

State of Rhode Island and Providence Plantations.

FORTIETH ANNUAL REPORT

OF THE

COMMISSIONERS OF INLAND FISHERIES

MADE TO THE

Compliments of the

Commissioners of Inland Fisheries.

JANUARY SESSION, 1910.

PROVIDENCE, R. I.

E. L. FREEMAN COMPANY, STATE PRINTERS.

1910.

Compliments of the

Compliments of the

State of Rhode Island and Providence Plantations.

FORTIETH ANNUAL REPORT

OF THE

COMMISSIONERS OF INLAND FISHERIES

MADE TO THE

GENERAL ASSEMBLY

AT ITS

JANUARY SESSION, 1910.

PROVIDENCE, R. I.

E. L. FREEMAN COMPANY, STATE PRINTERS.

1910.

9496(17)
5

5074



REPORT.

*To the Honorable the General Assembly of the State of Rhode Island
and Providence Plantations, at its January Session, 1910:*

The Commissioners of Inland Fisheries herewith present their annual report for the year 1909.

The programme of work of your Commission during the past year included:

The stocking of ponds and streams with fresh-water fishes.

The distribution of copies of the laws of the State relating to fisheries.

The collection of data and statistics relating to the commercial fisheries.

The enforcement of the State laws governing the fisheries, particularly those relating to the lobster fisheries.

The continued examination of the physical and biological conditions of Narragansett Bay with reference to the development of the fisheries.

The exhibition of the results of sea-farming experiments for the purpose of awakening interest in the development of the fishery industry.

The active co-operation with the fisheries authorities of other States, of the national government, and of other countries.

The propagation of lobsters at the rearing station at Wickford.

The continued scientific investigation of fisheries problems for the purpose of ascertaining fundamental facts upon which new and effective methods of developing the fisheries industries shall be established.

The financial statement for the year 1909 is as follows:

State of Rhode Island in account with the Commission of Inland Fisheries.

1909.	DEBIT.	
Oct. 11.	To paid American Fisheries Company for 40,000 yearling trout, as per voucher on file with the State Auditor.....	\$1,000 00
Dec. 31.	To expenses distributing same, as per ditto	85 94
	To expenses of Commissioners, as per ditto	681 53
	To services and expenses of deputies under lobster law, as per ditto.....	3,103 10
	To laboratory, as per ditto	6,836 39
	To egg lobsters, as per ditto.....	330 13
	To legal expenses, as per ditto.....	75 00
		\$12,072 09
1909.	CREDIT.	
	By received from State Treasurer.....	\$12,072 09

STOCKING STREAMS.

The continual restocking of the fresh-water streams of the State has been a part of the programme of your Commission ever since its creation forty years ago.

These many years experience has indicated that the most efficient method of stocking under the conditions of our State is the liberation of young fishes of considerable size, "fingerlings," from a year to a year and a half old. In pursuance of this method, and by enforcement as far as possible of the laws regulating the methods of fishing, the time of year when fish may be caught, and the size of the fish legitimately kept, your Commission has been able to provide good angling in many of the widely distributed streams of the State.

The trout fishing during the early portion of the open season, which extends from April 1st to July 15th, was good. The severe drought during the summer left the streams unusually low. After the middle of October, when the streams had again filled, forty thousand exceptionally fine yearling trout were purchased and widely distributed

under the supervision of your Commissioners. The trout reached the streams in excellent condition, and in many large shipments not a single specimen was injured or apparently weakened in the transit from the hatchery to the streams in which they were set free. Your Commission acknowledges, on behalf of the State, its obligation to the New York, New Haven, and Hartford Railroad for their courtesy in allowing free transportation of the trout and the messenger who accompanied them. Acknowledgment and thanks are also due the fishermen who assisted gratis in the work of distribution.

DISTRIBUTION OF COPIES OF THE LAWS OF THE STATE RELATING TO FISHERIES.

Even the best of laws regulating the fisheries, particularly the hook-and-line fisheries in various and widely distributed streams often remote from settlements, cannot be rigidly enforced unless they have the active support of those in whose interest the laws are made. The Commissioners must have the intelligent co-operation of the fishing public in this vital matter, and to this end copies of the laws, with index and tables of essential points, have been issued in convenient pocket editions and widely distributed. Copies of the laws can always be had on application to the secretary of the Commission.

Your Commission was created in the interests of the fisherman, and has been single hearted in its endeavor to maintain and improve all the fisheries within its jurisdiction. Its success has in no small measure been due to the appreciation of this fact by the intelligent representatives of all classes of fishermen.

THE COLLECTION OF DATA AND STATISTICS RELATING TO THE COMMERCIAL FISHERIES.

Dry and unreadable as statistics proverbially seem, they have at times a mighty importance in such matters as the commercial fisheries. They constitute one of the chief means of diagnosis of the condition of the industry, the pulse by which improvement or decline

is indicated. In the case of the commercial fisheries it is particularly and especially important to follow the improvement or decline for the very reason that the causes of the decrease or increase are either frankly unknown or much in dispute, while additional regulation of the various fisheries is inevitable, because of the increasing demands upon the fisheries and because of the pressure of conflicting interests. The long-standing and notorious dispute between the anglers and the trap fishermen as to the effect of trap fishing upon the permanent supply of fishes is one of very many cases in point. The question might reasonably be settled by the accumulation of reliable data to the equal satisfaction of both interests. Certainly drastic measures involving the elimination of an important industry should not depend upon rhetorical presentations or legal subtleties. In the specific case of the possible effect of the firing of heavy guns at Fort Greble upon the run of fishes in the bay, reliable statistics of the run of former years and of other conditions would have been of great and substantial value.

Your Commission fortunately has been able to submit statistical evidence of the extraordinary improvement of the lobster industry, in consequence of its endeavors to build up the industry, which has not only pointed the way to subsequent action but has made clearer than ever the necessity for reliable data concerning all the fishes under its administration. Complete and reliable statistics are difficult to collect, especially in such matters as free fisheries, and can only be obtained with the active co-operation of the fisherman. Your Board has for many years gathered and recorded data and has published regularly parts of this material in its annual reports.

The trap fishing in the bay and other waters of the State is one of the most important industries. During the past twelve years the statistics of location and ownership have been annually collected and published in detail in the reports of your Commission. The increase in the number of traps during these years is remarkable, and if it is an index of the growing demand for the products of the industry, is significant of its future importance to the State and the people.

Leaving out of account the traps at Block Island, numbering, this year, eight, the following table gives a summary of the numbers in the consecutive years from 1898 to 1909, inclusive:

Year.	No. of traps.	Year.	No. of traps.
1898.....	119	1904.....	214
1899.....	121	1905.....	234
1900.....	135	1906.....	243
1901.....	151	1907.....	265
1902.....	161	1908.....	271
1903.....	195	1909.....	269

It is to be noted that the growth in numbers has been constant and fairly even up to 1908; the yearly increase being 2, 14, 16, 10, 34, 19, 20, 9, 22, and 6. During the last season the number has diminished by two. As two additional traps were set at Block Island, the total for the State is the same as for 1908. The increase has been general in the various portions of the State, though in some quarters it has been greater than in others. This is indicated in the following table:

Year.	Prov. River.	East Greenwich.	West Passage.	Mt. Hope Bay.	Sakonnet River.	East Passage.	Off Shore.
1898.....	4	6	26	9	34	15	25
1908.....	7	38	32	12	37	22	73
1909.....	7	31	32	12	88	26	73

Unfortunately there are no accurate statistics showing the actual amount of the yearly catch of fish in the traps, and their value. Some general idea of the importance of the fishery, however, may be inferred from the fact that the shipment from Newport alone by regular transportation lines was, for 1909, 46,031 barrels of fish, exclusive of lobsters and other shell-fish and large fish like sturgeon, horse-mackerel, swordfish, etc.

The statistics collected by Wm. T. Luth, chief deputy under the lobster law, relating to the lobster fishery during four years were summarized in the general report of the Commission last year, pages

7 to 9, and given more in detail on page 29 and following. Making due allowance for inaccuracy these figures show an extraordinary and steady increase in the total catch for the five years, from 376,994 pounds in 1904 to 1,471,344 pounds in 1908. The total catch for the year 1909 was slightly less than that for the year 1908, and the number of pots was slightly increased.

The following tabulated statement summarizes, for purposes of comparison, a portion of the data respecting the lobster catch:

Year.	Total catch in pounds.	Newport.	Number of pots.
1904.....	376,994	226,994	7,935
1905.....	449,300	301,659	9,180
1906.....	671,914	353,573	11,355
1907.....	929,423	581,189	12,104
1908.....	1,471,344	665,009	20,011
1909.....	1,342,983	757,837	23,220

ENFORCEMENT OF THE LAW.

The enforcement of the law covering the fresh-water fishes is for the most part undertaken by your Commissioners themselves, and by volunteer deputies who serve without pay in the interests of better fishing. The enforcement of the lobster law is a different kind of a proposition and involves continuous watchfulness and hard, disagreeable work. Two deputies under the lobster law have been employed constantly, and four during the fishing season.

Twelve prosecutions have been made and fines imposed and paid under the lobster law as follows: (the names of those fined are omitted).

