,558	\$269,487
Haddock.....	32,571	111,735	14,640	6,316,801	422,163
Hake:					
Red.....	—	—	—	186,212	9,762
White.....	283,004	8,717	29,175	4,486,812	190,610
Pollock.....	11,815	534,318	4,275	5,727,706	134,444
Cusk.....	121,231	331	17,705	1,189,923	50,708
Halibut.....	1,390	110	920	44,440	12,285
Mackerel.....	288,218	91,399	182,057	3,351,769	157,569
Flounders:					
Gray sole.....	34,230	150	—	760,981	34,848
Lemon sole.....	125	—	—	1,135	73
Yellowtail.....	98,516	—	—	119,725	8,743
Blackback.....	34,230	—	—	832,881	39,774
Dab.....	39,181	—	14	585,591	15,777
Rosefish (ocean perch)....	714	16,162	—	55,502,605	2,014,071
Whiting.....	984,160	—	23,330	12,431,500	147,191
Wolfish (catfish)...	5,039	100	169	158,847	4,295
Shark.....	2,791	—	2,752	59,448	2,173
Shad.....	—	—	—	4,908	206
Tuna.....	108,758	—	6,161	159,604	15,134
Alewives.....	160,780	728,000	—	3,280,647	31,157
Herring.....	8,717,460	56,583,100	868,700	149,893,889	2,408,383
Smelt.....	1,050	16,117	239	160,776	40,003
Sturgeon.....	39	—	—	409	69
Eels.....	2,200	16,700	—	41,800	— 8,672
Suckers.....	9,305	—	—	9,305	651
Salmon.....	1,018	—	—	1,018	507
Menhaden.....	6,520	—	—	5,027,345	45,040
Cusk.....	—	—	—	12,627	188
Butterfish.....	—	—	—	227	10
Grayfish (dogfish)...	2,000	—	—	587,000	4,802
Miscellaneous.....	94,630	304,000	—	2,381,408	19,357
<b>Total.....</b>	<b>11,222,497</b>	<b>58,530,647</b>	<b>1,205,644</b>	<b>258,581,897</b>	<b>\$6,088,152</b>
<i>Shellfish, etc.</i>					
Crabs.....	4,746	16,667	—	734,399	20,217
Clams:					
Soft.....	154,902	3,650,715	23,062	8,622,872	1,419,691
Hard (quahogs)...	33,385	—	—	589,794	98,483
Lobsters, Maine....	451,125	1,901,476	1,573,879	19,272,495	6,696,961
Shrimp.....	—	—	153	9,853	1,806
Scallops, sea.....	—	48,941	—	508,916	179,845
Mussels, sea.....	—	195,386	—	386,321	15,345
Periwinkles.....	—	1,800	—	10,288	3,186
Squid.....	2,600	—	—	20,075	395
Sea urchins (sea eggs)	—	—	—	79,490	2,291
Bloodworms.....	—	3,883	—	401,716	297,021
Sandworms.....	—	2,271	—	33,811	18,910
Sea moss.....	105,000	—	120,000	1,125,000	18,704
Livers.....	39,177	37,029	779	1,779,347	123,937
Spawn.....	116	—	—	47,296	3,096
<b>Total.....</b>	<b>791,051</b>	<b>5,858,168</b>	<b>1,717,873</b>	<b>33,621,673</b>	<b>\$8,899,888</b>
<b>Grand total...</b>	<b>12,013,548</b>	<b>64,388,815</b>	<b>2,923,517</b>	<b>292,203,570</b>	<b>\$14,988,040</b>

## DIVISION OF LAW ENFORCEMENT

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As of June 30, 1950, the staff of this division consisted of 20 district wardens, five supervisors, a boat captain, an engineer and an administrative clerk. Daniel T. Malloy who served with the department as chief warden for two years from 1946 was stricken with serious illness in mid-1948 and died recently. He has not been replaced and his work is being carried on by the Commissioner who has charged the district supervisors with added responsibility.

With the exception of Chief Malloy there has been no vacancies since our last biennial report. Several wardens have passed discretionary retirement age of 60 while one will reach the obligatory retirement age of 70 in mid-1951. We believe that our policy of having a smaller force of better paid, vigorous men with larger districts and responsibilities is working out well.

A breakdown of the expenses of operating the warden service for the fiscal years 1948-49, 1949-50 is given as follows:

### 1948-49

Reimbursed expenses, auto travel, etc.....	\$25,205.67
Salaries.....	67,885.46
Clothing.....	2,448.29
Miscellaneous equipment and supplies.....	855.27
Transportation equipment.....	2,507.90
Disability compensation.....	170.25
Other miscellaneous expenses.....	41.05
	<hr/>
	\$99,113.89

### 1949-50

Reimbursed expenses, auto travel, etc.....	\$23,788.72
Salaries.....	72,472.48
Clothing.....	1,379.48
Miscellaneous equipment and supplies.....	636.24
Transportation equipment.....	173.66
Maintenance of prisoners.....	101.75
Other miscellaneous expenses.....	278.12
	<hr/>
	\$98,830.45

All new wardens are selected through competitive examinations and promotions to supervisor are made in the same manner. We find that the maintenance of district supervisors is an excellent sys-

tem that simplifies the field work and administration of a complicated legal fisheries set up.

The entire coast is divided into five districts with a supervisor in charge of each. So far as possible we have reassigned district wardens to more strategic locations with the resultant saving of mileage and expenses and duplication of work. Further reassignment is necessary in order to get maximum results with a minimum of men.

During the biennium the Governor and Council approved a new schedule of pay for the division which is in line with similar action affecting Inland Fisheries and Game enforcement officers. The present scale for district wardens is \$43 to \$53 a week while supervisors receive a flat \$63 weekly. The position of chief warden calls for \$75 weekly. Each man receives mileage on his car and expenses while on duty in the field.

Members of the force receive regular issues of uniforms, including shirt, pants, coat, ties, raincoats, rubber boots, hat and incidentals. The method of wearing and caring for the uniform is strictly regulated.

During the biennium we have obtained small boats with outboard motors for the wardens who need them and have also issued field glasses, whistles, trailers and other minor items of equipment.

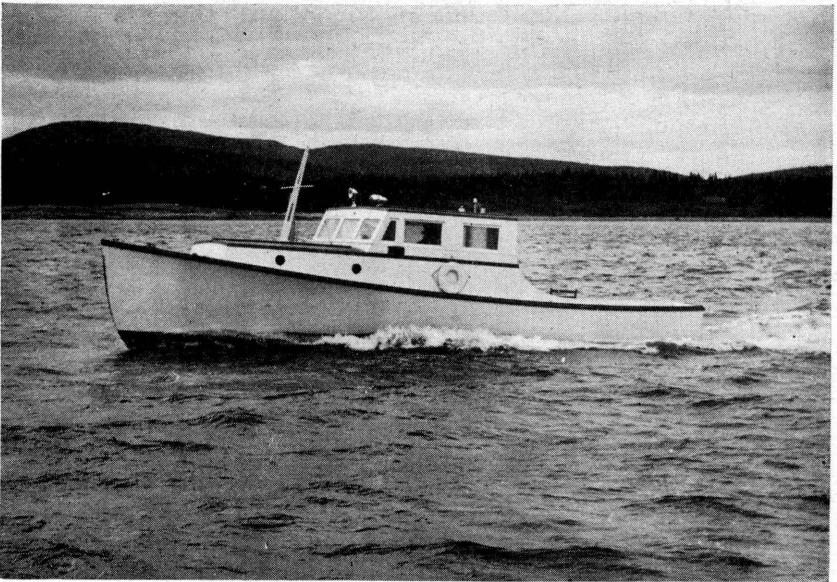
Full wardens meetings are held at least twice a year for the purpose of discussing department policy and mutual problems and the supervisors meet with the Commissioner and other staff officials at least once a month. After the latter meetings the supervisors call their district men together to discuss new developments and further orders.

All men are required to file comprehensive weekly reports of their activities and observations and a digest of these reports is prepared at least twice a month for distribution to the entire force.

Although law enforcement is the basic duty of all wardens they are also required to gather statistics and information, to consult with the industry on departmental matters, to help the fishermen and dealers whenever possible, to work on propagation and conservation projects and serve as all around representatives of the department in the field.

During the present National Emergency our wardens have been placed at the disposal of the State Director of Civil Defense and are receiving regular training along those lines. They are also made available to the State Police and Department of Inland Fisheries and Game for help and cooperation whenever needed.

Coverage of offshore islands is made by boat from the mainland but the department is considering stationing a full time warden with a boat on Vinalhaven to cover that area as well as Criehaven, Matinicus, Isle au Haut and adjacent islands.



*The Patrol Boat "Guardian"*

## VIOLATIONS

The number of violations has remained about the same as for the last biennium. (A full breakdown may be found on another page of this report). Possession of illegal clams and lobsters and the digging of clams in closed areas were again the leading offenses. We are particularly sorry to report that there were 27 cases of molesting gear and practically every offender has had his license revoked for three years.

The 1949 Legislature did much to clarify the laws and to repeal several that were unenforceable or impracticable. However there is still a lot of work to be done in modernizing the fisheries laws and we hope to make more progress at the 1951 session. Repeal of the so-called Four County clam law was most helpful from an enforcement standpoint. The law as written would not stand up in any of our courts and therefore caused the department much unnecessary trouble and expense as well as to create much unfair and unfavorable public opinion and publicity.

Closed clam areas were not as troublesome as in the past due to a more liberal attitude on the part of the U. S. Public Health Service and a legislative appropriation which permitted the department to make more comprehensive water and flats tests than had been done previously. (This work is described under the report of the division of conservation and propagation).



We had much less trouble with clam bootleggers but the short clam problem was still serious. The taking of clams under two inches in length definitely is harmful to conservation and can be stamped out only through strict enforcement and a continuous campaign of public relations and education.

The force seized many thousands of short lobsters from Canadian shipments and these were released in our waters to help build up the supply. The men also released thousands of pounds of seed lobsters which were purchased from the pounds by the department.

### CIVIL SERVICE

The Civil Service Commission set up by the 1947 Legislature is working out well and has resulted in a better trained, better disciplined force. The morale, unity and efficiency of the men has been greatly increased.

### WARDEN SCHOOL

We did not hold our regular warden school during the biennium but plan to resume this important project in the near future.

### PATROL BOATS

The department now has three patrol boats and a combination patrol-research boat which are based at Rockland, Southwest Harbor and Boothbay Harbor. A fourth craft, owned by warden Elmore Wallace of Portland, is available to us for duty in that district on a rental basis.

The 26-foot *Little Explorer*, which was purchased from the department of Inland Fisheries and Game in 1947, is at Southwest Harbor and is used mainly to cover the island fishing areas around Bluehill and Frenchman Bays.

The 34-foot *Guardian* which was built for the department in 1947 is based at Rockland and covers the Penobscot Bay islands from Isle au Haut to Matinicus, including Vinalhaven, North Haven, Mussel Ridges and others. She cost approximately \$4,000 and is in excellent condition. A new engine was installed in 1950.

The old 34-foot *Lively Lady* was sold in 1949 to private parties on Vinalhaven and was replaced this summer by the 28-foot *Hellcat* which is stationed at Boothbay Harbor for joint use by the wardens and our research staff.

In April 1949 we launched the 42-foot *Explorer* as a replacement for the near useless old 55 footer *Matne*. The latter was sold to New York parties in 1948. The *Explorer* is an ideal combination research,

work and patrol boat. She is well equipped with radio telephone, fathometer, hoisting gear and fishing equipment. She is powered by a 150 H.P. G.M. diesel and is economical to run. The boat is based at Rockland, under Captain Ronald Green, and is used extensively.

The cost to the department, fully equipped, was approximately \$11,000.

## DIVISION OF MARKETING AND DEVELOPMENT

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This division was set up to do a general promotional job for the industry and is largely financed by Maine Development Commission funds which are earmarked for such activity. Its principal responsibility is to encourage more people to buy and eat Maine sea-foods and to promote industrial development such as new plants, by-products, processing techniques and utilization of waste.

These activities are vital to the welfare of our fisheries and our state. Expansion of our markets means a bigger demand at better prices while new industries offer more jobs and efficient utilization of our vast ocean resources.

