REPORT OF THE SPECIAL COMMISSION FOR THE INVESTIGATION OF THE LOBSTER AND SOFT-SHELL CLAM.

I. GENERAL ACCOUNT OF THE LOBSTER AND CLAM INVESTIGATIONS.

By Hugh M. Smith.

DECLINE OF THE LOBSTER FISHERY.

The condition of the lobster fishery having become such as to occasion much concern on the part of fishermen and State authorities, the U. S. Commission of Fish and Fisheries in 1898 undertook special inquiries regarding the status and needs of this industry. At that time no branch of the American fisheries appeared to be more in need of intelligent treatment than the lobster fishery. Notwithstanding the existence of stringent protective laws and the regular prosecution of artificial propagation, the catch of lobsters along the entire coast was steadily diminishing; and it seemed evident that unless active measures were taken to increase the supply, the species would in a comparatively short time become practically extinct.

The decline of the lobster fishery may be attributed to three causes, namely, the relative infrequency of the breeding periods, the slow rate of growth, and reckless and illegal fishing.

The lobster does not ordinarily breed oftener than once in two years, and the intervals may be even longer. The eggs are carried by the female for ten or eleven months after extrusion, and when they finally hatch the young must pass through a long series of larval stages, during which they are subjected to many adverse conditions. If they survive the early critical period and establish themselves as young lobsters, it is probably four or five years before they become adults. Even under the most favorable conditions, the dangers are so great and the enemies are so numerous that only a small per cent reach maturity.

Overfishing and disregard for protective laws are mainly responsible for the present condition of affairs. In all the States it is legal to capture and kill at all times of the year, but all the States on the New England coast have enacted laws prohibiting the sale or possession of lobsters under certain lengths, and all prohibit the destruction of the

egg-bearing females. The strict enforcement of these laws is at present impossible, and it is safe to say that very few of the lobsters caught, no matter what their size or condition, are returned to the water.

STATISTICS OF THE LOBSTER FISHERY.

The Commission has, through its statistical inquiries, kept well informed as to the actual condition of the lobster fishery, and has published detailed statements of the quantity and value of the product at short intervals, beginning with 1880 and ending with 1902. In 1900 the lobster fishery gave employment to 4,348 persons; the vessels employed numbered 191 and were valued at $216,674; the number of boats used was 3,960, worth $261,918; the pots or traps set aggregated 208,563 and were valued at $224,111; and the shore, accessory, and other property connected with the industry was valued at $965,375, making a total investment of $1,668,060. The quantity of lobsters caught and sold was 15,767,741 pounds, for which the fishermen received $1,390,579.

Although the fishery is prosecuted from Maine to Delaware, inclusive, it is and always has been comparatively unimportant in New York, New Jersey, and Delaware; in these States in 1900 only 109 fishermen were engaged, and their catch was only 200,660 pounds, valued at $27,960. The lobster fishery in that section may therefore be omitted from further statistical consideration.

The New England lobster fishery reached its climax in 1889, during which year 30,449,603 pounds of lobsters were taken and sold for $833,736, as shown in the following table:

States.	Pounds.	Value.
Maine	25,001,351	$574,165
New Hampshire	137,175	6,415
Massachusetts	3,353,787	148,492
Rhode Island	456,000	21,565
Connecticut	1,501,290	83,099
Total	30,449,603	833,736

In 1902 the catch of lobsters in New England was 14,028,845 pounds, which sold for $1,271,962, the catch being apportioned as follows among the five States. Although the quantity of the output was 54 per cent less than in the banner year (1889) the value was 52½ per cent greater:

States.	Pounds.	Value.
Maine	11,435,739	$1,001,797
New Hampshire	128,463	14,863
Massachusetts	1,695,688	175,095
Rhode Island	397,305	39,488
Connecticut	371,650	40,719
Total	14,028,845	1,271,962

That the trend of the lobster fishery may be understood, there is shown herewith in condensed form the catch of the New England States for all the years for which the statistics are available, beginning with 1880. The plea has frequently been made during the past few years that there has been no real diminution of the lobster supply, and in proof thereof the financial condition of the lobster fishermen has been cited. It is true that the lobstermen are receiving more money for their lobsters than formerly, but in this fact lies one of the greatest dangers, for this state of affairs engenders indifference to the real condition and needs of the fishery.

Comparative statistics of the New England lobster catch.

Years.	Pounds.	Value.	Average price per pound.
1880	19,836,233	$473,341	$0.024
1887	28,627,600	784,238	.024
1888	27,640,282	808,842	.029
1889	30,449,603	833,736	.027
1892	23,409,927	1,035,501	.044
1898	14,661,808	1,276,967	.087
1900	15,567,081	1,362,619	.088
1902	14,028,845	1,271,962	.091

ARTIFICIAL HATCHING OF LOBSTERS.