Newport, June 26, 6 short lobsters.....	\$30 00
Sakonnet, July 30, 1 short lobster.....	5 00
Sakonnet, July 30, 3 short lobsters.....	15 00
Sakonnet July 31, 6 short lobsters.....	30 00
Sakonnet, July 31, 15 short lobsters.....	75 00
Hope Island, August 10, 6 short lobsters.....	30 00

Newport, August 23, 2 brushed, 1 egg lobster.....	\$15 00
Newport, September 11, 2 brushed lobsters.....	10 00
Block Island, September 16, 2 brushed lobsters.....	10 00
Block Island, July 10, 6 short lobsters.....	30 00
Block Island, September 20, 10 short lobsters.....	50 00
Saunderstown, November 22, fishing in close season.....	20 00
	\$320 00

The main purpose of the work of the deputies is to keep the law from being broken and therefore the value of their services bears no necessary relation to the number of arrests and fines.

The provisions of the lobster law and the strenuous attempt of your Commission to enforce them protect the honest fishermen against ignorant and unscrupulous competitors. The lobster law which has been in force for several years and the law as amended last year and now in force, were drawn up solely in the interests of the lobster fishery. The provisions are clear and simple. The lobsterman who breaks the law commits the offence against his fellow fishermen. The well-worn excuse of former times, "someone else will sell short lobsters if I don't," no longer has a shadow of justification. For these reasons no sympathy need be wasted upon the lobstermen convicted of keeping short lobsters or of brushing eggs.

The new lobster law passed by the General Assembly May 9, 1909, in substitution for the former law, took effect January 1, 1910. The essential provisions of this law are, in effect, that only citizens of the State may engage in this branch of the free fishery; that all persons engaged in the fishery must be licensed; that the method of determining the legal length of the lobster is modified so that the body shell alone is measured. The law was passed by the Assembly after several long hearings before the Committee, at which representatives of the various lobster interests, including the alien fishermen, freely discussed the provisions of the law from every point of view. It is a significant fact that the law as passed received the hearty and almost unanimous support of the American lobster fishermen and the

wholesale dealers, as well as of your Commission and their deputies. The passage of the law was strenuously opposed by the alien lobstermen, who were ably represented at the hearings by delegates and attorneys.

In view of a wide-spread and persistent misconstruction of the motives of your Commission in recommending the passage of this law, it may be stated with propriety that the clause limiting the privileges of the lobster fishery was recommended, not as a blow aimed at a particular nationality of foreigners, but as a bona fide attempt to secure for the citizens of the State the benefits of a free fishery maintained and developed at the expense of the State. Also in regard to the second section of the law, which provides that your Commission may grant licenses, subject to the regulation of the act, to whom they may think proper: the apparently plausible objection to the law has been raised ostensibly on the ground that the Commissioners are given too much discretionary power. That this hypothetical bugbear of the possibility of arbitrary and unfair discrimination would be raised for various purposes was, of course, foreseen, but the clause was recommended solely to give practical and effective means of enforcing the law for the better protection of the lobster fisheries. Everyone familiar with the subject knows that the laws regulating the free fisheries are in any case exceptionally difficult to enforce, and every practical means should be used to make enforcement possible.

PHYSICAL AND BIOLOGICAL CONDITIONS OF THE BAY.

All the fisheries industries depend upon the animal and vegetable contents of the water and upon the physical conditions, such as temperature and density of the water and the character of the bottom and shores. Your Commission has for several years conducted investigations in regard to these conditions in the bay, and is convinced that further work in this direction is justified as the only sound basis for control of the fisheries resources. The conditions of food production upon land and in the water are characteristically opposite

in many essential respects. A great portion of the vegetable production of the land is available at once as food for man; practically none from the sea is so utilized. (In Japan, however, the sea-weed is converted into edible form by an industry amounting annually to several million dollars.) The sea food which is available at once for man consists of animals, but the thousands upon thousands of tons of animals produced annually in our own waters and used as food depend, in turn, upon marine plants for their food. Again, as opposed to the conditions upon land, the plants which serve as the bulk of the supply of food are for the most part practically invisible. They are not stationary, attached to the ground, and of considerable individual size, but are floating and microscopic. These vegetable organisms, moreover, are not confined to one surface, as upon the land, but are distributed, though unequally, throughout the whole depth of the waters of the bay. Some idea of the numerical abundance of these plants may be had by those who have seen the phenomenon of "red water" in the upper parts of our bay. The red, soupy appearance of the water, miles in extent, has been shown to be due to the abnormal abundance of one species of these swimming microscopic plants which normally occur as one of the invisible components of the plant food of the bay. In samples of red water taken during a visitation of the plague some years ago, it was estimated that there were over five millions per quart of sea water.

In every part of the world where a scientific study of the fisheries is pursued, investigation of this microscopic floating population of the sea, under the general name of "plankton," is being carried on. Your Commissioners have taken their part in this investigation for the sake of our own interests and are employing, besides the standard methods and apparatus, some other methods peculiarly adapted to the unique advantages of our station.

The investigation of the conditions which determine the "setting" of clams, oysters, etc., are involved in this plankton work. The solution of these mysteries would be of great economic value.

Your Commission is also collecting data upon the occurrence, distribution, breeding habits, and economic value of the various animal forms found in the bay. One of the most interesting and important sections of this work is that relating to the fishes, for here is brought out in the clearest manner the complex relations between the occurrence and abundance of fishes and the physical and biological factors governing their breeding, rate of growth, methods of feeding, and migration. The observations bearing on the natural history of fishes are placed on record and published at such times as seem desirable. In 1905 was published "A List of the Fishes of Rhode Island." This contained a record of all the fishes known to have been taken in the waters of the State, together with such data regarding them as had been collected by your Commission and a summary of the most important facts of their natural history. This list of fishes proved to be so generally useful, not only as a matter of record but also for reference purposes, that the edition of reprinted copies has now for some time been exhausted. A new list of the fishes, which includes all the information available up to the year 1910, has been prepared for publication. Particular attention has been paid to the collection of information regarding eggs and young stages of the different species of fishes, since our knowledge of these phases of the natural history of fishes is widely scattered through a great number of special papers and has never previously been brought together and arranged in an easily accessible form. Into this list are also incorporated observations made by the Commission upon the rate of growth of some of our common fishes.

With respect to its marine fish fauna, this State is situated in an exceptionally favorable location. Cape Cod forms the general boundary between the Arctic and the temperate faunæ of the Atlantic coast, and therefore most of the species common to both are found in greater or less abundance in our waters. The Gulf Stream, also, runs within a hundred and fifty miles of the Rhode Island coast, and therefore many tropical and subtropical species are common, and sometimes abundant, within the limits of the State. At a compar-

atively short distance from our coast, also, is the edge of the continental shelf of the ocean bottom where it begins to slope off into the great depths of the Atlantic; this region is the source of the deep sea forms, like the tile-fish, which are an important part of the fauna of the State, particularly in the off-shore waters. It is therefore not surprising to learn that a large number of different species of marine fishes have been reported as present in the waters of this State. The fishes enumerated in the present list represent 199 species, belonging to 175 genera and to 84 families. Of these about 30 are important food fishes; about 70 may be said to be rare as far as the present records go; of these latter, about 30 have been taken but once as far as is authentically recorded. The type specimens of 6, or perhaps 7, species were taken in Rhode Island waters. Of the species named, 24 are exclusively fresh-water forms and 175 are marine; of the latter, 14 regularly spend a part of the year in fresh water for spawning or other purposes.

The number of marine species will undoubtedly be increased in the future by the capture on our coast of strays from the abyssal fauna of the depths of the Atlantic, from the tropical fauna of the Gulf Stream, and from the Arctic fauna of the region north of Cape Cod. To these categories belong the 40 specimens taken at Woods Hole, but not yet recorded from Rhode Island, as well as the 25 species taken in New York waters which have not been recorded from this State. Of the fishes mentioned in the Rhode Island list, one species has not been reported from Woods Hole, three other species have not been taken in New York waters, and ten have not been taken at either locality. The very rare species which sometimes stray to our southern New England shores number over a hundred. They should not, however, strictly speaking, be considered as a part of the fauna of the State. Yet their occasional occurrence is of interest, since by their presence we gain information regarding the geographical distribution and migrations of the species in question, and more especially regarding the physical and biological conditions of the State and the adjoining regions.

The shores of the bay from Field's Point to the Bonnet were examined for the extent of the yearly clam set. The set was, as a rule, poor, and in only one place was it very abundant. In nearly every year there are limited areas discovered in which the set is very abundant—as has been shown in previous reports—but it is not possible to predict where this will be. Last year the only place in which a great abundance was discovered was a small area near Field's Point, about an acre in extent. Here, toward the last of September, the small clams about half an inch long averaged about three hundred to the square foot.

In order to demonstrate again the feasibility of clam culture, your Commission, through the Wickford station, transplanted from this area to various comparatively barren areas, taken out in the name of the Commission, about fifty bushels of these small clams.

The State of Rhode Island has a unique interest in the soft-shell clam, not only on account of the famous institution—the clambake—but because through your Commission it was the pioneer in the discovery of the possibilities and the methods of clam culture. The results of the work which your Commission commenced more than ten years ago and continued under Chapter 174 of the General Laws have been confirmed, extended, and exploited in other States—notably in Massachusetts. For these reasons, and because the clam industry, at present at low ebb, has splendid possibilities, we recommend the question of regulation of the clam fishery to your serious consideration. Under the prevailing conditions the clam product of the State is an insignificant fraction of what it might be, and does not begin to supply the clams for home consumption. Occasionally, after an exceptionally good set of clams, the condition is temporarily improved, but even so the clams are dug or destroyed by digging before they are half grown.