It is the duty of the division to keep abreast of all new fisheries developments and to see that the pertinent ones are applied to our own industry when possible.

Efforts to make the nation Maine seafood conscious are progressing and have been especially successful so far as lobsters are concerned. This work is being carried on through advertising, publicity, shows and exhibits. We have enlisted the assistance of national organizations and groups and have received wonderful cooperation.

The great Maine sardine industry is now contemplating a nation-wide merchandising and promotional campaign which would be financed by a tax on all licensed packers of from 10c to 25c a case. This would raise a sum of from a half million to a million dollars a year and would be the most progressive project of its kind ever developed by any branch of the Nation's fishing industry. The present plan is to seek Legislation for such a tax which would be set up similar to the present potato program.

It is generally known that the sea has the greatest potentiality of any area of the earth for the creation of new wealth and resources and Maine is amply blessed along those lines.

We feel that the department has a responsibility to encourage growth of all phases of activity in the fisheries field. Although handicapped by lack of funds and personnel we have at least made a start and we believe that this division should eventually become greatly expanded.

We attempt to be alert for all warning signals of impending dangers to our fisheries economy and try to head off this trouble before it gets really serious. Such situations include foreign competition,



*Large crowds sampling Maine seafoods at Eastern States Exposition, Springfield, Mass.*

lowering of tariff rates, increased transportation rates, adverse publicity, loss of markets to other products and many other problems.

The lobster industry is now faced with extremely serious competition from imported crawfish. This specie is being shipped to the nation's seafood markets from Australia, Africa, Mexico and other countries, in increasingly large volume. Only the tails of the crawfish are used and they are marketed in a quick frozen state. This makes them easy to handle and, therefore, popular items with wholesalers and retailers.

Despite the fact that crawfish fishermen of other countries are usually subsidized by their governments our government in Washington will do nothing to help combat such unfair competition through a duty or quotas.

We have succeeded in getting regulations passed by the Federal Trade Commission to prohibit the selling and advertising of crawfish as lobster but enforcement of the measure is very weak. The department feels that the crawfish problem is a real one and that it must be met with stern and vigorous action by the state and the lobster industry.

In accordance with the law, one-eighth of the appropriations for the Maine Development Commission is earmarked for development and promotion of products of the sea. A similar set-up exists for

industry and agriculture. For the biennium our share has amounted to approximately \$35,000 a year. The money is expended under the direction of the Commission, of which the commissioner of Sea and Shore Fisheries is a member. It is only because of this plan that we are able to maintain the division.

Supervision of the division is under the direction of the Commissioner who carries on much of the work personally. He is assisted by Robert Perry, an employee of the Maine Development Commission, who specializes in booklets, shows and exhibits and Wayne Buxton of the same organization who assists on publicity.

Many of the promotional activities are handled in cooperation with the New York advertising firm of Brooke, Smith, French and Dorrance, which acts as advertising and merchandising counsellors for the State of Maine.

### NEW INDUSTRIES

Several out-of-state firms have either established branch plants or their principal place of business in Maine during the past two years. Numerous local enterprises have also sprung up to handle fish and shellfish.

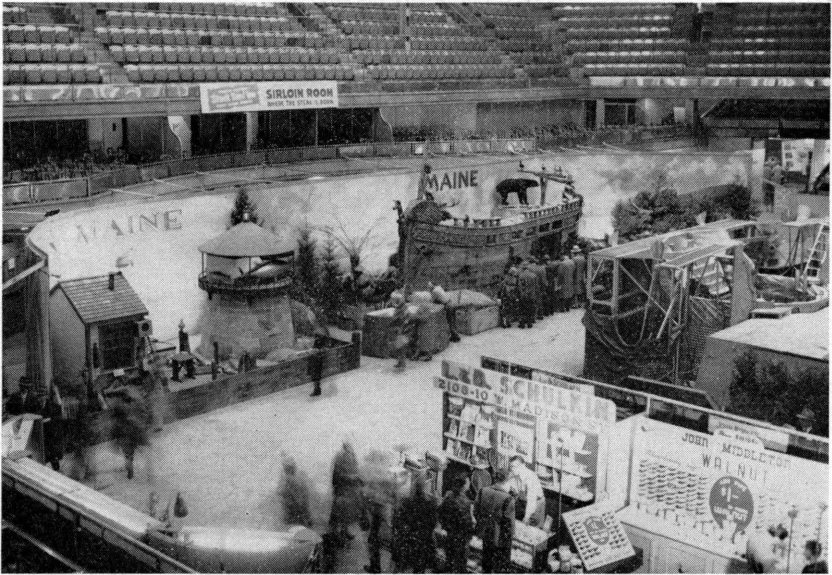
The department strives to encourage such progress and stands ready to cooperate in the creation of new industries and new payrolls.

Through the efforts of the Commissioner and Senator Brewster, the Congress has appropriated \$75,000 to survey the possibilities of developing a large commercial tuna fishery in the Gulf of Maine. The project will be handled by the U. S. Fish and Wildlife Service and it is expected that a large purse seiner will be chartered to carry on the work. If large schools of small Bluefins, weighing from 80 to 120 pounds each, can be located and a method devised to take them economically, it may result in a vast new canning industry for the Maine coast.

Continuous research on better methods of handling, packaging, shipping and merchandising Maine fish and shellfish products and by-products is being carried on by the department to the limit of its manpower, facilities and resources.

### ADVERTISING AND PUBLICITY

We have been especially active in these fields and with good results. Numerous publicity stunts such as clambakes in the Middlewest, seafood dinners for important groups in New York, Washington and other cities, participation in parades, national athletic events, tuna



*Sea and Shore was well represented at the Boston and New York Sportsmen's Shows*

tournaments, festivals, queen contests, recipe contests, fairs and fetes have all served to focus attention to Maine seafood products.

Other promotional efforts have included displays at national conventions of dietitians, food editors and women's clubs, Boston and New York Sportsmen's Shows, Eastern States Exposition, annual meetings of the National Fisheries Institute, hotel and restaurant shows, cooking schools, food fairs and others.

We have published numerous booklets and pamphlets describing various phases of the fishing industry and the products involved. These, along with inexpensive souvenirs, have been given National circulation and have won a lot of friends and customers for our industry and our state. Our "Best Seafoods Recipes" booklet is considered the finest publication of its kind in the country and is in great demand.

One of our most elaborate and recent promotions was the publishing of several thousand sets of seafood posters, in full color, for distribution to retailers.

A miniature sea chest which was developed by Robert Perry has proven to be a sensational public relations and promotional medium. The little wooden boxes are filled with thirteen cans of different Maine seafoods and the contents also include booklets and souvenir lobster pins. A certificate on the box cover is signed by the Governor and the Commissioner. The chests are sent to prominent friends of Maine throughout the country and have done much to boost the sale of our canned seafood products.

They are constructed at the State Prison in Thomaston and the

contents are provided by the various canners either at wholesale or free of charge.

The department maintains a library of films on the fishing industry which are loaned to schools, clubs and other organizations.

All of these efforts are supplemented by close cooperation with authors, magazine writers and newspaper people who write stories around our fisheries. We also prepare and distribute many stories to the press and radio.

### OTHER ACTIVITIES

We have cooperated with the National Fisheries Institute on a number of projects such as a fight against increased express rates on seafood products and the development of greater representation for the fisheries in federal government.

The Commissioner has made many trips to Washington to stir up congressional assistance against foreign competition and to appear at hearings before the tariff commission. We have worked closely with other seaboard states on fishery projects and sat in on conferences to shape the North Atlantic Fisheries treaty. Generally the department has taken a broad attitude on the value of letting the world know about Maine and its fishing industry.

### COMPETITION

When the world food situation becomes more stable, fish products will face greater competition from other foods. Because of this the industry must remain alert, improve its products and merchandising methods. We hope to be able to be of assistance in this effort.

### INFORMATIONAL SERVICE

As soon as facilities are available we hope to set up an informational service with regular bulletins to the industry on latest developments in marketing, processing and production techniques.

## DIVISION OF CONSERVATION AND PROPAGATION

Robert L. Dow, *Chief*

No continuous marine fisheries research program existed in Maine prior to 1946. In view of that fact and in further consideration of the limited funds and personnel available for full-time research it might appear that the Department's efforts have been spread rather thin. In order to offset this obviously undesirable situation, we have, fortunately, been able to obtain the assistance and interest of several Maine colleges, other state agencies, the U. S. Fish and Wildlife Service and other agencies directly or indirectly concerned with marine problems. In several specific instances certain segments of the industry, as well as interested individuals and coastal communities, have provided us with invaluable assistance.

In general, it has been the operating practice of the department, in so far as possible, to assist the industry on short-term problems, the solution, or partial solution, of which would be of practical value to the industry. At the same time, continuous research and experimentation to provide information on better management of the several fisheries has been carried on.

Outlined briefly below are some of the problems which have been, or are being, investigated by the department. Some of these investigations have been completed; others, with their initial phases completed have been discontinued or directed along more practical lines, while others, of basic value to the entire research program, must be continued on a permanent basis if their full value is to be realized.

### LOBSTERS

1. landings
2. stratified sampling of commercial catch to determine
  - a. size composition of commercial catch
  - b. seasonal fluctuations in size composition
3. tagging of lobsters in selected areas
4. fishing intensity
5. growth rates and recruitment
6. experimental traps
7. rearing methods
  - a. equipment and techniques
  - b. survival of fry to fourth stage



8. survival of liberated young
9. growth and survival of pre-legal sizes
10. moulting
  - a. Includes work done during the summer of 1949 by David Turkeltaub of Bates College and during the summer of 1950 by Dr. J. K. Donahue of Syracuse University in the investigation of practical means of retarding the moulting process in impounded lobsters and thereby prolong their period of marketability during the normal shedding season.
11. diseases
  - a. bacterial infections and their reduction by improved handling and holding practices
    - (1) "red-tail"
    - (2) shell disease  
meat discoloration from plugging
12. evaluation of the efficiency of various handling and packing methods currently being used by the industry
13. evaluation of non-traditional holding devices
  - a. recirculated sea water
  - b. recirculated artificial sea water

#### CLAMS

1. populations
2. commercial catch
3. flat survey methods
4. growth, survival and recruitment
5. effect of size restrictions
6. meat yield assays
7. bacterial surveys
8. clam flat management
9. flat improvement
10. predator control
11. competitor control
12. geological-biological environment
13. seed transplantation
14. hydraulic harvesting of seed stocks
15. effect of DDT on clam populations

## QUAHOGS

1. populations
2. commercial catch
3. growth and survival
4. salvage of stocks from over-crowded seed areas
5. culturing and rearing
6. seeding currently barren areas where clam populations have disappeared

## MUSSELS

1. experiments to determine possible commercial uses
2. methods of reducing mussels as clam competitors in those areas where the clam fishery has high economic value

## SCALLOPS

1. commercial catch
2. growth and survival
3. spawning
4. migration
5. culturing and rearing
6. reconnaissance
  - a. exploration of promising grounds
  - b. assessment of presently unproductive grounds

## OYSTERS

1. evaluation of selected areas in establishing local oyster fishery
2. survival and spawning of eastern, European and Japanese oysters in Maine waters

## SHRIMP

1. reconnaissance of promising grounds

## SMELTS

1. commercial catch
2. size of stocks
3. age, growth and survival
4. spawning, spawning grounds, hatch and loss of eggs
5. feeding habits
6. stream surveys
7. effect of catch restrictions

8. evaluation of times, places and methods now in force for taking smelts commercially or for sport

### HERRING

1. cooperative investigation with the U. S. Fish and Wildlife Service and the Maine Sardine Packers Association on
  - a. a rapid method of detecting fungus-infected fish
  - b. the effect of various sounding devices on the behavior of herring

### SHAD

1. cooperative tagging with the U. S. Fish and Wildlife Service

### ALEWIVES

1. the stocking of presently barren streams with spawners
2. stream improvement investigation in cooperation with the Atlantic Sea Run Salmon Commission



*Collection of plankton samples and other marine specimens is an important part of research activities.*

## SALMON

1. with the Atlantic Sea Run Salmon Commission investigation of streams and the improvement of passage to spawning grounds
2. experiments in the holding of immature silver salmon in impounded sea water until spawning. (The purpose of this experiment is to reduce the present dependence of the commission for spawn stock on a highly variable source of supply.)