The national government, through the U. S. Commission of Fish and Fisheries, cooperating with the States to maintain the lobster supply, has for many years been engaged in the artificial propagation of lobsters at its two marine stations on the Massachusetts coast, and many hundred millions have been hatched and planted. In recent years the work of gathering brood lobsters has been very thoroughly and systematically carried on, and each season during a period of several months immediately preceding the hatching time the entire coast of New England has been patrolled and practically every available egg-bearing lobster has been secured. This work has been conducted under an arrangement with several of the States, by which the lobstermen are permitted to retain the egg-bearing lobsters until an agent of the Commission shall have collected them, paying for them a little more than the market price. The "berried" lobsters are sent to the hatcheries and their eggs there removed, the old lobsters being afterwards taken back to their native localities and liberated. Another feature of this work has been the stationing of agents at points where lobsters are brought in from the Canadian provinces and the stripping of eggs therefrom, such collections some years amounting to many millions.

The extent of the lobster-cultural operations of the Commission from 1888, when the first practical work was done, to 1903, is shown in the following table. It will be seen that extensive operations have been

carried on only since 1894, and that notwithstanding greater efforts were made to obtain eggs, the output for the last five years of the decade was much less than for the first five:

Lobster fry planted.

Fiscal year.	Number.	Fiscal year.	Number.
1888	1,800,000	1897	115,606,065
1889	1,574,000	1898	95,234,000
1890	4,511,000	1899	108,463,000
1891	3,533,500	1900	77,166,000
1892	5,799,000	1901	60,879,000
1893	8,818,000	1902	81,020,000
1894	78,398,000	1903	68,631,000
1895	71,000,000		
1896	97,079,000	Total	879,511,565

While it can not be doubted that these efforts of the Government have been beneficial, they have not done more than retard the decline, and recently the lobster catch in certain sections has been so reduced that the supply of eggs for hatching purposes has greatly fallen off, and the conditions have become most serious.

Artificial hatching on a large scale is a comparatively simple matter, but the rearing of the young lobsters through their defenseless larval stages to the age when they are able to take care of themselves is a problem which has repeatedly been considered by fish-culturists and biologists, but appeared to present insurmountable difficulties, as all attempts to retain the fry in the hatchery for any length of time proved futile, the mortality being astonishingly rapid. The larvæ were therefore planted immediately after hatching.

It has been apparent to the Commission for years that the work of lobster cultivation would be vastly more effective if some method could be devised for rearing comparatively large numbers of the young, and, as this seemed to be the most practicable form of aid to the lobster fishery which could be rendered by the general government, it was determined to renew the experiments, this decision being influenced by some success in lobster rearing on a small scale achieved by Dr. H. C. Bumpus at the Woods Hole laboratory in 1898.

THE SOFT-SHELL CLAM.

Next to the lobster, this clam was the most important product of the shore fisheries demanding attention, and the Commission determined to acquire a more thorough knowledge of the breeding habits, time of sexual maturity, food, rate of growth, enemies, etc., as a necessary preliminary to the institution of measures for increasing the supply. During recent years the soft-shell clam has been rapidly diminishing in numbers on the New England coast, and prices for both food and bait clams have at times been very high. The scarcity has been par-

ticularly noteworthy in the more southern sections of the region, and grounds that had for years been productive had become depleted, so that in many places there was no longer a local source of supply.

The following statistics do not suggest an especially alarming condition in the fishery, but it must be remembered that the increased fishing population and the increased demand for clams between 1880 and 1902 should have resulted in a steady increase in the output.

Comparative statistics of the New England soft-clam yield.

States.	1880.		1889.		1902.	
	Bushels.	Value.	Bushels.	Value.	Bushels.	Value.
Maine	318,383	$112,706	842,369	$200,761	497,132	$175,674
New Hampshire	17,960	8,980	300	150	3,000	3,000
Massachusetts	158,626	76,195	251,823	137,711	227,941	157,247
Rhode Island	53,960	48,564	33,375	32,475	26,490	32,514
Connecticut	75,000	38,000	26,360	24,900	22,460	26,743
Total	623,929	284,445	1,154,227	395,997	777,023	395,178

In the summer of 1898 Prof. J. L. Kellogg was engaged by the Commission to make a special study of the clam in Massachusetts and Rhode Island, and as a result of his inquiries it appeared feasible to develop a method of clam culture applicable to commercial conditions.