With respect to the most feasible means of reinstating the clam industry, the expedient of closing a portion of the shore for a term of two or more years and then opening it to the public, under suitable restrictions, might be commended, but it is impracticable. Nothing

short of a standing army of honest and enthusiastic wardens could enforce such a regulation. The only feasible solution of the problem yet proposed is, we believe, the leasing, to individuals, of the shore rights for the cultivation of clams. According to the proposed law before the legislature of Massachusetts, the cities or towns are given the discretion in the matter of leasing. In this way consideration of local interests is guaranteed. The objection to the leasing of a part of clam grounds to individuals on the theory of the rights of the free fisheries loses force and justification when the particular fishery is depleted almost to the vanishing point and no one is getting the benefit of what might be a considerable industry.

An extraordinary visitation of small "clams" occurred in April of last year, and continued during the summer, at Easton's Beach, Newport. These were not, however, the soft-shelled clam, but the young of the beach clam, or sea clam, "*Macra solidissima*." These mollusks, an inch more or less in diameter, were cast upon the beach by successive storms, where they died in the sun and were an intolerable nuisance. They were carted off by the ton and deposited on the sand dunes.

EXHIBITION OF SEA-FARMING.

Your Commissioners believe that the importance of the present fisheries industry and the possibilities of aquiculture in its various forms should be brought to the notice and comprehension of the public in every legitimate way. Accordingly this year, as for several years past, they have co-operated with the authorities of the South County Fair, at Kingston, in installing a so-called "Sea-farming Exhibit." After considerable experimentation a salt-water aquarium has been installed which is rather a unique success. For, though the sea water has to be carted in street sprinklers for several miles and then used over and over, and though the whole equipment is out of commission except during fair week, the water is kept clean with good circulation, and the many specimens of marine fish of various kinds live throughout the week in excellent condition. In fact, the mortality is lower

than in the case of the fresh-water fish in adjoining aquaria. The secret of success lies in continually filtering water through a thick sand filter and in keeping it cold by the use of ice in specially devised compartments of the aquaria.

The experimental station and hatchery at Wickford is a continual exhibit, and the entertainment of the many hundreds of visitors is no small item in the demands upon the time of the staff. However, this time is well expended, for it extends correct information regarding the fisheries problems in the most effective manner.

CO-OPERATION WITH THE FISHERIES AUTHORITIES OF OTHER STATES.

Co-operation with the Fish Commissioners of other States is one of the duties imposed upon this Commission by the legislative Act which created it. The specification of this policy as a duty of the Commission is a tribute to the good sense of those who drew up this Act in 1871. For years your Commissioners have co-operated actively, not only with the Fish Commissioners of other States, but also with those of the United States and with those of many foreign countries, and have gained thereby valuable experience and assistance, as well as much-cherished recognition of their scientific results.

During the past year, at the request of the United States Bureau of Fisheries, an exhibit illustrating the growth of the clam and the scallop was installed with the government exhibit at the Alaska-Yukon International Exhibition at Seattle.

At the last meeting of the American Fisheries Society one of your Commissioners was again elected to an important office.

Your Commissioners have been in correspondence with the Commissioners of Maine, Massachusetts, and Connecticut regarding the betterment of the fisheries whose interests are common to all. Your Commissioners take this occasion to express their obligation especially to the Commissioners of Connecticut for valuable assistance in the lobster experiments.

PROPAGATION OF LOBSTERS.

At the experimental laboratory at Wickford your Commission has continued its work upon the hatching and rearing of lobsters to the bottom stage, and has made further experiments in attempting to improve the methods. The problem undertaken eleven years ago was to discover a method by which newly hatched lobsters could be protected until they reached the bottom stage. This has been accomplished, and for several years the annual output of such lobsters has been many times greater than that from any of the several stations in this country and abroad, where efforts have been made to do this. With the report of your Commissioners of last year was published a resumé of this work from its beginning, to which you are respectfully referred for a full description of the apparatus and methods and an account of the experiments and results. During the last year a number of new experiments were carried on in the endeavor to further improve the method. These met, as usual, with varying degrees of success. A new pattern of the apparatus was tried in a part of the plant and gave greater facility in handling the heavy cars. Certain experiments made with reduced speed of the propellers and with varying conditions of light yielded experience at the expense of the lobsters. Some of the old floats which have been in use for several years are too far gone for further use, and new ones are being built on the improved pattern to take their places.

Experiments were made during the summer looking to the installation of electric power to take the place of the rather cumbrous power and driving system now in use. After many trials and failures, a feasible scheme was finally put into operation on a small scale and run for some time. It did not, however, seem safe to change the whole installation until further tests could be carried out. Such an installation as is contemplated would greatly extend the possibilities of this method of fish culture which has proved uniquely successful at Wickford and which has received favorable recognition at home and abroad.

Some progress was made toward overcoming a difficulty which is always encountered in rearing lobsters, namely that of the growth of parasitic organisms upon the shell. These fuzzy growths interfere with the movements of the swimming fry and with their feeding and molting. Since the growth consists mainly of plant organisms to which copper is fatal, experiments were made, at the suggestion of Mr. Barnes, the superintendent of the station, with copper paint on the inside of the cars. By this expedient, and by proper shading of the cars from the direct rays of the sun, the cleanest, healthiest, and largest lobsters ever seen at the station were obtained. The cars so painted were much more easily cleaned, as comparatively little growth and silt accumulated upon the sides and bottom.

One of the opportunities for further improvement of the rearing methods lies in the matter of the feeding the fry. A great number of experiments has been tried in previous years with a great variety of food, of which beef seemed to be the most satisfactory. Last year eggs were given a thorough trial. Paradoxical as it may seem, eggs are the cheapest food which has been found at all satisfactory. The eggs used are not of the freshly laid and strictly gilt-edged variety, but are broken eggs sold by the gallon. These were scrambled without the use of grease and then finely ground and beaten up into fine particles. There is no waste, and therein is the economy. The fry are extremely fond of this food, and its bright color in the water attracts their attention. They seemed to thrive upon this diet as well as upon that of meat. Maggots were also tried as food and seemed to be fairly satisfactory in the case of the older fry. The maggots remain alive in the salt water for many hours, and living food has its advantages.

The total output of bottom stage lobsters was 178,542, which was considerably less than that of the year before, and, though much greater than that of any other station, it was nevertheless a great disappointment. The season opened most auspiciously. The equipment and preparation for the work were more nearly complete than ever before, and throughout the season greater care than ever was

given to the young lobsters. Many fry were sacrificed in some of the experiments, but this would by no means account for the decrease in output. In spite of the special preparations and careful attention, a combination of adverse climatic conditions balked the attempt to surpass previous records. The previous fall and winter had been unusually mild, so that the eggs matured and began to hatch some two weeks before their usual time. At first this gave great encouragement, but during June the weather was exceptionally cold and wet and the fry developed with extreme slowness, taking nearly twice the usual time to reach the bottom stage. This had the double disadvantage of giving the fry twice the opportunity to devour one another and of keeping the cars occupied so that newly hatched fry could not be handled to advantage. As though to put the finishing touch to the adverse conditions, the temperature rose suddenly during the last of the hatching season, so that all remaining eggs were hatched long before the normal time, thus cutting short a valuable part of the season.

CONTINUED INVESTIGATION.

For more than ten years your Commissioners have systematically and continuously conducted scientific investigations of fisheries problems. They have through their work won a creditable place among the Commissions and scientific bodies at home and abroad, and have been fortunate in getting many results of immediate practical application as well as laying foundations for final results.

Besides the investigations recorded in previous reports of your Commission, and those outlined in the present report, there are in progress a series of investigations upon the identification of the young and the rate of growth of the fishes and invertebrates of economic value. In order to control the conditions of artificial propagation or of natural increase these problems must be solved. There is no evident reason why, for example, the set of clams and oysters must forever be left as a matter of chance. Control of the

set and of the rate of growth of these two species alone would yield annually more money than the investigations of your Commission would have cost in twenty years.

It is characteristic of scientific investigation, as our former colleague, Professor Bumpus, so strongly contended, that results do not appear all at once or at any scheduled time, and that the most valuable applications arise from unexpected sources. The success of the scientific investigations and their application which your Commission has achieved is due in large measure to persistent effort on the part of your Commissioners and to the continued support of the State.

THE COLLECTION OF DATA AND STATISTICS RELATING TO THE COMMERCIAL FISHERIES.

The difficulty of collecting complete and accurate statistics of the total catch of fishes has been remarked upon in previous reports. There are so many and so various channels through which fishes reach the market or the private consumer that it is practically impossible to keep track of them all. This difficulty is not peculiar to Rhode Island, but applies to the fishing industry generally. Nevertheless, a fair indication of the relative status of the fisheries is to be had by comparing the statistics taken year after year from the same sources. With this word of explanation, the following tables of the catch of fishes and lobsters, based upon the records of dealers and transportation lines, are, as heretofore, submitted:

Table Showing the Amount of Fish, Lobsters, and Other Sea Products Shipped Monthly from Newport by the Principal Transportation Companies During the Year 1909.

1908.	Fish.	Lobsters.	Crabs.	Sounds.	Sword-fish.	Sturgeons.	Horse-mackerel.	Sharks.	Clams.	Oysters.
January.....	1,553	2								
February.....	1,582	3							1	30
March.....	1,928½									78
April.....	1,427	10	5							88
May.....	14,981	138	66			3		5	5	17
June.....	12,106½	315	43	5	8	1	4	2	4	7
July.....	3,018	676	13	7	28		3			1
August.....	1,765	666	11	12	25		1			7
September.....	1,380	1,365	5	3			6			103
October.....	2,283	74½	1	2		2	5			101
November.....	1,886	2	1				2		4	100
December.....	1,821	1								121
Total, year 1909.....	46,031	3,252½	145	29	61	6	21	5	14	673

Table Showing Shipment of Fish, Lobsters, and Other Sea Products from Newport for the Last Twenty-Three Years.