## GENERAL

Tidal pollution investigations in cooperation with the Maine Division of Sanitary Engineering and the U. S. Public Health Service.

Details of progress in the several investigations currently being carried on are included below with reports by the several investigators concerned.



*Built as a lobster rearing station, this plant now houses the department's research and experimental activities.*

## FISHERIES RESEARCH STATION

P. L. Goggins, *Station Superintendent*

Since the establishment of the research and experimental program by the Department, the laboratory facilities at the Fisheries Research and Experimental Station at Boothbay Harbor have been expanded to include three laboratory rooms. At the present time the laboratories are equipped for basic work in specialized fisheries problems (Bacteriology, Chemistry, Pathology).

A research library has been established and a publications exchange with other fisheries laboratories throughout the world has been arranged.

Part of the old lobster hatchery space has been utilized for holding experimental tanks.

The marine aquarium which was redesigned by Robert L. Perry was the subject of much favorable comment by visitors during the past summer. The marine aquarium is a cooperative effort of the

Department and the U. S. Fish and Wildlife Service. Two college students were employed to attend the aquaria. Twenty thousand visitors from every state of the union and many foreign countries visited the marine aquarium during July, August and September.

During the past summer season the Department provided laboratory space for Dr. J. K. Donahue of Utica College who worked on one of the Department's research problems. From Dr. Donahue's favorable comment on location and laboratory facilities, there is a possibility that the summer work program by visiting biologists can be exploited to the Department's advantage.

## PROGRESS IN FISHERIES RESEARCH

Fred Baird, Jr., *Senior Biologist*

Donald Harriman, *Biologist*

Louis Taxiarchis, *Biologist*

Thurlow Farmer, *Biological Aide*

### INTRODUCTION

Since the publication of the 15th Biennial Report several changes have been made in personnel of the Fisheries Research Station at Boothbay Harbor. On July 1, 1950, Clyde Taylor resigned as Chief Biologist to return to the employ of the Fish and Wildlife Service, and Fred Baird, Jr. was placed in the position of Senior Biologist to succeed him. Donald Harriman was moved from the Clam Investigation to the position of Biologist and in charge of the Lobster Investigations. Thurlow Farmer has been made a Biological Aide to assist in all research problems. In October the staff was increased to include Louis Taxiarchis, who will continue as a Biologist in the Clam program, but will be based at Boothbay Harbor as an active member of that research group.

The Department has been fortunate, during the course of its fisheries investigations, to be in close contact with the U. S. Fish and Wildlife Service and the Canadian Biological Stations thus prohibiting a duplication of work and often receiving much needed advice and cooperation. Several of the Maine colleges have cooperated on parts of certain problems and two students from the University of Maine have done Master thesis on Fishery problems, under College and Departmental cooperative programs.

A new research group is now active in the federal station at Boothbay Harbor. This group, the Fish and Wildlife Service Clam Investigation, is conducting a long-range program of the soft and hard shell clam resources of the Atlantic coast. We are fortunate in being closely allied with them in some of our research projects and have available mutual facilities and materials.

### EQUIPMENT

The Boothbay Laboratories are now equipped to handle almost any fisheries problem which may arise. New laboratory space has been constructed since the last Biennial Report, and is adequate for present needs. However, we are reserving additional space in

the station to meet the possible needs of future expansion especially for visiting biologists working in collaboration with our program. New equipment has been added and will be added as its need arises.

The new motor vessel, *Explorer*, and a smaller boat, *The Hell-Cat*, are available when needed for use in any part of the research program.



*The department is continuously experimenting to find new and more efficient methods of gathering seed clams.*



## PROGRESS REPORT ON INVESTIGATIONS LOBSTER INVESTIGATION

Donald Harriman *in Charge*

### *Shell Disease*

In 1948 lobsters were received from pounds which showed lesions of the shell, with reports of accompanying mortality. The condition, reported by Hess in the Journal Biol. Bd. Canada in 1947, is caused by bacteria growing on the chitin. Experiments in the tanks at Boothbay Harbor indicated that mortality was quite independent of the proportion of shell involved, but lobsters which died showed gill damage. On the basis of this, a histological study was conducted by students under direction of the Bates College Biology Department. The results of this study were reported in the Sea and Shore Fisheries Bulletin, A STUDY OF LOBSTER SHELL DISEASE WITH OBSERVATIONS AND RECOMMENDATIONS, 1948.

### *Holding of Live Lobsters*

For several years there have been consistent inquiries from dealers and others in inland areas concerning the efficacy of certain preparations designed to replace sea water in the live storage of lobsters. In an attempt to answer the questions preliminary tests have been made at the University of Maine Agricultural Experiment Station by John Getchell and at Boothbay Harbor. These have been inconclusive so far, but additional study on the effects of metallic ions from the containers is indicated.

The problem is being split into two phases. Getchell is continuing a study of the relative efficiency of the sea salts with respect to survival time and concentrations of lobsters in tanks. The second phase concerns the toxic effects of various metals in contact with the solutions. This is to be studied in a series of experiments at Boothbay Harbor.

### *Gaffkya ("Red Tail")*

Following the occurrence of severe mortalities in pounds, tanks, and cars, Snieszko and Taylor isolated a bacteria. (A BACTERIAL DISEASE OF THE LOBSTER, HOMARUS AMERICANUS. S. F. Snieszko and C. C. Taylor, U. S. Fish and Wildlife Service, Science Vol. 105, No. 2732, May 9, 1947.) In 1946 the Governor and Council appropriated \$6,000 from the contingent fund which was made available to John Getchell at the Agricultural Experiment Station.

His report, A STUDY OF ABNORMAL SHRINKAGE OF MAINE LOBSTERS ("RED TAIL") WITH OBSERVATIONS AND RECOMMENDATIONS, Sea and Shore Fisheries Bulletin, 1950, contains descriptions of the disease with recommendations for its control.

At present the work is being done largely at Boothbay Harbor, with two lines of attack being followed viz. bacteriological and hydrographic. The bacteriological approach will consist of methods of determining relative concentrations of bacteria and the interpretation of this data with regard to the seriousness of the infection and possible control measures. At present we are testing for the presence of disease by examination of sick lobsters and by the checking of water samples.

Recently a consideration of the hydrography of lobster pounds has presented a completely new concept of the disease and its possible control. The nature of lobster pounds is such that a number of factors may well produce a stratification with regard to either salinity or temperature. Such stratification, once formed, may effectively block the exchange of water between the pound and the outside water even though the tide may rise over the dam by three or four feet each tide. This stratification could be expected to result in stagnation with a coincident drop in dissolved oxygen. A series of D. O.'s taken in a large number of pounds, bears out this assumption. In two pounds which showed no such tendency to stagnation, Gaffkya has not been a serious problem.

This approach to the problem is being developed with a statewide survey of lobster pounds to be continued through another season. It is expected that by the fall of 1951 information will be available which will either discount these factors or upon which we may base recommendations which will go far in eliminating Gaffkya as a source of mortality in lobster pounds.

### *Natural History*

In addition to studies of special problems such as the above, the Department is continuing to collect data and information which gives more complete knowledge of the lobster in its native environment. This is accomplished by checking up on curious occurrences or freaks reported by the fishermen, by tagging operations, and by experimental fishing. These data are being collected and organized to give us more complete information concerning the growth, migration, and fishing mortalities among lobsters. In the fall of 1950, lobsters were tagged around Monhegan. The returns from this tagging should give us information of interest about the movements of offshore lobsters and the effectiveness of the fishing effort in reducing the population.

## THE SMELT FISHERY

One of the first problems approached under this program has been that of the Atlantic Smelt Fishery. We are now in possession of some three years data based on all phases of the life history and fishery for this species. We are at present directing most of our efforts on the smelt investigations to the effect of fishing efforts on populations and especially on the conditions which affect the outcome of recruitment from spawning.

The ever increasing importance of this species as both a commercial and sport fish, makes it doubly necessary that it be properly protected. Through our close associations with Canada where a like investigation is underway and as a result of our own observations, we hope in the near future to make several basic recommendations for the maintenance and increase of the fishery.

## THE SHRIMP FISHERY

Some investigative dragging has been done for shrimp with poor results, and it is felt that until more personnel and funds are available, we should limit the work primarily to exploratory dragging.



*Thousands of scallops are tagged annually to trace migrations and to study other phases of the life and habit of these bivalves.*

## THE SCALLOP FISHERY

The Scallop Program has taken several definite steps since the early phases of the Research Investigations. The original staff was unable, due to lack of time, to carry on an active program of research on this species, but we were fortunate to secure the services of Walter Welch, a graduate student at the University of Maine, to take on a project dealing with scallops, thus observations have been made on growth rate, age composition, spawning, etc., as the basis for his Masters Thesis. The work has been completed and will soon be published; likewise it is now being used as a background study for a more active scallop survey including trial dragging of suspected scallop areas, age and growth studies, tagging to check movement and populations, and experiments in the station on the spawning and rearing of the species.

## ATLANTIC SALMON RESTORATION

The Boothbay Harbor staff works closely with the Fish and Wildlife Service and the Department of Inland Fisheries and Game in the Atlantic Salmon Restoration Program. Our part of the work at present consists of supplying help in the distribution of fish, operation of temperature checks in this area, and the conducting of an experiment in the holding and developing of silver salmon to maturity to maintain a supply of eggs of this species which might become a very important sport fish.

## PROPOSED TUNA INVESTIGATIONS

At this time, plans for 1951 call for the inauguration of a Fish and Wildlife Service tuna investigation with headquarters at Boothbay Harbor. Some groundwork for this investigation has been inaugurated by this laboratory and a close liaison will be maintained with the group.

## GENERAL ACTIVITIES

Since the inception of this research station, it has been the policy to be prepared at any time to start any work on any species of fish which was deemed necessary. This has led us several times to participate with various towns in the starting or improving of alewife runs or advising of methods by which such runs might well be started or improved. Some work has been done on shad, but at present it is not deemed advisable to spend either too much time or money on a shad project. It is, however, quite possible that we will cooperate with the Fish and Wildlife Service in their work with this species.

## TECHNOLOGICAL STUDIES

A fair proportion of the time of personnel at the Research Station is spent on projects of a technological nature. The following are a few of the experiments now in progress or which have been completed.

Experiments with the use of artificial and recirculated sea water as a medium for holding lobsters. This work is being or has been done by John Getchell at the University of Maine or Clyde Taylor.

Experiments with the use of treated lobster plugs failed to reduce the meat discoloration in the claws of lobsters. However, during the course of this experiment it was proven that plugs made of plastic materially reduced the discoloration. A detailed description of this work can be found in Fisheries Circular No. 6.

Another project now in progress is the testing of various paints and tar products to reduce the destruction activity of certain marine borers now widely reported along our coast. These borers are credited with complete destruction of lobster traps within a six-month period. Early results of this experiment should be available by late spring.

Other technological projects of this nature, such as temperature studies of lobster shipping containers, measuring devices, and observations on lobster shell disease have been carried out and results published in reports by the Department. Further work of a like nature will be started in the near future, especially along bacteriological lines.

## CLAM FLAT POLLUTION SURVEY

P. L. Goggins, *Bacteriologist, Project Leader*

The 1949 legislature appropriated \$22,500 for a survey of the fifty-six clam flat areas closed because of pollution.

The Department of Sea and Shore Fisheries personnel with the aid of Department of Health personnel initiated the work in the Freeport area in September 1949. The facilities of the Department of Health bacteriological laboratory in Augusta were used for this work.

In October 1949 P. L. Goggins, bacteriologist, was employed as a project leader for the clam flat pollution survey. Thereupon, a bacteriological laboratory was set up at the Fisheries Research Station at Boothbay Harbor with the aid of the Department of Health.

Since the start of the pollution survey work, 21 areas have been studied and nine closed areas have been opened.

In order to get as complete a picture as possible of the condition of the clam flats and waters over the clam flats, bacteriological and hydrographical data were collected in the closed clam flat areas. These data were correlated with the results of the sanitary reconnaissance conducted by this Department and the sanitary surveys conducted by the Sanitary Water Board.