PERSONNEL AND PLANS OF THE SPECIAL COMMISSION.

It having been demonstrated that the ordinary funds available for the biological inquiries of the Commission were not ample to allow for the prosecution of the lobster and clam experiments on a sufficiently large scale, the Commissioner sought relief from Congress, and the urgent deficiency bill approved February 9, 1900, carried a special appropriation of $7,500 for this purpose.

The direction of the investigations and experiments was placed in the hands of a special commission, created by the Commissioner, consisting of Dr. H. C. Bumpus, chairman; Dr. H. M. Smith, secretary; Mr. W. de C. Ravenel, and Capt. E. E. Hahn. Most of the labor connected with the planning and supervision of the work devolved on Doctor Bumpus, to whom more than to any other member of the Commission is due the credit for the methods and outcome of the investigations.

Inasmuch as the general government had no control over the lobster and clam fisheries, it was apparent that the only aid which it was practicable for the Commission to give was (1) the study of obscure points in the life histories of the species, (2) the determination of the best methods of increasing the supply, (3) the dissemination of information on the foregoing topics among the fishing population, and (4) cultivation of the species. The work began in the spring of 1900 and

was actively pushed for three years. In the investigations and experiments the special commission had the valuable services of Dr. A. D. Mead, who, as a member of the Rhode Island Commission of Inland Fisheries, cooperated with the U. S. Fish Commission in the development of methods of clam culture and lobster rearing; of Prof. James L. Kellogg, of Williams College, who gave attention to the natural history of the clam and the establishment of experimental beds of planted clams; of Mr. George H. Sherwood, of Brown University, who was in immediate charge of the hatching and rearing of lobsters; and of Prof. Frederic P. Gorham, of Brown University, who studied the causes of mortality in artificially hatched lobster fry. Doctor Mead's work was carried on principally in Narragansett Bay; Professor Kellogg's at Woods Hole, Essex, and other points on the New England coast, and Mr. Sherwood's and Professor Gorham's at Woods Hole and Wickford. Dr. W. C. Kendall, assistant of the Commission, laid out a number of beds of planted clams on the shores of Casco Bay, Maine, and also experimented in the rearing of lobsters at Orrs Island, Maine.

RESULTS OF THE EXPERIMENTS, AND RECOMMENDATIONS.

In the reports of Mr. Sherwood, Professor Kellogg, and Professor Gorham, which follow, a detailed statement of the different lines of work and their outcome is given. Following is an epitome of the principal conclusions reached and work accomplished by the special commission:

Lobsters.—1. The hatching of lobsters as ordinarily conducted has had but little effect in arresting the decline in the fishery, owing in part to the fact that the larvæ must be planted soon after hatching and a very large percentage of them are quickly destroyed, and in part to the comparatively small number of fry liberated when the extent of the fishery and the area of the fishing grounds are considered.

2. The artificial rearing of lobsters until they have passed the most vulnerable period of their existence is one of the most vitally important steps that can be taken to maintain the supply, and one that is most appropriate for the general government to undertake.

3. While the rearing of lobsters presents difficulties, these are not insurmountable, and the special commission has developed a method which is applicable to economic conditions.

4. In the most favorable experiments upward of 50 per cent of the larvæ have been reared beyond the free-swimming stage, and there seems to be no reason to doubt that this record may be equaled or surpassed on a commercial scale as greater experience is gained.

Clams.—1. The supply of soft clams is susceptible of great increase, and the fishery can be placed on an enduring basis by the institution of cultural methods.

2. The special commission has developed a plan of clam culture which is very simple and effective, the pecuniary results being extraordinarily large.

3. Immense quantities of small, unmarketable clams are now lost each year, which, if utilized for planting purposes, on either barren or productive grounds, will increase the output of given sections many fold.

Among the measures which the special commission advocates for the betterment of the lobster and clam industries are the following:

1. The more extensive cultivation of the lobster; the extension of the work so as to save the eggs on lobsters taken throughout the year instead of only during a few months; and the rearing, to the lobsterling stage, of as much of the output of the hatcheries as possible.

2. The more effective enforcement of the existing lobster laws, and the enactment of additional legislation that may be found desirable for the protection of the lobster, such as the prohibition of the sale of all female lobsters for a term of years, and the proscription of the use of traps which will retain the undersized lobsters that may enter.

3. The dissemination among the lobster fishermen of authentic printed information showing the necessity for protecting the lobster and the injury that results to themselves from their failure to give cordial support to the State officials in enforcing restrictive laws.

4. The general adoption of clam planting on barren and depleted grounds.

5. The enactment of such legislation as will place clam culture on the same substantial basis as oyster culture.