	Barrels Fish.	Barrels Lobsters.	Barrels Quahaugs.	Barrels Crabs.	Barrels Clams.	Barrels Spawn.	Barrels Sounds.	Number Sword-fish.	Number Sturgeon.	Number Horse-mackerel.	Number Turtles.	Number Sharks.	Number Porpoise.	Barrels Eels.	Barrels Oysters.
1887.....	16,657	834													
1888.....	15,033	1,161													
1899.....	19,306	2,047													
1890.....	8,933	2,650													
1891.....	18,032	2,204													
1892.....	26,832	2,123													
1893.....	24,452	1,399													
1894.....	17,769	2,392													
1895.....	24,622	2,119													
1896.....	20,425	1,728						143							
1897.....	52,098	2,039						45							
1898.....	34,065	1,163						74							
1899.....	34,917	4,143						162							
1900.....	38,184	4,793						166							
1901.....	50,500	4,393						21							
1902.....	53,986	4,342		1				179							
1903.....	54,384	1,474		84				164	11	79				18	
1904.....	62,106	1,921		45	8			554		336					
1905.....	50,127	977		122	80	3	23	723	26	91		1	1		
1906.....	60,855	1,306½	233	17	15	2	6	811	11	40	2	12	1		112
1907.....	59,674	1,529		322	12	8	24	263	13	112	1	12			18
1908.....	48,814	2,517½		287	23		21	198	3	93	5	3			
1909.....	46,031	3,252½		145	14		29	61	6	21		5			673
Total.....	810,802	52,507½	233	1,323	152	13	103	3,564	70	772	8	33	2	18	803

The Number of Pounds of Lobster Caught in Rhode Island Waters for the Season of 1909, Compared with 1904, 1905, 1906, 1907, 1908.

Compiled by Wm. T. Luth, Chief Deputy Commissioner.

Fish Markets.	1904.	1905.	1906.	1907.	1908.	1909.
Wholesale						
H. McGinn.....	113,420	147,464	182,462	209,204	174,380	106,507
C. B. Anderson.....	34,074	31,963	63,398	158,427	123,780	121,000
Alex Raftakes.....	.....	.....	.....	71,376	125,586	128,803
J. W. Hammond.....	.....	.....	.....	33,568	101,000	75,000
Union Lobster Co.....	.....	.....	.....	.....	.....	141,395
Retail.						
Saloons and Restaurants.	6,700	45,436	41,850	37,814	51,763	49,444
Burlingame & Carry.....	12,000	8,079	6,480	6,300	7,743	7,645
Tollefsen & Dewitt.....	10,000	15,000	15,100	16,000	18,000	22,163
C. Ash.....	15,000	20,636	11,500	19,200	17,766	20,000
F. W. Wyatt.....	9,000	8,004	7,348	7,000	6,291	6,500
E. C. Smith.....	9,500	10,000	10,135	6,000	4,500	5,000
Easterbrooks.....	5,000	6,525	6,550	6,550	6,500	6,500
Lancaster.....	5,000	.....	.....	.....	.....	.....
F. Lawton.....	6,000	8,000	8,000	8,000	8,000	8,000
J. Z. Lawton.....	.....	.....	.....	.....	5,000	8,999
J. Ring.....	800	550	550	.....	.....	.....
Crowly.....	500	.....	.....	.....	.....	.....
Brightman.....	.....	.....	.....	1,800	4,700	.....
Basilas Caravotes.....	.....	.....	.....	.....	.....	28,000
John Stamas.....	.....	.....	.....	.....	.....	11,681
W. Chase.....	.....	.....	.....	.....	.....	11,200
	226,994	301,659	353,573	581,189	665,009	757,837
Lobsters shipped on commission by fishermen to New York.....						61,763
Wholesale Dealers.						
Cap. J. A. Pettay, Sakonet.....	.....	97,641	163,341	193,243	191,218	191,731
H. C. Wilcox, Tiverton..	.....	.....	.....	.....	286,724	91,107
Block Island, Narragansett Pier, Watch Hill, Point Judith,	150,000	100,000	155,000	155,000		
	377,004	499,300	671,914	929,432		

Wholesale Dealers.	1904.	1905.	1906.	1907.	1908.	1909.
Block Island.....					248,330	236,000
Point Judith, } Watch Hill, }						66,318
Total.....						1,342,993

1909.

LIST OF TRAPS AND OWNERS.

Off-Shore Traps. (See Charts.)

Anderson, C. B.....	West Cormorant Rock.
Anderson, C. B.....	South Sakonnet Light.
Atlantic Trapping Company.....	South Cormorant Rock
Atlantic Trapping Company (00)*.....	South Sakonnet Light.
Atlantic Trapping Company.....	South Narragansett Pier.
Atlantic Trapping Company (00).....	South Seal Rock.
Atlinger, C.....	Breakwater, Point Judith.
Brightman, W (00).....	Seal Ledge.
Brightman, W.....	South Seal Rock.
Brightman, W.....	West Cormorant Rock.
Brownell & Church.....	Coggeshall's Ledge.
Brownell, J.....	Lower Pier.
Brownell, J.....	North Narragansett Pier.
Brownell, J (00).....	South Seal Rock.
Church, J.....	South Ochre Point.
Church, J.....	South Ochre Point.
Church, J.....	Coggeshall's Ledge.
Clarke, F. E.....	West Breakwater, Point Judith.
Cottrell, George (00).....	Seal Rock.
Cottrell, George.....	South Seal Rock.
Cottrell, George.....	South Sakonnet Light.
Cottrell, Church & Luther (00).....	Seal Rock.
Cook, Charles & Co. (00).....	North Sakonnet Light.

NARRAGANSETT BAY.

Showing the Location of Fish Traps for 1909.

PREPARED BY THE

Rhode Island Commission of Inland Fisheries
to accompany Report for 1909.



Cook, Charles & Co.....	West Sakonnet Light.
Easterbrook, C. (00).....	Price's Neck.
Fisk, Jim.....	South Seal Rock.
Fisk, Jim.....	South Sakonnet Light.
Grinnell & Gray.....	West Cormorant Rock.
Hall & Gardiner.....	South Seal Rock.
Hall & Gardiner.....	Easton's Point.
Lockinger, H.....	South Breakwater.
Lockinger, H.....	Sakonnet Light.
Macomber & Nickerson.....	South of Pier.
Macomber & Nickerson (00).....	South Seal Rock.
Macomber & Nickerson (000000000).....	South Sakonnet Light.
Mann, Thos. E.....	West Breakwater, Point Judith.
Petty, J.....	South Cormorant Rock.
Rose, George (00).....	North Sakonnet Light.
Rose, George.....	South Sakonnet Light.
Rose, George.....	Brown's Ledge.
Rose, George.....	West Cormorant Rock.
Susa, G. (000).....	Easton's Point.
Susa, G.....	West Sachuest Point.
Tew Brothers (00).....	West Price's Neck.
Wait, B.....	Breakwater, Sakonnet.
Wilcox, H. C.....	South Cormorant Rock.
Wilcox, H. W.....	South Sakonnet Light.
Wilcox, H. W.....	South Seal Rock.
Wilcox, H. W.....	Easton's Point.
Wilcox, H. W. (00).....	Brown's Ledge.

Other Traps.

Aldrich & Company (00).....	North Point.
Aldrich & Company.....	Below North Point.
Aldrich & Company (00).....	Quonset Point.
Almeta, John.....	North Fogland Point.

Almy, Frank.....	High Hill Point.
Almy, Frank (00).....	South High Point.
Anderson, C. B. (00).....	Coddington Cove.
Avaline, G.....	Coddington Cove.
Baker Brothers.....	West Vial's Creek.
Baker Brothers.....	Conanicut.
Baker Brothers.....	South Wild Goose Point.
Brayton, G.....	Podjac Point.
Brayton, G. (00).....	Pine Hill Point.
Carpenter, G.....	South Ferry.
Coggeshall, Leander.....	Lower west shore Sakonnet.
Coggeshall, Leander.....	South Sandy Point.
Coggeshall, Leander.....	North Sandy Point.
Cook, H.....	Upper East Shore Sakonnet.
Corey, Ed. (000).....	Lower West Shore Sakonnet.
Corey, Ed. (00).....	Wood's Castle.
Corey, George.....	High Hill Point.
Corey & Allen (00).....	South High Hill Point.
Corey & Allen (00).....	Brown's Point.
Corey & Martin (00).....	South High Hill Point.
Corey & Martin (0000).....	North Brown's Point.
Corey & Martin (00).....	North Church's Point.
Cottrell, S.....	West Popasquash Neck.
Cottrell, S.....	West Popasquash Neck.
Cottrell, S.....	West Popasquash Neck.
Cottrell, S.....	West Popasquash Neck.
Cottrell, S. (00).....	Mount Hope Point.
Cottrell, S.....	South Mount Hope Point.
Cottrell, S. (000).....	Upper East Sakonnet River.
Cottrell, W. (00).....	North Tiverton.
Falkner, G.....	South Portsmouth.
Fish, Clinton.....	North Tiverton.
Fish, Clinton.....	North Tiverton.
Fish, Clinton.....	North Tiverton.