As a direct result of the pollution survey, considerable acreage of nine of the twenty-one areas studied were found to be safe according to standards established by the U. S. P. H. S. and were therefore opened.

The areas opened are as follows:

- Closed Area # 5—Wells—winter digging
- Closed Area # 8—Cape Porpoise—winter digging
- Closed Area #10—Jones Creek, Scarboro—year round
- Closed Area #17—Freeport—year round
- Closed Area #22—Wiscasset—year round
- Closed Area #30—Rockport—year round
- Closed Area #47—Bar Harbor—winter digging
- Closed Area #53—Milbridge—year round
- Closed Area #56—Dennysville—year round

Closed Area #10, Scarboro, especially proved to be a bonanza to the clam diggers in the Scarboro area. At latest reporting, clams valued at approximately \$20,000 were taken out of this area. In

addition to Jones Creek area, the areas opened at Wells and Dennysville have proven to be very valuable and have brought the total income made possible during the first year of this program to well over \$30,000.

The clam flat pollution survey has been carried out with the close cooperation of the State of Maine Department of Health, the Sanitary Water Board, and the U. S. Public Health Service. The data received from the Sanitary Water Board's sanitary surveys have been especially valuable as an aid in the evaluation of the clam flats.

It is the belief of the Department that the continuation of the clam flat pollution survey would open additional valuable clam flat acreage for digging.

## SHELLFISH PROGRAM

Dana E. Wallace, *Specialist*

The following report on the shellfish program of the Department of Sea and Shore Fisheries summarizes information obtained from our experiments and investigations since 1946 together with recommendations on what future activities can best be carried on by the Department to benefit the fishery and the industry.

As we have pointed out in previous reports and publications, the Department's shellfish program is closely coordinated with other shellfish programs being carried on in Canada by the Fisheries Research Board, in Maine and elsewhere along the Atlantic coast by the Clam Investigation of the U. S. Fish and Wildlife Service and the U. S. Public Health Service, in Massachusetts by the Division of Marine Fisheries of the Department of Conservation and the Woods Hole Oceanographic Institution, and in Connecticut by the Milford Laboratory of the U. S. Fish and Wildlife Service.

### I. RECOMMENDATIONS

What positive actions, which offer some promise of alleviating the declining clam population, can be continued or undertaken by the Department of Sea and Shore Fisheries?

Since a management program for our clam flats appears to be the most logical approach to any constructive program, we offer the following tentative recommendations based on our present knowledge and experience. We believe that it is necessary to continue cooperative basic research and experimentation with other agencies to learn more about the behavior of clams and their environment and to make practical use of recommendations offered by those agencies directly responsible for basic research work. The agency in this country responsible for basic biological research work is the U. S. Fish and Wildlife Service which has headquarters for the Clam Investigation at Boothbay Harbor under the direction of John Glud.

#### A. *Transplanting*

1. *We do not recommend the use of stunted seed clams in transplantation operations.*

a. The transplanting of seed clams is, for the most part, impractical. This statement applies to stunted seed stocks and requires the further explanation which is given below. From our experiments in typical flats in twenty-six clam producing towns the entire length



of the Maine coast, we conclude that using stunted slow growing seed is economically unfeasible. Considering these experiments in light of a commercial operation and the value of recoverable clams, we found that, for each dollar invested, there would be only a fractional return.\*

Early in our work, it was obvious that the principal cost of a seeding operation using stunted clams was the initial labor cost of digging the seed by hand. Experiments to develop mechanical methods of obtaining these clams were carried on; and, although these were promising, the type of bottom was a limiting factor and the initial cost of the equipment and its limited use did not appear to encourage further work along these lines.

(1) Any transplanting of seed clams on a commercial scale must take into consideration the amount of seed available (in volume or in number), the cost of digging and transporting, and the amount that becomes successfully established in the flats. Once relayed to any area, there must be a high percentage of survivals or excellent growth rates which permit increases in volume sufficient to offset losses through mortalities.

(2) If young fast growing seed clams are not available, a commercial scale seeding operation appears to be out of the question, since our work with slow growing stunted clams has generally been economically unsuccessful. We have found that stunted and slow growing clams do not readily establish themselves in the flats, usually fail to make any significant new growth and, when redug, the percentage of recoveries in experimental plots has been so low that a commercial scale operation would have been impractical.

2. *We recommend the expansion of the use of fast growing and readily available seed stocks.*

a. Concurrent with our stunted clam experiments, serious consideration was being given to the practical use of large concentrations of fast growing, young seed stocks in an area where constant shifting of the flats precluded their survival to commercial size. Transplanting experiments, using these seed stocks, were carried on in areas where the flats were more stable. The success of these experimental plots resulted in limited commercial plantings which clearly demonstrated the desirability of using this type of seed for the extensive commercial transplantings that might be carried on in the future in various types of favorable flats.

b. In our initial attempts to obtain these fast growing seed stocks

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\*There are indications from our experiments during the last several years that, in certain areas where survival was not especially favorable, the growth rate was excellent and, if the clams had been allowed to remain for a period in excess of one growing season, the cost of the operation might have been justified.

the cost of hand digging was extremely high, and experiments in the development and use of equipment for reducing costs were undertaken in 1947. The most promising equipment developed to date is hydraulic. The Maine Forest Service cooperated with us in the first use of hydraulic equipment; and later the Department, in cooperation with the Fish and Wildlife Service, developed methods and equipment which, under average conditions, has reduced by 90 per cent the initial cost of gathering this small seed.

3. *Other circumstances under which transplanting may be recommended:*

a. When it is a question of salvaging seed stocks from an area where clam survival to legal size is improbable in commercial quantities,\* or the salvaging of clams from areas which are closed because of pollution. The clams must be in sufficient quantity to keep the cost of the operation low and, at the same time, become or be of a size to command a favorable price when they are redug.

b. Where the cost of the operation is of secondary importance and the primary objective is to have a token clam population sufficient to permit limited home consumption digging and more or less sport digging by tourists and summer residents.

c. Even under those conditions when the salvage of stunted clams for purposes other than commercial digging is to be carried out, it is still desirable to dig them at a time when the cost of the operation is at a minimum, and the clams should be redug during the time when the greatest benefits can be realized.

4. *Continue the Department's efforts to introduce quahogs in those areas where clams have disappeared altogether or declined abnormally and yet flat conditions and water temperatures offer reasonable promise for establishing a quahog fishery.*

a. Already experimental plantings of quahogs have been made in a half dozen places along the Maine coast where they have not been present. These quahogs have survived well and in certain instances, have made growth comparable to those in areas where quahogs have been commercially established for many years.

5. *Continue and expand the Department's quahog transplanting program.*

a. We have successfully transplanted quahogs into depleted and barren areas adjacent to commercially productive beds. We believe

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\*In several areas where growth and yield of clams was extremely poor, a recovery took place and the clams grew rapidly and produced excellent meat yields. The reasons for this recovery are not known.

that our information is complete enough to warrant continuation and even an expansion of this quahog transplantation program.

6. *It is recommended that the facilities of the Boothbay Harbor station be used to propagate and rear quahogs in order that a supply of quahog seed may be more readily available for transplantation and introduction to new areas.*

a. Techniques for this operation have been worked out at the Milford laboratory of the Fish and Wildlife Service.

b. Preliminary work has been done at Boothbay Harbor on this program.

## **B. Flat Modifications**

1. *The varying results of experiments thus far would seem to indicate that further efforts along this line should not be undertaken until more information has been obtained under the cooperative geological-biological investigation.*

a. Another approach to the clam problem is the matter of flat improvement by means of brush, sod, netting, screening, wood barriers, and other materials which are designed to encourage the setting of clam spat by either (1) altering the hydrographic pattern; or (2) modifying composition of the flats; or (3) changing the surface conformation of the flats.

(1) The use of these devices has not yet produced significant results.

(2) In most areas no clam set was obtained at all.

(3) The set of clam spat which has occurred in any given area could not be attributed to the materials used because of the settlement of spat in adjacent untreated areas.

(4) The most promising of any of these methods which have been used is the plastic screening; but results have not been consistent and, if this method is found satisfactory under certain conditions, there is still the problem of evaluating its commercial efficiency in light of the cost of materials and the areas that can be treated.

b. Flat modifications of a permanent nature have not been attempted because of the expense involved. This type of modification consists of the construction of permanent or long-lived barriers, retaining walls, revetments or other shoreline structures designed to reduce shifting flat conditions and to stabilize, as much as possible, clam flat surfaces. Even the cost of a pilot operation would require a considerable initial investment with possible high maintenance expense and additional years of adjustment and change before an evaluation of such an approach could be made.

## C. Geological-Biological Investigation

1. *We strongly recommend that this geological-biological work be continued.*

a. Since the initiation of the geological-biological investigation, undertaken cooperatively in 1948 by the Department of Sea and Shore Fisheries and the Maine Geological Survey under the direction of Dr. Joseph M. Trefethen, geologists and biologists in other sections of the country are extremely interested in this type of work and have encouraged a continuation of the Maine project.

b. In addition to the geological-biological work being undertaken by the Maine Geological Survey and the Department of Sea and Shore Fisheries, Dr. William Bradley, Chief Geologist of the U. S. Geological Survey, has spent two field seasons on the Maine coast and plans to continue this work during 1951. Dr. Bradley's work is being supplemented on the biological side by the Clam Investigation of the U. S. Fish and Wildlife Service as well as the geological-biological work of the Maine Geological Survey and this Department.

c. The minimum time interval between surveys of specific areas will not expire until 1951, and therefore any evidence of geological-biological changes taking place in our clam flats will not be available for another year.

(1) There are indications from work already done that the particle size of the sediments, their stability, and sub-surface drainage have definite influence upon the survival and growth of clams in any given area.

(2) In the majority of places which we have observed during recent years, where shore erosion has deposited clay or other fine material on the flats, an appreciable decline in clam population has taken place; and the survival of clam spat to commercial size is unlikely.

d. John J. Donohue, who worked on the initial geological survey of the Sea and Shore Fisheries investigation, has continued his work along the coast as a doctorate candidate at Rutgers University.

## D. Spat Collectors

1. *We recommend that further experiments be undertaken using the more promising of the spat collecting devices outlined under Flat Modifications.*

a. We believe that this type of work should be of limited scope since considerable emphasis is being placed on these experiments in other areas where lack of seed settlement and survival has been even a greater problem than it has in Maine.

(1) This problem is being intensively investigated by the Newburyport branch of the Fish and Wildlife Clam Investigation, the Division of Marine Fisheries of the Massachusetts Department of Conservation, by the Woods Hole Oceanographic Institution, and at Georgetown by the Boothbay Harbor headquarters of the Fish and Wildlife Service Clam Investigation.

## E. Predator Control

In general the predator problem, although serious in Maine, is not as serious as it is in other clam producing states.

Considering the damage done in specific cases by known clam enemies, the annual toll on the clam population, other than by man, must be tremendous.

Destruction by clam enemies is not applicable in the same degree in all areas. The predominant clam enemy in one area may not occur in an adjacent flat in destructive numbers.

### 1. Green crabs

*a. We recommend doing some work on the control of green crabs but believe that our limited budget and personnel preclude the extensive experiments that are being conducted elsewhere.*

(1) Our experiments will be closely coordinated with the work to be undertaken on this problem in Massachusetts by the Fish and Wildlife Service Clam Investigation and the Division of Marine Fisheries of the Massachusetts Department of Conservation.

(2) The green crab population in several areas along the Maine coast has increased greatly during the last several years and has become a major problem. In an area where no other known predator was found, recent sets of clams disappeared entirely. The presence of a large green crab population leads us to believe that the clam seed was destroyed by this predator. This belief is based on observing green crabs in the process of eating clams, the finding of partially consumed clams and empty shells, and observing large quantities of green crab burrows in the flats where the remnants of an excellent clam population remained.

### 2. Horseshoe crabs

*a. In one or two isolated instances, we suggest that passive measures might be undertaken with some promise of success.*

(1) Considerable amount of control work has been done in Massachusetts on horseshoe crabs. This work has consisted of active and passive control measures.