Fish, Clinton (000)	McCurry's Point.
Gladding, A. B. (00)	South Castle Hill.
Gray Brothers (000)	East Hope Island.
Gray Brothers	South Hope Island.
Gray Brothers	Conanicut Park.
Gray Brothers (0000)	Prudence Park.
Gray Brothers	Southwest Prudence Island.
Gray, Geo. E. & Co.	South Sandy Point.
Gray, Geo. E. & Co.	North Sandy Point.
Gray, Geo. E. & Co. (000)	South McCurry's Point.
Grinnel, E. (00)	North Pine Hill Point.
Grinnel, E.	Hull's Cove.
Harvey, Chas.	South Coal Mine, west shore Rhode Island.
Hicks, O. G.	Castle Hill South.
Hilliard, John	Buttonwoods.
Howland, J.	Island Park.
James, Arnold	Taylor's Point.
James, Arnold	Jamestown.
James, Arnold	Mackerel Cove.
King, Chas.	Fogland Point.
King & Wait (00)	South McCurry's Point.
King & Wait	South McCurry's Point.
Lake, Benjamin (00)	Fogland Point.
Lake, I.	West Viall's Creek.
Lake, I.	Northwest Conanicut Island.
Lawton, Ed.	Mackerel Cove.
Lawton, Ed.	Mackerel Cove.
Lawton, F.	Mackerel Cove.
Lawton, F.	Mackerel Cove.
Lawton, F. (00)	Brenton's Cove.
Lewis Bros.	Packard's Rock.
Lewis Bros. (000)	Wild Goose Point.
Lewis Bros. (00)	Dutch Island Harbor.
Lewis Bros.	North Dutch Island Harbor.

Lewis Bros.....	Sandy Point.
Lewis Bros.....	South Sandy Point.
Lewis, Wilson (0000).....	North Black Point.
Lewis, Wilson (000).....	North Sandy Point.
Locke, Moses.....	Buttonwoods.
Locke, Moses.....	South Chepiwanoxet.
Locke, Moses (00).....	North Chepiwanoxet.
Macomber, F. A. (00).....	North High Hill Point.
Macomber & Rose.....	North Pine Hill Point.
Madison, P. (00).....	Northwest Hope Island.
Madison, P. (00).....	Northeast Hope Island.
Madison, P. (00).....	Buttonwoods.
Madison, P.....	Buttonwoods.
Manchester & Simmons.....	South Sandy Point.
Manchester & Simmons.....	North Sandy Point.
Manchester, D.....	Quonset Point.
Manchester, D.....	Viall's Creek.
Martin, C.....	High Hill Point.
Matteson, C.....	Fox Hill Point.
Matteson, C.....	Conanicut.
Matchet, H.....	Hope Island.
Mitchell, E.....	North Prudence Park.
Mitchell, E.....	South Podjac Point.
Northup & Co.....	Austin's Hollow.
Northup & Co.....	Austin's Hollow.
Pierce, J.....	South Black Point.
Pierce, J.....	North Sandy Point.
Providence Fish Co.....	Off Wood's Castle.
Ramus Bros. (000).....	Wood's Castle.
Rice, H. H.....	Warwick Neck.
Rice, H. H.....	Warwick Neck.
Rose, Arthur (00).....	Hog Island.
Rose, Geo.....	Church's Cove.
Rose, Geo.....	North Mount Hope Point.
Rose, Geo.....	North Mount Hope Point.

Rose, Geo. (000)	North Sapowet Point.
Rose, Ed.	Upper East Shore, Sakonnet River.
Rose, Ed.	South Stone Bridge.
Rose, Sam	Upper East Shore, Sakonnet River.
Rose, Sam (00)	North Sapowet Point.
Sanford, J.	South High Hill Point.
Seabury, Benjamin	Black Point.
Shepard, J. (00)	North Point Papasquash.
Shepard, J.	Rumstick.
Sherman, Albert	North Sandy Point.
Silvia, P. (00)	Flint Point.
Sisson, Geo	South Greenwich Bay.
Smith Bros.	East Shore, Conanicut
Smith Bros.	East Shore, Conanicut.
Smith Bros.	Southeast Prudence.
Smith, W	West Quonset Point.
Smith, W	Sauga Point.
Smith, W	East Shore, Conanicut.
Snell, A. (00)	South Sapowet Point.
Snell, A.	South Sapowet Point.
Snell & Pierce	South McCurry's Point.
Stafford, J.	North R. R. Bridge, Tiverton.
Taber, Son	North Tiverton.
Tallman & Boyd	North Castle Hill.
Thomas, S.	North Castle Hill.
Tourgee, P.	Austin's Hollow.
Tourgee, P.	South Saunderstown.
White, W.	East North Point Prudence.
Wilcox, H. W.	Church's Cove.
Wilcox, H. W. (00)	High Hill Point.
Wilcox, H. C.	Church's Cove.
Wilkie, A.	South Sapowet Point.
Wilson, L.	Buttonwoods.
Wilson, L.	South Podjac.
Wilson, L. (00)	South Greenwich Bay.

FISH-TRAPS SET IN RHODE ISLAND WATERS, AND LIST OF TRAP OWNERS.

The table giving the number and distribution of the fish-traps for the past eleven years is given below, and continues to show the same steady increase in the number of traps in various locations and as a whole. Especially noticeable is the continued increase in number in the Sakonnet river and off-shore divisions, where the cordon of traps is being extended and covers new territory each year. A glance at the accompanying chart, which shows the location of each trap, shows that the fishermen are continuing to push their traps a surprisingly great distance off shore. The West Passage and East Passage divisions show little change; but in these divisions beam trawling in the late fall and early spring has added materially to the value of the fisheries.

TABLE SHOWING NUMBER AND GENERAL DISTRIBUTION OF FISH-TRAPS SINCE 1898.

The following arbitrary divisions have been made for the sake of convenience:

I. *Providence River*.—South to a line joining Warwick Point and Popasquash Point.

II. *Greenwich Bay*.—South of Providence River division in west passage to a line drawn east and west touching southern part of Hope Island.

III. *West Passage*.—The west passage south of Greenwich Bay region to a line drawn due west from Beaver Tail and west of a line connecting the east end of Greenwich Bay boundary and North Point.

IV. *Mount Hope Bay*.—North of railroad bridge, Tiverton, and a line connecting Bristol Ferry and Mussel Shoal Light.

V. *East Passage*.—South of Providence and Mount Hope Bay divisions and north of a line from Beaver Tail to Breton's Point.

VI. *Sakonnet River*.—The Sakonnet River south of railroad bridge to a line connecting Flint Point and the breakwater.

VII. *Off Shore*.—Traps south of above divisions and not off Block Island.

VIII. *Block Island*.

YEAR.	Providence River.	East Greenwich.	West Passage.	Mount Hope Bay.	Sakonnet River.	East Passage.	Off-Shore.	Block Island.	Total.
1898.....	4	6	26	9	34	15	25	.....	119
1899.....	3	10	23	11	35	15	24	.....	121
1900.....	4	16	24	16	34	12	29	.....	135
1901.....	7	15	24	13	52	14	26	.....	151
1902.....	6	22	27	13	52	14	27	.....	161
1903.....	7	21	32	13	72	16	30	.....	195
1904.....	6	27	33	7	78	14	49	6	220
1905.....	6	26	33	11	82	20	56	6	240
1906.....	6	35	27	11	80	20	64	6	249
1907.....	7	37	30	12	87	22	70	6	271
1908.....	7	38	32	12	87	22	73	.....	271
1909.....	7	31	32	12	88	26	73	8	277

Compiled by E. W. Barnes, A. M.

*The Number of Boats Engaged in Lobster Fishing in the State of Rhode Island,
for 1909.*

Compiled by Wm. T. Luth, Chief Deputy Commissioner.

	BOATS.	POTS.	MEN.
Newport.....	119	11,040	176
Block Island.....	46	6,230	93
Jamestown and Saunderstown.....	14	1,040	18
Cliffs.....	4	88	5
Sakonnet and East River.....	28	2,072	39
Narragansett Pier.....	11	662	14
Warren, Bristol, and Prudence.....	8	318	14
Watch Hill.....	5	550	8
Point Judith.....	13	1,220	14
	248	23,220	381

As a postscript to this report, Deputy Luth reports that no less than 30,000 pounds are retailed from the wharves at Newport, some 5,000 to 6,000 pounds at Narragansett Pier, and about 18,000 pounds at Bristol, Warren, and Tiverton Four Corners, of which no official reports are obtainable. This would add about 53,000 pounds, making the total 139,903. He also remarks that since in 1908, at Block Island, there were only 61 men engaged in lobster fishing as against 93 in 1909, there would seem to be an error in the report of Deputy Willis, in which the catch for 1909 is reported as some 12,000 pounds less than in 1908.

SANDY POINT

BLOCK ISLAND.

Showing the location of Fish Trench for 1959.





THE CONTINUED EXAMINATION OF THE PHYSICAL AND BIOLOGICAL
CONDITIONS OF THE BAY.

Data relating to the character of the shores and sea bottom, the temperature and density of the water, the occurrence of animal and plant life in various places and at various times; facts relating to rare or unusual animals; information about breeding times and habits of fishes and invertebrates, and miscellaneous data of similar character, are continually being gathered and placed on file. From time to time the Commission has brought together portions of these data in the form of special papers. (See index.)

The present report includes the following special papers:

THE FISHES OF RHODE ISLAND.

No. VIII. Annotated List of Fishes Known to Inhabit Rhode Island Waters, by H. C. Tracy.

Notes on the spring and summer fishing in deep water off Newport, during the years 1905-1909, by Supt. E. W. Barnes.

The Plague of Sea Clams at Easton's Beach, by Supt. E. W. Barnes.



ANNOTATED LIST OF FISHES KNOWN TO INHABIT THE WATERS OF RHODE ISLAND.*

BY HENRY C. TRACY, Ph. D.,
Biological Assistant, Wickford Station.

In the year 1898 the Commission of Inland Fisheries began a "systematic examination of the physical and biological conditions of Narragansett Bay." The importance of the study of the fish fauna, as a part of this investigation, is obvious from a practical as well as from a scientific point of view. Development of the fisheries by artificial culture and restrictive legislation depends for its effectiveness on our knowledge of the life history and life conditions of the different species of fishes inhabiting our waters. The results of the investigation of the distribution of the various fishes, times of occurrence, food, diseases, enemies, etc., furnish a body of facts in themselves of great value to the scientist, to the sportsman, and to the man practically interested in the commercial aspect of the fisheries.

Since the biological study of Rhode Island waters was begun, numerous isolated facts regarding the fishes inhabiting them have come into the possession of the Commission. The first systematic contribution to this investigation was the "List of Fishes of Narragansett Bay," by Dr. H. C. Bumpus, which was contained in the Report of the Commissioners of Inland Fisheries for 1900. This was a bare list of fishes, as the title indicates, with no notes or information regarding any of the species included. The Report for 1901 contained a further contribution to this subject, under the title "Additions to the List of Fishes Known to Inhabit Narragansett Bay, with Remarks on Rare Species Recently Caught." Since this time a series of articles dealing

* Previous papers in this series are as follows :

- I. A List of the Fishes of Rhode Island, 36th Report, 1905, page 38.
- II. The Common Fishes of the Herring Family, 36th Report, 1905, page 100.
- III. The Fishes of the Mackerel Family, 37th Report, 1906, page 33.
- IV. A List of Rare Fishes Taken in Rhode Island in the Year 1906, 37th Report, 1906, page 65.
- V. The Flat-fishes, 38th Report, 1907, page 47.
- VI. A Description of two young Specimens of Squeteague (*Cynoscion Regalis*) with Notes on the Rate of their Growth, 38th Report, 1907, page 85.
- VII. The Life History of the Common Eel, 39th Report, 1908, page 43.

with the natural history of the Rhode Island fishes has been published in the annual reports of the Commission. These articles, collectively included under the title "The Fishes of Rhode Island," were written from two different points of view. Four of these were concerned with particular groups of fishes and were intended to state, in as complete a way as possible, the most important facts which have been ascertained regarding their life histories. The other papers of the series were primarily intended to contain such data regarding the fishes of the State as had been secured by the Commission in the course of its examination of the biological conditions of Narragansett Bay.

The most inclusive of these papers was that entitled "A List of the Fishes of Rhode Island," published in the annual report of the Commissioners of Inland Fisheries for the year 1905. This list enumerated systematically those species which had been authentically recorded from the waters of Rhode Island. In it were also included brief statements regarding the geographical distribution, spawning habits, food, rate of growth, etc., of the different species mentioned, as well as many new observations regarding their occurrence and life relations in Rhode Island. This list proved to be quite generally useful for reference purposes, and the limited number of the reprinted copies has now been exhausted. It therefore seems advisable at this time to revise the paper, and bring it up to date by including in it those additions which have in the meantime been made to our knowledge of the fishes of this vicinity. An opportunity is thus given for the publication of numerous observations and data collected by the writer and others connected with the Rhode Island Fish Commission.

In this revision of the list of the fishes of Rhode Island, the natural history notes have been entirely rewritten and much new material added. References have been given to the most important and most accessible papers in which information regarding particular species can be found. Details regarding the geographical distribution of the different species have been added, especially in the cases of those fishes which are particularly rare or whose distribution is of particular interest. The occurrence of such species in the waters

of Massachusetts, southern New England, and Long Island, is of special interest in the study of the fauna of Rhode Island, and therefore notes on the geographical distribution of the different fishes often includes a statement of their occurrence in the waters of neighboring States. The notes on the eggs and young of the different species have been given special attention. All the available literature has been consulted in the attempt to include a brief statement of whatever facts are known regarding the early stages of the different fishes. Information regarding these exceedingly important but as yet comparatively little known phases of the life history of the fishes is scattered through many special papers, and the bibliography of the various species is not readily accessible. It has therefore been thought important to give all the obtainable references to the description of the eggs and young of those species of which the early stages are known.

The new material included in this revised paper consists chiefly of, first, observations relating to the time during which the various species are present on our shores; second, observations relating to the occurrence in our waters of the eggs and young of fishes; and third, data which are of interest with reference to the rate of growth of some of our more common species. Data regarding the period of sojourn of the different fishes on our coast can be determined quite readily by following the trap fishery in the summer and the beam-trawl fishing in the winter. This latter method of fishing has recently become extensively practiced in Narragansett Bay during the winter, and it is now possible to determine more satisfactorily than formerly the nature and abundance of the species present during the coldest part of the year. With reference to this subject, the papers dealing with the fauna of our neighborhood have, probably from necessity, been somewhat vague. There is little doubt that our cold-water fauna is considerably more extensive than one would infer from the statements in the literature on the subject.

For some years past, the Commission has given a considerable amount of attention to the collection of data relating to the rate of growth of fishes. This work is as yet far from complete, yet in the

natural history notes relating to the different species, observations will be recorded which tend to show that most of the smaller shore fishes, such as mummichogs (*Fundulus*), silversides (*Menidia*), anchovies (*Stolephorus*), pipefish (*Siphostoma fuscum*), bill-fish (*Tylosurus marinus*), and cunner (*Tautogolabrus adspersus*), come to maturity on the second season after hatching from the eggs, that is, when they are about a year old. On the other hand many of the larger forms, such as the bluefish (*Pomatomus saltatrix*), scup (*Stenotomus chrysops*), tautog (*Tautoga onitis*), squiteague (*Cynoscion regalis*), butterfish (*Poronotus triacanthus*), the toadfish (*Opsanus tau*), and menhaden (*Brevoortia tyrannus*), probably come to maturity in the third season, that is, when about two years old. This last group of species probably do not attain the average adult size until after three or four years.

The fresh-water species have received greater attention than in the preceding lists. Twenty-four exclusively fresh-water fishes and about fourteen other species which regularly spend a portion of their lives in the fresh water have been reported from the inland waters of Rhode Island. On this basis it would appear that this State is comparatively poor as far as its fresh-water fauna is concerned. It may be recalled in this connection that the physical conditions in Rhode Island are different than those existing in our neighboring States. Rhode Island forms no part of any great river system, neither are there found within her borders many mountain streams and lakes such as exist in New England further to the north. Hence our fresh water species are mostly those which belong to the fauna of lowland streams and ponds. Nevertheless the poverty in fresh-water species which is suggested by this list is more apparent than real, since our knowledge of the fish life of our ponds and streams is very inadequate. There is little doubt that a systematic investigation of these waters would yield many species not previously reported from this vicinity.

It is perhaps needless to say that a discussion of the fishes of Rhode Island must of necessity take into consideration the conditions existing in the offshore waters of the south of our State. It is

impossible to adequately understand the life history of many of our important food fishes, most of which are pelagic and migratory in their habits during a considerable portion of their existence, unless the fish fauna of the open water is included in our investigation. Furthermore, the offshore fisheries between Newport and Sakonnet, and those of Block Island, are of great importance to the citizens of Rhode Island; and the rich variety of rare species already known to have been taken in those waters is of great scientific interest. For these reasons this list takes account of every species of fish which has been known to be present in the waters of Rhode Island, using that term broadly to include, besides Narragansett Bay and the fresh-water streams of the State, the open waters of the ocean bordering on the southern shores of the State and of Block Island.

In these open waters is found a fauna of remarkable richness and variety. Cape Cod forms a general boundary between the Arctic fauna of the north Atlantic coast and the temperate fauna which extends south to Cape Hatteras. Therefore, many species belonging to each of these regions are normally present in greater or less abundance in the marine waters of our State. The edge of the Gulf Stream, also, is scarcely over a hundred and fifty miles from our coast, and hence each year in the summer and early autumn a great number of tropical species are brought to our shores from regions far to the south. It is a characteristic feature of this element in our fauna that many of the species constituting it are represented in our waters solely or chiefly by their young. The explanation of this probably lies in the fact that the eggs and pelagic young of such fishes as spawn in the open water of the tropics drift passively northward in the current of the Gulf Stream. The adults, however, on account of their better developed swimming powers, are less likely to be carried far from their natural habitat.

In the appendix to this list of fishes are given the names of certain species which will serve to illustrate how the fauna of our waters is enriched by contributions from the tropics. These species were taken by the United States Fish Commission while investigating the extent

of the tile-fish grounds. These grounds include an area between 69° and 73° west longitude and between 40° and $40^{\circ} 20'$ north latitude, and are situated on the edge of the Gulf Stream, directly to the south of the Rhode Island coast. These fishes are mostly surface forms whose native waters are in the tropics. That such fishes form a large part of the fish fauna of the Gulf Stream helps to explain the occurrence of so great a number of tropical species in our coast waters.

Still another and quite a different source contributes to our varied fauna. Our shores are relatively near the outer edge of the great continental shelf where it begins to slope off into the vast abyss of the ocean. This region is the home of a remarkable and extensive fauna from which stray individual sometimes reach our shores. These fishes form a small but scientifically interesting element of the marine life of the waters of Rhode Island.