(a) Active control—The actual removal of the horseshoe crabs from the flats. The most extensive operation of this nature was that carried on by the town of Ipswich during July and August of 1949. A scallop drag was used for this operation, and it was estimated that during the two months' period some 50,000-60,000 horseshoe crabs were removed from the clam flats. Other towns as well as Ipswich have, in the past years, hired men to pick up the horseshoe crabs from the flats and destroy them. It is the general observation of those who have taken part in this operation that the control effects were not very successful because of the relatively small number of the total population that could be removed by these methods.

(b) Passive control—On the whole, passive control measures, although more restricted in area control, have proved more successful in protecting populations of young seed clams. These methods have consisted of fencing small areas having a good seed clam population. This work has been carried on by the Newburyport branch of the Fish and Wildlife Service Clam Investigation, by the Woods Hole Oceanographic Institution and by the Division of Marine Fisheries of the Massachusetts Department of Conservation.

(2) In one of our clam seed transplanting operations there was 100 per cent mortality caused by horseshoe crabs.

### 3. Polynices

*a. Control experiments that have been carried on to date outside of Maine do not indicate any practical measures that can be taken at the present time; and, until effective measures are found, we do not recommend the expenditure of time and money on this problem.*

(1) Experiments in the control of Polynices have been carried on in Canada by the Fisheries Research Board of Canada, have been and are being carried on in Massachusetts by the Woods Hole Oceanographic Institution, and are being carried on at the U. S. Fish and Wildlife Laboratory at Milford, Connecticut.

(2) In one selected area where Polynices damage appeared to be as great as anywhere in Maine, we found a seasonal fluctuation in clam mortalities caused by these drills. Samples taken in this area from July to the following January indicated that, in September, mortalities had reached a peak of slightly more than 27 per cent.

### 4. Other predators

*a. Of the several remaining known clam predators, little or nothing can be done in the way of practical control measures except in the case of herring gulls. The population of these birds is now being controlled*

*under the joint Fish and Wildlife—Sea and Shore Fisheries gull and cormorant control program.*

(1) Gulls and other birds

(a) The amount of damage done has not been positively determined, although gulls have been observed many times feeding on seed clam populations in areas where the clams were near the surface of the flats or were temporarily exposed. Large shell heaps can be found along ledges and rocks in the quahog producing areas of Maine indicating that the numbers of quahogs taken by gulls during the course of a year would amount to a great many bushels.

(2) Winter flounder

(a) Canadian researchers have found more than two hundred clam siphons in the stomach of a single flounder.

### **F. Competitor control**

1. *Although the encroachment of mussels on former clam producing flats is, in some areas, a serious problem, we do not recommend control measures be undertaken at the present time in view of the cost of such a project, the limited operational ability of any one control unit, and the lack of adequate information on the effectiveness of results.*

a. Our investigations during the past two years have led us to the conclusion that the effective control of mussel encroachment on clam flats would require large expenditure of time and money and would require a great deal of equipment and additional personnel. The experience of the town of Ipswich indicates that the cost of equipment and of operating this equipment in any area where dragging operations could be carried on efficiently would be at least \$6,000 for each operating season.

b. A more complete summary of this problem is contained in a report on mussel control.

(1) As far as Maine's clam flats are concerned, the common blue mussel, *Mytilus edulis*, is by far the most important.

(2) Our investigations indicate that effective control of these competitors requires their physical removal from the flats.

(3) A shallow draught power boat equipped with a drag appears to be the most effective equipment for mussel control.

### **G. Pollution**

1. *In view of the value of the clams which have been made available to commercial fishermen during the past year as a result of the continuous sanitary survey, it is recommended that this program be continued.*

a. By having the continuous sanitary survey, authorized by the 1949 Legislature, it has been possible to salvage clams from closed areas during periods when conditions met Public Health requirements. The value of the clams taken by commercial fishermen from these areas that have been opened as a result of this program exceeds \$30,000. In addition, several of these areas have provided home consumption and other incidental digging which cannot be evaluated on the basis of commercial catch.

b. Under this program, an increasing fund of information is being built up which will be of value to any Federal or state pollution abatement program.

## H. Rotation of Opened and Closed Areas

1. *It appears desirable to expand experimentally the practice now being carried on in several coastal communities of rotating opened and closed areas.*

a. The practice of rotating opened and closed areas in local communities appears to create certain advantages, both to the community and to the state.

(1) It would permit closer cooperation between the community and the Department on local problems.

(2) It would furnish for study certain areas in various stages of exploitation and depletion.

(3) It would give economic information on the local clam fishery.

(4) It would arouse more community interest in, and responsibility for, the value and use of the local clam resource.

(5) It must be in effect to obtain the best possible results from a program of transplanting seed stocks where it has been determined experimentally that such operations are desirable as previously outlined.

(6) It would eliminate the great destruction to future yields which results from digging a few legal size clams scattered among a large population of uniformly small clams well below the legal minimum size.

b. There are certain disadvantages that could arise from rotating areas in any one community.

(1) The practice of rotating areas does not invariably insure greater clam yields since predators, disease or other mortality causing agents and conditions may be great enough to offset any possible advantage that otherwise might be gained.

(2) A hard and fast schedule of rotated areas in any one community could work to the disadvantage of that community by exag-



generating normal seasonal variations in clam production. For example, an area which was scheduled to be opened at the same time that clam production was high elsewhere and market demand was poor would obviously be of disadvantage to the community.

### **I. Law Enforcement**

1. *In view of the probable small percentage of clam spat that survives to reach commercial size, it appears to be imperative that all conservation laws which protect this resource be continued.*

## BRUNSWICK QUAHOG SEEDING PROJECT

Department of Sea and Shore Fisheries

1950

Dana E. Wallace

In the latter part of June, 1950, our attention was called to the fact that Maquoit Bay, Brunswick, contained two areas of several acres in extent where a large set of quahogs had become established in such concentrations that quahogs were becoming stunted, many of them were found on the surface of the flats, and mortalities were occurring. Similar conditions were found in a small area to the east of Crow Island in Middle Bay.

After looking at the seed beds, it was decided that, for better growth and survival of the quahogs, they should be transplanted to commercially depleted sections of Maquoit or Middle Bay. The areas chosen where the transplanting would take place were, for the most part, those sections of the flats near the mean low water line where the possibility of heavy mortalities from ice action in the winter would be less and the quahogs would have a better opportunity to survive and grow.

At the first inspection of the upper seed bed on the western shore of Maquoit Bay we found concentrations of quahogs as high as 154 to the square foot. Detailed population surveys, using surveying instruments, were later run and we found that the upper seed bed covered an area of 223,500 square feet or 5.13 acres.

The lower seed bed, southwest of Bunganuc Point, covered an area of 142,900 square feet, or 3.28 acres.

It was quite evident that, if we were to move any large amount of seed from these two beds and relay them into commercially depleted flats, it would be necessary to gain all the cooperation possible from diggers, dealers, town officials and everyone who could be interested in the conservation venture. The project was launched July 8 with fourteen diggers volunteering their efforts and moving 200 bushels of the quahogs from the upper seed bed. The next day two diggers voluntarily moved 25 bushels from the small seed bed on Crow Island in Middle Bay.

A special meeting of the clam diggers and town officials was held. The conservation problems created by the presence of large amounts of seed clams in the flats were discussed as were the general town conservation needs. Support for the continuation of transplanting efforts was readily volunteered. A conservation committee was elected, and this group consisted of diggers John Dubois, Ernest

Prindall, Rupert Pollard, Elmer Haney, Webster Haney; selectman Harry Schulman; and town manager John Desmond. The diggers on this committee were appointed town shellfish wardens with full authority to enforce all local and state laws. Winfield Staples of the Consolidated Feldspar Company, Topsham, offered us the use of large rock forks to aid in gathering the seed, and these proved to be very effective. If these forks had not been available, only a relatively small amount of seed could have been moved.

Within a few days after the general meeting, 37 diggers again gave their time and moved 430 bushels from the upper seed bed.

After these initial efforts on the part of the diggers, a contribution of \$500 to the conservation fund was made by the Blount Seafood Corporation. Clyde Kincaid made \$100 available, and the Brunswick Shellfish Corporation contributed \$100 for continuation of the work. As part of a special town meeting held in September, it was voted that money paid by the diggers to the town for shellfish licenses would be earmarked for shellfish conservation work. The conservation committee decided that the diggers would be paid \$10 a day for moving seed, and this schedule of payments was followed until the \$700 fund was depleted on October 7.

On October 17-18 a planimetric survey was made of the lower seed bed by members of the Sea and Shore Fisheries Department. This quahog population and area survey was made after 75 bushels of quahogs had been transplanted from the area. At the time of the survey we found that the 3.28 acre area contained an estimated volume of 6,637 bushels. The quahogs ranged in size from 27 mm. to 56 mm. with a median size of 43 mm. and the average densities in the different sections of the bed ranged from 4 per square foot to 125 per square foot.

On November 7 the upper seed bed was likewise mapped, after 1595 bushels had been transplanted from the area. At the time of the survey we found that the 5.13 acre area contained an estimated volume of 6586 bushels. The quahogs ranged in size from 35 mm. to 61 mm. with a median size of 47 mm., and the average densities in the different sections of the bed ranged from 4 per square foot to 77 per square foot.

Transplanting activities being carried on by the Department of Sea and Shore Fisheries, the town of Brunswick, and local diggers and dealers had been brought to the attention of the Campbell Soup Company during the summer months. In November this company made money available for the continuation of the transplanting project, and these funds were used starting November 13. It was decided that the method of paying for the transferring of seed should be changed and diggers paid at the rate of 50 cents per bushel for the amount of seed dug, transported and transplanted in designated

areas. This rate was paid until the eighteenth of November when the rate was changed to 75 cents in order to give greater incentive to the seed moving effort. This relaying of seed was carried on until the sixth of December, when weather conditions made continuation impractical.

The quahog reseedling project, carried on from July 8 to December 6, resulted in the moving of 3,012 bushels of quahogs with \$1,623.39 being paid to the diggers for their efforts.



*Transplanting seed quahogs from crowded areas to depleted areas has proven successful.*

Included as a part of this report is a statement indicating the dates when quahogs were transplanted, rates of pay to the diggers, amounts paid, bushels dug, and areas from which quahogs were taken and where they were planted. The attached photograph of a coastal chart shows the general location of the seed beds and the areas where the quahogs were planted. Areas indicated are not drawn to scale. A legend appears on the photograph. Also in this report are planimetric survey sheets of the upper and lower seed beds. Area #1 is the area near the head of the bay, and area #2 is the area southwest of Bunganuc Point.

It was possible to carry out this project because of the high degree of cooperation given by the many people involved. The commercial diggers on the shellfish committee functioned effectively in representing the diggers. Selectman Harry Schulman and town manager John Desmond worked for the best interests of the community, and the extensive conservation efforts were made possible only by money

contributed by the Blount Seafood Corporation, the Brunswick Shellfish Company, Clyde Kincaid and the Campbell Soup Company.

Daniel Pender, buyer for dealer Clyde Kincaid, was of valuable assistance to everyone during the entire season in taking care of the forks, making other equipment and facilities available, and serving as liaison man between the Department, town officials and the diggers.

Plans for further transplanting work another year await investigation of the effects of the winter conditions on the seed beds, the transplanted stock, and the entire quahog producing area.

The Sea and Shore Fisheries Department plans a small experimental area near Bunganuc Point to gather specific information about the quahogs in the bay. Experimental plots were established last summer in the closed conservation area east of Simpson's Point in Middle Bay. We will determine growth and mortalities of transplanted and native quahogs over a period of years as well as note ecological factors that may affect the commercial production of the area.

It is hoped that information can be gathered in this experimental area in cooperation with the Bowdoin College Biology Department.

## **CLAM MEAT ASSAYS**

Donald M. Harriman

In 1949 representatives of the Maine clam industry asked the Department of Sea and Shore Fisheries to gather information about the total meat solids of clams, as taken directly from the flats, and the free liquid in the commercial packs of fresh shucked clam meats.

The Maine dealers who ship shucked clams out of the state had requested the Federal Security Agency to hold a hearing and consider information on clam meat qualities with a view to establishing Federal standards of quality. Currently, several states use total solids as a criterion of fresh water adulteration.

Men in the clam industry have felt that a thorough review should be made of the standards of quality currently accepted and that extensive information should be gathered in order to establish fair and realistic standards.

In order to determine the quality of the clams that are found along our coast the Department carried out an investigation from October 1949 to February 1950, and clam samples were taken for laboratory analysis from commercially producing areas having coastwise geographical distribution.

The findings of this investigation will be presented to the Federal Security Agency when a hearing is held to consider all information.

The information gathered for this report does not support the

theory that clam meat quality can be measured by existing standards. A brief summary of our conclusions and recommendations follow:

### CONCLUSIONS

1. Since clam samples were taken directly from the flats of representative areas geographically distributed along the Maine coast, it may, for practical purposes, be reasonably assumed that these samples were representative of the Maine clam population during the period covered by the survey.

2. In order to determine by the total solids whether any particular lot of clams has been adulterated with fresh water it would be necessary to know what the total solids yield would have been prior to washing.

3. Unwashed samples show solids ranging from 15.28 per cent to 23.89 per cent with a mean of 18.27 per cent and a median of 18.28 per cent.

4. If a standard of 18 per cent were upheld, 38 per cent of the unwashed samples taken would be adulterated according to legal standards.

5. Thirty-minute washing results in a loss of 3.75 per cent of the total solids. This would make 98 per cent of the samples adulterated according to such standards.

6. The amount of free liquor that can be drained from packed clams has been found to depend more upon the technique of the operator than the washing time.

### RECOMMENDATIONS

1. Total solids should not be considered as a criterion of adulteration.

2. Free liquids in the pack should be limited to 10 per cent.

A full report of our work was published in April, 1950 as Research Bulletin No. 3 and is available upon request from the Department of Sea and Shore Fisheries, Augusta, Maine.

# A REPORT OF INVESTIGATION OF EXPERIMENTS IN MUSSEL CONTROL ON CLAM PRODUCING AREAS

By Robert L. Dow and Dana E. Wallace

## OBJECTIVE

We were directed by Commissioner Reed to investigate methods of controlling mussel encroachment on productive clam flats and to make recommendations on a mussel control program.

## SUMMARY OF CONCLUSIONS

The conclusions reached as a result of our experiments in the control of mussels are summarized briefly below. In the main body of the report, these conclusions are repeated together with a discussion of procedures followed and results obtained in addition to a discussion and evaluation of the individual experiments.

1. The hand-raking of mussels is ineffective as an encroachment control.

2. The use of the mixture of gasoline and crank case oil does not work satisfactorily in the control of mussels.

3. The use of harrows or other similar devices for breaking up the surface mat of a mussel bed is impractical.

4. The use of hand tools to cut channels through a well established mussel bed is ineffective.

5. The use of commercial flame guns is entirely inadequate as a control measure.

6. The physical removal of mussels by means of a mechanical drag as employed by the town of Ipswich, Massachusetts, during 1948-49 is the only efficient method that we have found to date.

a. It would appear that the equipment would have to be owned, operated and maintained on a local basis because of the time necessary to do an effective job in any one community.

7. A full-scale mussel control program should not be undertaken at the present time.

8. Any further experimental work undertaken by the Department of Sea and Shore Fisheries using mechanical equipment should be carried on in an area to be selected at the discretion of the Commissioner over a period of time sufficient for proper evaluation.

## *Procedures, Findings, Discussion and Evaluation*

### *1. The hand-raking of mussels is ineffective as an encroachment control.*

Our first experiments were conducted with the view of finding out what was necessary to control mussel encroachment. Three areas having different flat conditions were selected for these experiments. These three areas also represented areas having varying degrees of encroachment and mussels of different sizes and percentages of live mussels. Two areas were in Scarborough—the Libby River and the Spurwink River. A third area was in Flanders Bay, Gouldsboro.

The area in the Spurwink River was one of recent mussel encroachment where the mussels had formed small clusters scattered over a flat of former high productivity. The plots were staked off in this area, and the mussels were raked by hand into piles about three feet high and four or five feet in diameter and also in windrows about twenty feet long and having a cross-sectional area of about three square feet. The purpose in carrying on this raking experiment was to clear a test plot entirely of mussels and to determine if leaving the mussels in windrows or in piles would result in their dying and being washed from the flats by tidal action. Periodic checks were made to evaluate the results. We found that the tides spread the mussels out again and the few that died in the piles had no appreciable effect on the total picture.

On the Libby River flats, where mussel encroachment had been going on for many years, the depth of the bed was found to be in excess of four feet. How much deeper the debris and accumulated silt under the bed might have been, we were unable to determine except by estimate. We estimated that in some places the depth of this bed may have been as much as eight feet.

The hand-raking of mussels can be an effective, although expensive, control in certain limited cases. When a productive clam flat has a few scattered clumps of mussels covering a small area, these mussels can effectively be removed by the use of rakes as a safeguard against further encroachment. In the case of a widespread set of mussel spat, this method is not practical; because, by the time the mussels have reached a size whereby they can be gathered together by rakes, they have blanketed the flats.

### *2. The use of the mixture of gasoline and crank case oil does not work satisfactorily in the control of mussels.*

We tried burning the mussels with a mixture of old crank case oil and gasoline in order to kill the mussels; but we found that we had to use a large amount of gasoline and, where the mussels were several layers thick, part of them survived.



3. *The use of harrows or other similar devices for breaking up the surface mat of a mussel bed is impractical.*

In the Libby River area several other methods were tried. One of these was dragging a weighted spring tooth harrow behind a lobster boat at high tide in an attempt to break up clumps of mussels so that they might be removed from the area by the tide. Although this did loosen up some of the mussels and debris, the results were unsatisfactory.

4. *The use of hand tools to cut channels through a well established mussel bed is ineffective.*

Attempts to cut channels through mussel beds and thereby open up the bed to removal by the tide also proved to be unsuccessful.

Channels were cut in a well established mussel bed where tidal currents were strong and it was believed that the force of these currents would undercut the bulk of this mussel bed by making channels through it and effectively remove the mussels from the flats. The area was checked periodically thereafter, and it was found that the original channels had filled in again with mussels and debris from the adjoining bed. It must be concluded that this procedure was entirely ineffective.

5. *The use of commercial flame guns is entirely inadequate as a control measure.*

In the Gouldsboro area there had been a heavy set of mussel spat. The flats in this area consisted of a mixture of clay and silt and rock and therefore differed considerably from the almost pure sand flats of the Scarborough areas. Because these mussels were small, it seemed possible that raking them into piles would be effective. When a check was made a few weeks later, it was found that not only had the mussels spread themselves back over the cleared areas but they had even attached themselves in considerable quantity to the stakes which were used to mark the cleared areas. In this same area we used a flame gun. This flame gun uses kerosene and under pressure shoots out a four-inch-wide flame about two feet from the nozzle and develops a temperature of 2000 F. at the nozzle opening. We wished to find out how much of an area we could cover and how long we would have to burn the mussels before they would be killed. So we exposed square-yard plots of mussels, where the mussels numbered 400-500 per square yard and ranged in size from  $\frac{1}{2}$  inch to 2 inches, to the flame for different lengths of time and found that for effective use we had to spend at least a minute on a square yard. Even this exposure was not enough on some beds containing larger mussels. At this rate it would take approximately 80 hours to do an acre or, figuring at best, 20 four-hour tides on a flat with about this same

concentration of mussels. When we rechecked this area where we had used the flame gun we found that the shells from the dead mussels remained in the flats and were acting as collectors for additional sets of mussels.

6. *The physical removal of mussels by means of a mechanical drag as employed by the town of Ipswich, Massachusetts, during 1948-49 is the only efficient method that we have found to date.*

During the course of our experiments on methods of controlling mussel encroachment, we heard that similar experiments were being carried on at Ipswich, Massachusetts. We visited this area and discussed the problem with those who were carrying on the experiments. We learned that, in addition to the methods we had tried, more drastic steps were being taken at Ipswich because of the seriousness with which they considered the mussel encroachment problem.

At Ipswich, mussels had been removed from the flats by hand and loaded directly into small boats for removal to dumping grounds. Also mussels had been raked by hand at low tide, bagged and transported to dumping grounds by boat. These methods were expensive because of labor costs and were, according to the men engaged in the operation, neither efficient nor effective.

However, experiments were currently being carried on in the mechanical dragging of the flats during high water. The hull of a L. C. V. P. (Landing Craft Vehicular Personnel) had been purchased by the town through the assistance of the Massachusetts Department of Conservation and had been outfitted for dragging. We accompanied the five-man crew and observed these operations. We were unable, however, to observe the results except as they pertained to the actual number of mussels removed from the flats during the high water period.

As the result of our observations and the observations reported by shellfish officials of Ipswich and the Massachusetts Division of Marine Fisheries, it appeared that this method, or a closely related method, would be the most practical to be used in setting up a program to control mussel encroachment.

Although we were given unqualified assistance by shellfish officials of Ipswich and of the Massachusetts Division of Marine Fisheries, our efforts to locate equipment at a cost comparable to that expended by the town of Ipswich were not successful. All sources of supply in both Maine and Massachusetts, where the necessary equipment might be obtained, were investigated by letter or by personal contact when the latter was possible in conjunction with other work over a period of several months. From these many inquiries, the lowest cost estimate for obtaining the necessary equipment was in excess of \$3,500. This did not include putting the equipment into operational

condition, and it was estimated that the equipment fully operational would cost at least \$4,000. Using the operational cost index determined by the town of Ipswich, it did not appear likely that, with the money available for this work in Maine, we would be able to conduct dragging operations for more than two months.

Since the town of Ipswich planned to continue their work during 1949 and offered us any information that they might obtain, we believed it more practical to refrain from any parallel experimental program of our own and to work with Ipswich officials in obtaining all possible information.

Mussel dragging operations were carried on at Ipswich until December, 1949. This work was not continued during 1950 on account of the serious illness of the man in charge of the work. We have recently discussed the problem with several municipal officials in Ipswich as well as with personnel of the Massachusetts Division of Marine Fisheries. These people believe that this type of operation is worth while and that it should be resumed in 1951 provided a man capable of supervising and directing the operation can be obtained.

During 1948 and 1949 a total of \$10,805.90 was spent in the town of Ipswich on clam flats. \$5,337.67 was spent in 1948, and \$5,468.23 in 1949. Of this two-year total, \$9,525.90 was spent on dragging mussels. The remaining sum was spent on the control of predators and seeding. During the same period, the state contributed \$2,850. Part of this state money went into the mussel dragging work, and the remainder was spent on other shellfish projects.

Mussel dragging was commenced in August, 1948, and continued through the fall until about the first of December. In 1949, dragging operations were commenced in May and were continued throughout the fall until December, except for July and August when flat improvement efforts were diverted to the removal of horseshoe crabs and other predators. In the two-year period approximately fifty acres of clam flats were dragged.

On the basis of the moneys expended for mussel control, the amount of debris removed, and the number of acres of flats dragged, the cost per acre amounted to \$190.52 while the cost of removing the mussels and debris from the flats per ton amounted to \$5.95. The cost of the operation on a monthly basis amounted to \$1,058.43.

The plan of operation in attempting to clear the flats of mussels was first to drag a buoyed area in order to break up the heavy blanket of mussels. After the initial dragging had been accomplished, the same area was redragged at a later date to pick up scattered clusters of mussels. It will be observed that the entire area was not cleaned of mussels even with the second dragging. However, breaking up the solid blanket of mussels permitted the washing away of much of the debris and silt accumulated by the mussels.

Although we did not see the flats or examine the clams in the flats prior to the initial dragging, we were assured by the men doing the work that the clams were of very poor quality; and, although there were clams beneath the mussel beds, they were not worth digging because of their poor quality. We were also informed that, during the period when mussels were present on the flats in quantity, there was no evidence of a set of seed clams.