So many factors contribute to the fauna of our offshore waters that it is not surprising that a very large number of marine fishes have been reported from Rhode Island. Of the 199 species enumerated in this list, 175 are salt-water fishes. About 70 of these may be considered as rare. This latter number, however, is by no means final and will doubtless be increased in the future as the result of the capture of strays from the tropical and deep-water regions. Comparison with similar lists from other States shows that from Long Island 217 marine species are reported (Bean, 1903), and from Woods Hole, 233 species (Smith, 1900). The marine fauna of Woods Hole and vicinity has of course been much more thoroughly investigated than that of our State or that of Long Island. There are thus something over 40 species which have been taken in neighboring waters but which have not been reported from Rhode Island. On the other hand this State reports ten species not taken at either Woods Hole or Long Island; one species in this list is found at Long Island but has been not taken at Woods Hole; three species reported from this State are found at Woods Hole and vicinity but are not recorded from Long Island. It is evident from these figures that there are known from the southern shores of New England and from Long Island somewhat over a

hundred species of fishes which, strictly speaking, do not belong to the fauna of this region at all, but which are accidental strays or, at most, irregular visitors to our coasts. The normal habitat of such species is to be found either in the tropics or in the cold waters north of Cape Cod, or in the great depths of the Atlantic. Yet their presence here is of interest and is worthy of record, since it throws light on the distribution and migration of the species in question and also upon certain physical and biological factors which normally influence the conditions in our own waters.

In the introduction to the previous list of fishes (1905), suggestions were made regarding the different lines of work which were to be followed in the future. Of these there are two which seem again to justify particular mention.

On account of the unusual geographical relations of the coast line of the State of Rhode Island and the islands contained within its jurisdiction, the sea fisheries of the State are carried on in waters which represent an extraordinary variety of physical and biological conditions. The quiet, shallow waters of the Providence River, which seldom contains any species except those most typical of our fauna, show a great contrast in conditions from those existing in the deep water off the exposed shores of Block Island. The waters between these extremes present almost every possible combination of shore, current, and bottom. In all these different regions exists a more or less highly developed commercial fishery. Reference to the list of fish-traps and their locations, contained in this report, shows that about 275 traps are in operation in Rhode Island waters, and that they are scattered all the way from Point Judith to Providence River, from Providence River to Newport, out in the open water from Brenton's Reef to Sakonnet Point, up and down the Sakonnet River, and off the shore of Block Island. The immense floating traps off Newport and Sakonnet are particularly adapted for the capture of the pelagic species. The great variety of conditions under which the fish of the State are found, when considered in connection with the varied marine fauna of these waters, furnishes a field, as yet far from

exhausted, for the systematic investigations of such questions as the factors influencing the local distribution of fishes and their time of arrival and departure, the influence of fishing in the abundance of fishes, their rate of growth, spawning and many other similar problems.

Other methods of fishing which often yield interesting scientific data are the fyke nets in the early spring and the seine fishery for menhaden. The oyster dredge also often secures specimens of such bottom species as toadfish, flatfishes, blennies, sculpins, lump-fishes, etc. Another important source of information is furnished by the recent considerable development of the winter trawl fishing in Narragansett Bay. By following this fishing systematically, our present knowledge would be much enriched, particularly with regard to the bottom forms and the fish life of our waters during the winter.

The study of the fauna of Block Island would be a subject of unique interest. A small amount of information regarding the fresh-water fishes of the island has been secured. Further investigation of the fresh-water fauna would not only be of interest in itself, but might furnish an important contribution to general biological theory. The marine life of its shores also has a peculiar interest. Block Island is located so near the boundaries between the northern and southern division of the Atlantic coast fauna, and so near deep water, that it undoubtedly has a fauna of great richness and variety. There is every reason to suppose that it is as favorably situated in these respects as Woods Hole. Fishermen say that frequently in these off-shore waters they take fish which are new to them, and that they see even whole schools of unfamiliar species. It is to be hoped that a thorough study of the biological conditions of the whole island may sometime be undertaken.

In addition to these questions of more or less local interest, there are two general lines of investigation which the writer believes to be fundamental to any very extensive advance toward the solution of unsolved problems connected with the fisheries. An ultimate factor in the life history of all organisms is its food supply. The final

source of the food of marine fishes is the microscopic life of the sea, and therefore a thorough knowledge of the marine plankton, both from a qualitative and quantitative point of view, and the factors which influence its abundance and distribution, would unquestionably afford a basis for substantial progress in our knowledge of the life history of the fishes. Much has already been done in this line, but so far as it concerns our marine fishes, our effective knowledge of the plankton is but in its infancy.

Another investigation which would be very fruitful of results in comparison with the time and energy necessary for its prosecution, is a thorough study of the eggs and young of the fishes. Various European fishery organizations (Board of Fisheries of Scotland, Marine Biological Association of the United Kingdom, Conseil permanent international pour l'exploration de la mer; Commission zur wissenschaftlichen Untersuchung der deutschen Meere) have carried on this sort of investigation very successfully, but owing to the comparative neglect of this important subject by American investigators, a large amount of work still remains to be done in the description and identification of the eggs and larvæ of different species of our marine fishes. Such work is a necessary preliminary to a study of the distribution and abundance of the eggs and larvæ of fishes, and of the physical and biological conditions influencing them. The eggs of many of the more common species have been seen by various observers and certain isolated statements regarding them exist in the literature. Few of these eggs, however, have been figured and fewer still have been studied with any completeness with reference to the identification of the eggs of different species during the successive stages of development. Similar statements might be made regarding our knowledge of the larval and young stages of the fishes.

The greatest contribution to such knowledge as we possess of the early stages of our fishes has been made by various European workers. Our knowledge is fairly complete regarding those forms like the herring, mackerel, cod, etc., which are common to both shores. Of American investigators of this subject, J. A. Ryder has made the

largest and most important contribution. His work was not only extensive, but accurate, and has well endured the test of time. The same, however, cannot be said of the other important contributor to this work. Alexander Agassiz (1878-79, 1882), has written three papers describing the young stages of certain teleosts, and A. Agassiz and C. O. Whitman (1885) contributed another extensive paper on the same subject. In these papers certain early stages of about twenty species were figured and described, together with several unidentified eggs and larvæ. Unfortunately, however, the work of various later investigators has shown in several cases their identification of the eggs and larvæ was either quite erroneous or at least questionable. The following criticisms have come to the notice of the writer.

Osmerus mordax.

A. Agassiz (1882) hat "Entwicklungsformen von *Osm. mordax* beschrieben, die aus planktonischen Eiern stammen sollen; die jüngsten aus solchen Eiern gezüchteten Larven sind aber bestimmt nicht *Osmerus*, sondern anscheinend *Clupea spec.*; über die als *O. mordax* bezeichneten älteren Stadien, welche Agassiz abbildet, lässt sich nichts Sicheres sagen." (Ehrenbaum, Nordisches Plankton, X, 1909, 343).

Roccus lineatus.

Ryder discusses at some length the young which Agassiz (1882) identified as belonging to this species. "These differences lead me to think that the larval fishes figured by Mr. Agassiz as pertaining to the species here under consideration must belong to another form, as none of his figures can be reconciled with those taken from larvæ of the striped bass, the parentage of which is undoubted. In this opinion I am most conclusively confirmed by a drawing which has fallen into my hands by the late Professor Henry J. Rice." (Ryder, Report U. S. Fish Commission, XIII, 1885, 503.) Ehrenbaum says, "Man darf daher mit Ryder annehmen, dass die zahlreichen Abbil-

dungen, welche Agassiz von Larven und Jungfischen des *Labrax lineatus* gibt mehr oder weniger ausnahmslos einer anderen Fischart zuzurechnen sind. Selbst die Larven der zwar verwandten aber doch schon stärker abweichenden *Morone americana* welche aus sehr kleinen, im Süßwasser am Grunde klebenden Eiern stammen, zeigen gewisse allgemeine Charakterzüge der *Roccus*-Larven deutlicher als die von Agassiz abgebildeten Formen." (Ehrenbaum, op. cit. IV, 1905, 17.)

Myoxocephalus groenlandicus and *Hemitripteris americanus*.

"Professor Alex. Agassiz (1885) records the ova of certain American Cottid as pelagic, a feature very different from those of our country and probably requiring re-investigation." (McIntosh, Report, Fishery Board for Scotland, 14, 1895, 181).

"Im Widerspruch hiermit [that the species of this family lay demersal eggs] steht der Umstand, dass Agassiz und Whitman sowohl für *Cottus groenlandicus* wie für *Hemitripteris americanus* planktonische Eier und dazu gehörige Larven gefunden und beschrieben haben. Dass die genannten Autoren sich im Falle des *C. groenlandicus* geirrt haben, unterliegt schon längst keinem Zweifel mehr; es ist aber auch wahrscheinlich, dass die als *Hemitripteris* beschriebenen Eier und Larven von irgend einem anderen Fische herkommen, der nicht zur Cottiden-Familie gehört." (Ehrenbaum, T, c., 53).

Agassiz and Whitman say that the eggs of the first of these species are found in July, and the eggs of *H. americanus* are taken throughout the summer months. But it is now known that both these species spawn in the winter.

Opanus tau.

"Ryder hat einige Embryonalstadien abgebildet (Bull. U. S. Fish Com. vol. VI., 1886, 4-8.) welche die jungen Larven auch nach dem Platzen der Eihaut als festsitzende Tiere zeigen, selbst noch in einer Grösse von 8 mm. Dagegen hat A. Agassiz, (1882), eine hierher gehö-

rige 8 mm. lange Larve abgebildet, welche schon den Dotterrest verloren hat und offenbar planktonisch gefischt wurde, obwohl sie gegen die älteste Ryder'sche Larve in der Entwicklung der Flossen zurücksteht." (Ehrenhanm, T. c., 45.)