We did examine the flats shown in the photographs during the fall of 1950 and found that the clams were of good quality and were being dug commercially. A local digger estimated that the yield per fisherman of clams on the flats which had been dragged had increased approximately 100 per cent since dragging operations were first begun. In addition, we found a token set of seed clams in the flats apparently of the 1950 set. It is doubtful that this set will be of any commercial significance because of reported poor survivals in the area because of predator damage. The set ranged in density from twelve to about twenty per square foot.

*a. It would appear that the equipment would have to be owned, operated and maintained on a local basis because of the time necessary to do an effective job in any one community.*

There are several limiting factors in the use of this equipment which have to be taken into consideration. They are:

- (a) Operating radius is restricted.
- (b) Weather conditions and tide limit operations.
- (c) In towns where considerable area is covered by mussel beds it would possibly take several years to remove the mussels, and then a waiting period of several years would be necessary in order to determine the effectiveness of the operation and how often the dragging would have to be repeated.
- (d) The type of bottom is a determining factor. It is very unlikely that dragging could be carried on in many of the areas that are now covered by mussel beds.

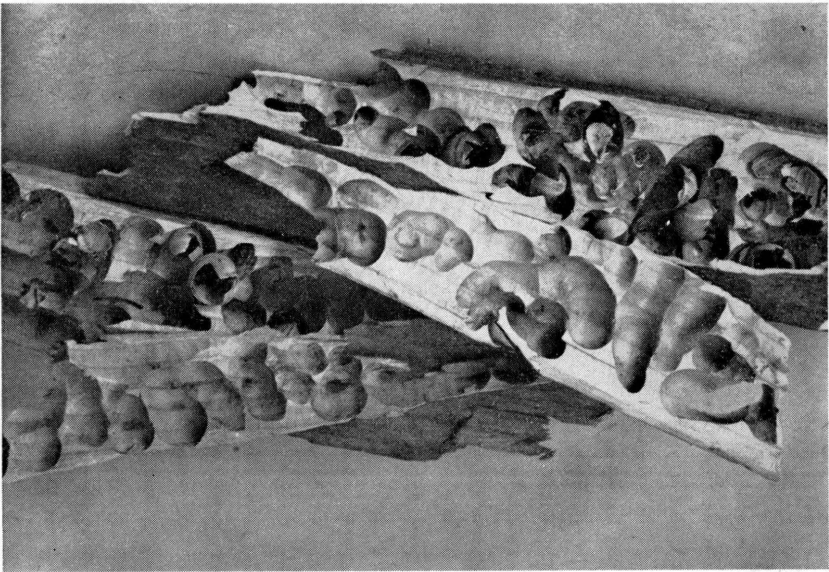
*7. A full-scale mussel control program should not be undertaken at the present time.*

The solution to this problem is still in an experimental stage and if, after further experimental work which at present is not authorized, results indicate that the mussel control program should be continued and expanded, it could best be undertaken by individual towns or a small group of towns working cooperatively in an area of mutual interest. The state could act in an advisory capacity and, if money

were available, financial assistance could be given to the individual towns or towns cooperating on any specific project.

8. *Any further experimental work undertaken by the Department of Sea and Shore Fisheries using mechanical equipment should be carried on in an area to be selected at the discretion of the Commissioner over a period of time sufficient for proper evaluation.*

If money is made available to carry on this work, we believe that experiments should be carried on in one or possibly two areas to be selected at the discretion of the Commissioner of Sea and Shore Fisheries in order that the best possible evaluation may be given to mussel control procedures over a minimum period of time at minimum cost.



*A type of marine borer, usually foreign to Maine waters, is causing heavy damage to lobsterman's gear.*

## MARINE WORM REPORT

(By Robert L. Dow)

Some general information on the presence or absence of marine worms in productive clam areas is contained in the associative reports compiled between 1948 and 1950 by the joint geological-biological investigation carried on by the Department of Sea and Shore Fisheries and the Maine Geological Survey.

Only those species of marine worms which are taken commercially in Maine waters, *Sandworms* (Nereis) and *Bloodworms* (Glycera) are included in the present report. Furthermore, worm information must be limited, because of the nature of the investigation, to those areas which are, or have been within recent years, commercially productive clam areas.

Production information for those years during which landings by species have been compiled by the Department of Sea and Shore Fisheries and the Fish and Wildlife Service is listed below:

Year	BLOODWORMS		SANDWORMS	
	Pounds	Value	Pounds	Value
1946	59,269	\$57,125	58,379	\$47,188
1947	163,633	144,530	51,157	37,086
1948	567,987	305,044	77,871	57,307
1949	401,716	297,021	33,811	18,910
1950	311,404	242,081	56,873	37,158

It is obvious from these records that, since 1947 at least, the bloodworm industry has been far more important commercially than has been the sandworm industry.

The geological-biological investigation of clam flats has included areas in Jonesport, Jonesboro, Milbridge, Whiting, Wells, Sullivan, Harpswell, and Medomak.\*

These areas vary in size from two or three up to an estimated one hundred eighty acres. No one of the areas investigated can be considered to be a commercial worm area.

From the information obtained the following observations may be made:

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\*One other area (Surry) having a non-commercial population of both clams (*Mya*) and quahogs (*Venus*) was investigated. In this entire area only two small *Glycera* were found.

1. *Commercial clam areas may be entirely barren of bloodworms.*

Of ten\* areas investigated, seven were found to be barren of bloodworms. In 1950, of 110 samples taken in the Jonesport area, only one contained bloodworms.

2. *Bloodworms and clams may occupy the same portion of a flat.*

Twenty-eight per cent of the Harpswell area and eleven per cent of the Sullivan area was occupied by clams and bloodworms together.

3. *Clams are more likely to occupy that portion of a flat where there are few or no bloodworms.*

Eighty-six per cent of the Harpswell area was occupied by clams but only twenty-eight per cent of the area was occupied by clams and bloodworms together.

Seventy-two per cent of the total clam population in the entire Harpswell area occupied that portion of the flats barren of bloodworms, while twenty-eight per cent of the total clam population occupied that portion of the flats also occupied by bloodworms.

Ninety-one per cent of the Harpswell area which was barren of bloodworms was occupied by clams.

Sixty-four per cent of the Sullivan area was occupied by clams but only eleven per cent of the area was occupied by clams and bloodworms together.

Seventy-nine per cent of the total clam population in the entire Sullivan area occupied that portion of the flats barren of bloodworms, while twenty-one per cent of the total clam population occupied that portion of the flats also occupied by bloodworms.

Sixty-three per cent of the Sullivan area which was barren of bloodworms was occupied by clams.

4. *Bloodworms are more likely to occupy that portion of a flat where there are few or no clams.*

Thirty-six per cent of the Harpswell area was occupied by bloodworms but only twenty-eight per cent of this area was occupied by clams and bloodworms together.

Twenty-eight per cent of the total bloodworm population in the entire Harpswell area occupied that portion of the flats barren of clams, while seventy-two per cent of the total bloodworm population occupied that portion of the flats also occupied by twenty-eight per cent of the clam population.

Sixty per cent of the Harpswell area which was barren of clams was occupied by bloodworms.

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\*Areas and years of survey are: Milbridge—1949, Jonesboro—1949 (2 areas), Jonesport—1949, Jonesport—1950, Wells—1950, Whiting—1949, Sullivan—1949, Harpswell—1948, and Medomak—1949.

Nineteen per cent of the Sullivan area was occupied by bloodworms but only eleven per cent of this area was occupied by clams and bloodworms together.

Forty per cent of the total bloodworm population in the entire Sullivan area occupied that portion of the flats barren of clams, while sixty per cent of the total bloodworm population occupied that portion of the flats also occupied by twenty-one per cent of the clam population.

Twenty per cent of the Sullivan area which was barren of clams was occupied by bloodworms.

That portion of the Jonesport area which was occupied by bloodworms in 1950 was barren of clams.

*5. In general, it appears that bloodworms can tolerate conditions which are not favorable for clams.*

With respect to the intertidal zone (between high and low water), bloodworms appear to be present, for the most part, below that portion of the flats occupied by clams. In both Harpswell and Sullivan, the bulk of the bloodworm population was in that portion of the flats adjacent to the low tide mark.

Ten per cent of the Sullivan area was subject to "much fresh water run-off," according to the biologist making the investigation. This sub-area was barren of clams but approximately one-third of it was occupied by twenty-nine per cent of the total bloodworm population in the entire Sullivan area.

This condition may account for the presence of marine worms further up tidal rivers than clams are found.

*6. Clams and sandworms are usually found together but the percentage of the area which is occupied by both species varies considerably.*

In 1949 eight per cent of the Jonesport area was occupied by both clams and sandworms.

In 1950 nineteen per cent of the Jonesport area was occupied by both clams and sandworms.

Sixty per cent of the Medomak area was occupied by both clams and sandworms.

Fifty-nine per cent of the Harpswell area was occupied by both clams and sandworms.

Sixty-six per cent of the Wells area was occupied by both clams and sandworms.

Fifteen per cent of the Sullivan area was occupied by both clams and sandworms.

All ten clam areas covered by this investigation were occupied by sandworms.



7. *Sandworms are more likely to occupy a commercial clam flat than are bloodworms.*

Area*	% of area occupied by sandworms	% of area occupied by bloodworms
Sullivan.....	19	19
Harpswell.....	65	36
Wells.....	73	0
Medomak.....	83	0
Jonesport 1949.....	8	0
Jonesport 1950.....	26	.9

8. *Almost without exception the portion of a flat which supports a commercial clam fishery does not support a commercial worm fishery.*

This statement is supported by the information obtained from the geological-biological investigation of commercial clam flats and the observations made by other personnel of the Department of Sea and Shore Fisheries.

#### *Feeding Habits of the Commercial Marine Worms*

Comparatively little information has been obtained on the feeding habits of the commercial marine worms. Both Taxiarchis, who was employed by the Department on the geological-biological investigation, and Glidden, who was employed by the Department on a marine worm investigation, observed and reported worms feeding upon marine algae.

The frequent discovery of marine worms in the shell cavity of dead clams would indicate the possibility that worms are scavengers that feed, in part, upon decomposing organic material. Doctor Cope-land's experiments with marine worms, cited by Glidden in his report, indicate that marine worms have a very keen food detection sense and would respond to the odor of dead clams in the flats.

#### *Remarks*

There is the possibility from the information gathered and the observations made in the several areas investigated under the geological-biological program since its inception in 1948 that abnormal declines in clam populations in certain areas and the presence of certain marine worms (both commercial and otherwise) in these same areas may be a symptom of the deterioration of conditions favorable to clam growth and survival.

\*Other areas not listed here were barren of bloodworms; no percentage figures on sandworms are available although all of these areas were occupied by sandworms.

The clam producing history of the Harpswell area investigated geologically and biologically in 1948 had been good as late as 1941. Clam experiments carried on there by the Department during 1947 and again in 1948 indicated that this area had greatly deteriorated since 1941. Considerable deterioration appeared to have taken place between 1947 and 1948.

Within a comparatively few years of the Sullivan investigation made in 1949, that area had had a good record of clam production. By March 1949, before the summer investigation was made, Department personnel had observed and photographed large numbers of dead and dying clams throughout the area. It was largely because of these mortalities that this area was selected for geological-biological investigation.

# LOBSTER PLUGS AND THEIR EFFECT ON THE MEAT OF THE LOBSTER'S CLAW

By Frederick T. Baird, *Aquatic Biologist*

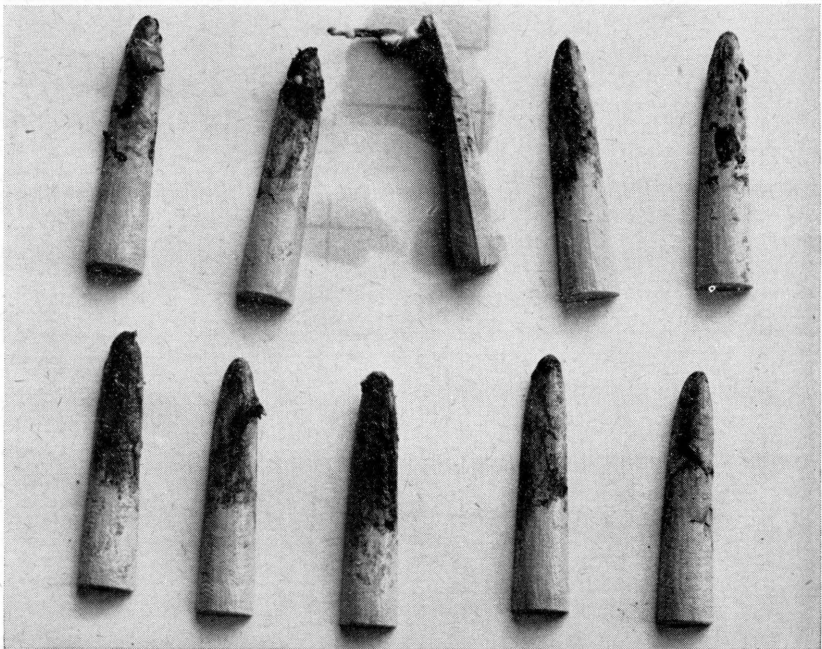
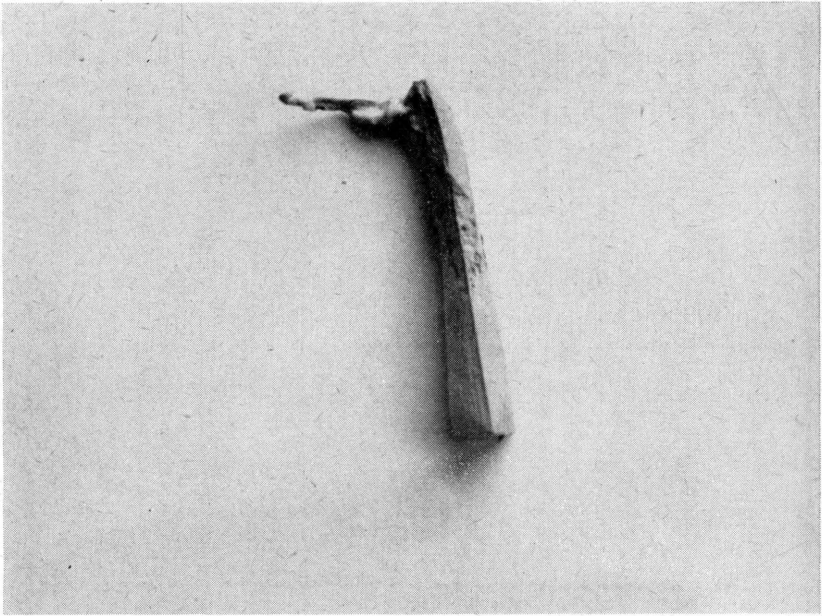
During the period of storing and handling lobsters for market, it has been found necessary to inactivate one or both claws of the lobster. This reduces mortality and is accomplished by the use of a plug inserted into the claw to wedge the movable jaw tightly against the main claw shell. Plugging, therefore, prevents the lobster from maiming or otherwise injuring his fellows while in the close confinement of pounds or other storage areas. Although plugging reduces storage mortality, it poses a second problem for the lobster dealer: that of placing on the market lobsters with varying degrees of discoloration in the claw meat due to the plugging. This discoloration may be so slight as to be unnoticeable, or may penetrate large areas of the claw meat. In August, 1948 it was brought to the attention of the Department of Sea and Shore Fisheries that some dealers were receiving demands for unplugged lobsters in order to supply their customers with a product free from discoloration. Since most dealers do not feel that it is economically safe to store unplugged lobsters, it appeared necessary either to devise a plug that does not cause discoloration or to find some other effective, yet practical and inexpensive, method of inactivating the claw.

Initial work on this problem was based on the theory that discoloration might be caused by contamination of the plug, either from contact with the gloves used by fishermen both for baiting and plugging or from some other source before actual insertion of the plug into the lobster. The original experiments were set up to check this theory by testing the effectiveness of plugs treated with various chemical agents known to inhibit bacterial growth and which might possibly reduce or prevent discoloration.

## Materials

### A. Plugs.

The wooden plugs used in the experiments were the various types of machine-made plugs available to commercial fishermen. Although differing slightly in size and shape, no differences were noted with respect to discoloring effects when inserted into lobster claws. Two types of plastic plugs were used: polystyrene and cellulose acetate.



**Top:** Even with heavily infected claw, soft plastic plug generally removes discolored material.

**Bottom:** Infected material adhering to soft plastic plugs after removal from lobster claws.

## B. Plug treatments

Wooden plugs were treated with the following chemical agents:

1. *Zephiran*,\* a quarternary ammonia compound with high germicidal action. Plugs were thoroughly soaked in a 1:200 solution and then dried.

2. *Roccal*,\*\* a quarternary ammonia compound with high germicidal action. Plugs were soaked in a 1:200 solution and dried.

3. *Bonded zephiran*. Plugs soaked in zephiran were coated with plastic to retard speed of leaching.

4. *Iodine*. Plugs were soaked in saturated tincture of iodine and dried.

5. *Zein protein*.† Used in saturated alcohol solution, plugs soaked and air dried.

6. *Penicillin*,‡ 100,000 units in sterile water solution. Plugs were soaked in this solution and then dried.

In addition to the above chemical treatments, wooden plugs were dipped in paraffin to give them a smooth, impervious surface. In some of the experiments, plugs were deliberately contaminated by dipping them in gurry obtained from lobster bait barrels.

## C. Controls

Steam sterilized wooden plugs inserted into a thoroughly sterilized claw was the standard control used in these experiments. Untreated plugs inserted into unsterilized claws were also used as controls. In some of the experiments a control group of unplugged lobsters was used.

## D. Lobsters

Both Maine and Canadian lobsters were used. The lobsters were selected for vigorous condition and had at least one claw which had not been previously plugged. The lobsters were held in tanks supplied with running sea water and were acclimated to the tanks for at least 24 hours before plugging.

## Methods

### A. *Experimental design*

Each experiment consisted of one or more treatment groups and one or more control groups. In some of the experiments, it was

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\*Winthrop Chemical Co.

\*\*Winthrop Chemical Co.

†Sheffield National Dairies, Inc.

‡Crystalline Penicillin G, sodium salt; Commercial Solvents Corporation.

possible by holding several lobsters from each treatment group and from the control group together in the same tank compartment to maintain a random sample. In other experiments the various groups were separated by compartments but compartments for the groups were randomly arranged.

#### B. *Plugging methods*

The manner of inserting plugs depended on the treatment used. In general, the plugs were inserted immediately following removal of the lobster from the water. Elaborate precautions to obtain sterility were taken in inserting steam sterilized plugs. The plugs were sterilized 20 minutes in the steam sterilizer at 15 pounds in cotton-plugged tubes. They were handled with sterile forceps. The claws were scrubbed with *Roccal* and rinsed with 70% alcohol. In the experiments where the plugs were sealed off with paraffin and collodion, following the alcohol rinse the alcohol was flamed off and the dry claw dusted with sulfamerazine.

#### C. *Examination of plugs and claw meat*

Progress of discoloration was determined by periodic examination of the lobsters. About half of the lobsters were boiled 15 to 20 minutes before examination, the plug withdrawn, the amount of discolored material adhering to the plug and the extent of discoloration in the claw meat noted.

#### D. *Bacterial examination of plugs and claw meat*<sup>1</sup>

To determine the presence of bacteria in the wound caused by plugging, the claw and exterior portion of the plug was sterilized by a cotton swab dipped in a 1:500 solution of *Roccal*. The plug was then withdrawn with sterile forceps and the tip drawn lightly over media in petri plates. Discolored material within the claw was smeared in a similar manner.

The following medium has been found to give satisfactory growth of marine bacteria in this laboratory (Zobell pg. 41)\*:

Bacto Nutrient broth	8gm
Potassium phosphate	.05gm
Bacto agar	15gm
Make up to 1000 ml. with filtered sea water.	

Plates were incubated 48 hours at 25°C. The absence of growth at the end of 48 hours was taken as evidence that bacteria were not present on the plug or in the meat.

\*cf. Claude E. Zobell, *Marine Microbiology*, Chronica Botanica Co., 1946, page 41.

### E. *Sealing*

Sealing of the plug and claw was carried out to eliminate contact between the plug wound and sea water, and, therefore, to prevent the entrance of any bacteria which might be present in sea water. Treatment of the claw prior to plugging has been described above. Plugs were steam sterilized and inserted with sterile forceps. Immediately after plugging, the wound, plug and claw were covered with some compound such as collodion, paraffin, or rubberoid and, when these had solidified, the lobster was returned to the holding tanks.

### F. *Inoculation and infection*

Inoculations of the bacteria common to the plugs were made to check the belief that the bacteria would cause discoloration. Tubes of pure cultures were rinsed with sterile sea water and the resulting suspension was injected into the claw or tail sections of the lobster in doses of 1/10 or 1/100cc. Lobsters injected with the same doses of sterile sea water were held as controls.

### G. *Results*

Of the 250 lobsters used for plug tests, all showed varying degrees of discoloration, and all those tested showed the presence of a gram-negative, rod-type bacteria present in sea water. There was no noticeable difference in the discoloration or absence of it which might be attributed to the treatment of the plug used. The extent of discoloration seemed to be proportional to the length of time the lobster remained plugged. It is obvious that no plug was effective in reducing or preventing bacterial action or discoloration. We wish to note here, however, that in the case of the soft plastic or cellulose acetate plugs, although the above holds true, the discolored material adhered to the plug and was removed from the lobster when the plug was withdrawn. This happened in over 90% of the cases involved and is not a characteristic of any other plug used.

The results based on the outcome of thirteen attempts to form a complete seal over the lobster's claw served as further proof of our theory that the organism is present in sea water and enters after plugging. In three of the attempts we were able to apply complete seals and in each of these cases discoloration and bacteria were absent. In all other cases failure to create a seal which was water-tight allowed contact between the plugging wound and sea water and bacteria and discoloration were present.

The results served to support our theory that although the organism is free in sea water, it enters the lobster through the wound caused by plugging and causes discoloration.

As a further test of the activity of the bacteria in question and to further prove the theory of discoloration, a series of controlled injection experiments were carried out. These experiments, described above, were highly conclusive. Injections of 1/10cc were shown to be too lethal to give the desired effects, but when these doses were reduced to 1/100cc we were able to keep specimens alive long enough to observe closely the progress of infection and reisolate the organism. Specimens of discolored flesh caused by these injections were indistinguishable from flesh specimens taken from plug infection.

In order to correct the belief held by some people that a lobster may bleed to death after plugs are removed, especially if the lobster is not immediately returned to the water, we conducted the following series of tests.

After plugs had been removed for testing, the lobsters from which the plugs were removed were held in baskets out of water at temperatures ranging from 52°F. to 68°F. for periods of 30 minutes to 2 hours and 30 minutes. Bleeding ceased almost immediately and, although lobsters were sometimes weak when returned to holding tanks, they were revived and seemingly none the worse for the treatment after 24 hours in the tanks.

All lobsters survived the removal of plugs and bleeding was not excessive. All were normal within 24 hours and seemingly suffered no effects as a result of bleeding. Our observations indicate that bleeding ceases, even out of water, within 5-10 minutes.

#### H. *Conclusions*

All types and treatments of plugs tested in the experiments resulted in discoloration in the claw meat about the plug. Sterilization of plugs and claws followed by sealing prevented the formation of discoloration, indicating discoloration is caused by a factor not associated with the plug itself. Smears made with plugs, and discolored material from the claw gave abundant bacterial growth on suitable media indicating bacterial infection as the source of discoloration. A gram-negative rod bacterium found in sea water was associated with all instances of discoloration. This organism, injected into the lobster, caused discoloration indistinguishable from that caused by plugging. In addition, the bacterium was shown to be highly toxic to lobsters.

Discolored material was found to adhere to a plug made of cellulose acetate so that all, or nearly all, the discolored material was withdrawn from the claw with the plug. No other plug tested possessed this characteristic to any degree. This plug is recommended as a means of diminishing the amount of discolored material in the claw following withdrawal of the plug after cooking.



Further study of the bacterium found to be associated with discoloration is recommended. Since dilute injections of pure cultures of this bacterium cause high mortality in lobsters, the possibility is suggested that plugging may be a cause of some of the losses associated with the handling and storage of lobsters.

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