Compare also Ryder (loc. cit.), who shows a figure of a specimen $\frac{1}{2}$ -inch long with the yolk sac still fixed to its attachment. The larvæ of this species, according to my own observations, do not become released from their attachment and become free-swimming until about 15 or 16 mm. in length. At Beaufort, N. C., Gudger found that at hatching the young toadfish are from 16 to 19 mm. long.

Motella argentea.

"Es sei erwähnt, dass auch Agassiz (1882) 2 Jugendformen einer amerikanischen Phycis-Art abgebildet und als *Motella argentea* beschrieben hat." (Ehrenbaum, op. cit. X., 1909, 276).

Pomatomus saltatrix.

With regard to this species, Agassiz and Whitman say that the eggs are found from the middle of June to the middle of August. Statements of other observers, however, seem to indicate that the bluefish spawns earlier in the season, probably in the spring, before it arrives on our shores. Smith says that at Woods Hole a few bluefish have ripe spawn in them when they begin to arrive in May and June, although roes have been found in bluefish at Nantucket as late as July 15th.

Young specimens from one to two inches long are common in Narragansett Bay in June, and young three to five inches long are abundant along the whole coast in July and August. These facts show that the identification of the eggs and young described by Agassiz and Whitman as belonging to the bluefish is questionable and requires corroboration.

Tautogolabrus adspersus.

The stages of the young of this species are described at length by Agassiz (1882). The eggs and young of this species and those of *Tautoga onitis* resemble each other very closely, and the present writer believes that Agassiz has confused the young of these two species, and that several of the specimens described as belonging to *T. adspersus* are really young tautog. The evidence for this belief the writer hopes to publish soon in a paper based upon his observations made at the Wickford Experiment Station, where every year the eggs and young of the two species in question occur in considerable numbers in the lobster rearing pens.

Pseudorhombus oblongus.

Much confusion exists in the synonymy of the three species of *Paralichthys* found in this vicinity, but according to Jordan and Evermann (1898, p. 2630), *Pseudorhombus oblongus* (Günther) is to be identified with *Paralichthys lethostigmus* (Jordan and Gilbert.) This species, however, is a southern form and not reported north of New York, and therefore that its eggs should be taken in the neighborhood of Newport is improbable. But this fish closely resembles the common summer flounder of Rhode Island waters, and Agassiz and Whitman may have intended his description to apply to the young of *Paralichthys dentatus*. The difficulty of deciding just which species the author had in mind is further increased by a confused arrangement of the descriptive matter in the text and a discrepancy in the labeling of the plates. But whatever the species intended, it is doubtful that these eggs belong to *P. dentatus*. They are described as having no oil globule; if they really belong to any species of *Paralichthys* they furnish an exception to the general rule stated by Cunningham (1896), that the eggs of most left-sided species of flat-fishes have a single oil globule. Furthermore, it is not known that *P. dentatus* spawns in inshore waters. I have been able to find in the literature no references to the eggs and young of this species, and

except for certain unauthenticated statements by fishermen, I know of no evidence that ripe specimens of this fish have ever been taken. Yet this species is very abundant on the southern coast of New England from May to October, and therefore the almost absolute lack of observations bearing on its breeding habits is good reason for believing that it does not spawn in our waters during the summer months. With regard to this subject, Rathbun says:—"Nothing is positively known regarding the breeding habits of this species except that it does not spawn in the shallow water near the shore." (Report, U. S. Fish Com., XVII, 1889, 161.)

Pseudopleuronectes americanus.

Agassiz and Whitman (1885) state that the eggs of this species are found at Newport in May and June, but are most common in July and August. They are described as closely resembling the eggs of the cunner (*Tautoglabrus adspersus*) and not easily distinguishable from them. These statements, however, are quite erroneous, since it has long been known that this species spawns in February, March, and April, and that the eggs are demersal (Rathburn, loc. cit.). The error of Agassiz and Whitman in the identification of these eggs has already been pointed out by Cunningham (Jour. Mar. Biol. Ass., III, 1893-95, 244).

Plagusia.

In discussing the young attributed to this genus, Agassiz (1878-79) says: "What eventually becomes of this species I am not able to say and it is not improbable that this species is identical with that described by Steentrup, and it may also be the young of the *Plagusia* found on the Atlantic coast of the southern States." Nevertheless, one may well be excused for doubting the probability that the eggs of a species not reported north of Cape Hatteras should be taken at Newport. Apropos of these specimens, Cunningham has said:—"Agassiz described transition stages, quite similar to those of Steen-

strup, captured at the mouth of Newport Harbor, and ascribed them likewise to the genus *Plagusia*. Emery, the Italian ichthyologist, has pointed out that these specimens of Steenstrup and Agassiz certainly do not belong to the genus *Plagusia*, because in the latter the dorsal and postanal fins are continuous with the caudal, and in these specimens they are quite distinct and separate. Without discussing the question at length, or carefully examining the evidence, Emery suggests that the North Atlantic specimens belong to the genus *Rhomboidichthys*." (Jour. Mar. Biol. Ass. II, 1891-92, 328.) This latter suggestion has a certain degree of probability, since *Platophrys ocellatus*, although most abundant in the tropics, has been taken as far north as Long Island (by Bean, in 1890). Also Jordan and Evermann (1898, p. 2661) examined some small transparent flounders from the Gulf Stream which they considered as possibly the young of the *P. ocellatus*.

The material used in the preparation of the following list of fishes has been derived from the following sources:

1. The "List of Fishes in Narragansett Bay," by Dr. H. C. Bumpus, referred to above.
2. Data gradually acquired by the Rhode Island Fish Commission in years past.
3. Data furnished by Mr. E. W. Barnes, of Wickford, R. I., Superintendent of the Experiment Station. The data secured by Mr. Barnes refers more particularly to the food fishes.
4. Statements regarding time of occurrence, abundance, etc., of various fishes, made by fishermen and others practically interested. I am under special obligations to the Lewis Brothers, of Wickford, for information of this kind and for other favors, for which I here make acknowledgment.
5. Collections made at various times in the past, particularly by the late Prof. J. W. P. Jenks, and by Mr. J. M. K. Southwick, of Newport, Vice-President of the Commission.

6. Collections and personal observations made by the writer, during the years 1905 to 1909. The fish-traps and beam trawls furnish a nearly inexhaustable source of data regarding many important aspects of the life history of the different species. The seine has also been much used in securing the young of many fishes and the smaller shore fishes.

I should add, further, that in several cases references of the isolated occurrences of certain rare species in Rhode Island waters have been found in various works on ichthyology or in special papers. I have made use of these sources also, as a matter of record, giving the proper reference under each particular species.

The material for the notes on the food of the various species, in addition to data obtained by personal observation, has been taken from a variety of sources. The observations on the stomach contents of fishes made by Dr. Edwin Linton (1899, 1904) have been largely used. Other information regarding the food of fishes, particularly of the fresh-water fishes, has been obtained from various papers, chiefly those by Kendall, and by Kendall and Goldsborough.

The notes on the natural history of the different species have been taken from many sources. The greatest proportion has been taken from papers in the various publications of the United States Bureau of Fisheries, from special papers by Theodore Gill and others, and from monographs and reports of various Commissions and Boards of Fisheries.

The more important of the papers which contain information regarding particular fishes mentioned in the list are referred to in the notes on the different species. Below is given a list of other more general papers which give important data regarding various phases of the natural history of the fishes of our waters. This list does not exhaust the bibliography of the subject, but aims to include the most important and accessible papers in English. A few important German references have also been added.

GENERAL REFERENCES, PERIODICALS, ETC.

American Naturalist, Ichthyology notes and Reviews in the, by D. S. Jordan.
Canadian Biology, Further Contributions to; 39th Annual Report of the Department of Marine and Fisheries, Fisheries Branch, 1902-1905.

- Conseil permanent international pour l'exploration de la mer. Bulletin des résultats acquis pendant les courses periodiques publié par le Bureau du Conseil, Copenhague.
- Commission zur wissenschaftlichen Untersuchung der deutschen Meere in Kelu. der Biologischen Anstalt auf Helgoland, Wissenschaftliche Meeresuntersuchungen.
- Illinois State Laboratory of Natural History; Bulletins.
- Marine Biological Association of the United Kingdom; Journal, Vol. I, 1887-88, N. S., Vol. I to VIII, 1889-90 to 1907-1909.
- Marine Biological Association of the United Kingdom, List of Publications recording the Results of Researches from 1886-1907; Jour. Mar. Bio. Ass., Plymouth, VIII, 1908, 241.
- New York Public Library, Fish Bibliography; Bull. N. Y. Pub. Lib. III, 1899, 296.
- New York Forest, Fish, and Game Commission; Annual Reports.
- Academy of Sciences, Philadelphia; Proceedings 1841-1909. Vol. I to LXI.
- Rhode Island Fish Commission; Annual Reports, Vol. 28-39. General Index, Vol. 40, 1909.
- Fishery Board for Scotland; Annual Reports, Vol. I to XXIX.
- Smithsonian Institution; Annual Reports, 1846-1908.
- Smithsonian Institution; Miscellaneous Collections, Vol. I to 49, 1862-1907.
- Smithsonian Institution; Proc. U. S. Nat. Mus. Vol. 1 to 35, 1878-1904.
- United States Fish Commission; Annual Reports, Vol. I-XXIX, 1871-1903.
- United States Bureau of Fisheries; Annual Report of the Commissioner of Fisheries to the Secretary of Commerce and Labor, Vol. XXX, 1904.
- United States Fish Commission; Bulletins, Vol. I to XXIII, 1881-1903.
- United States Bureau of Fisheries; Bulletin, Vol. XXIV to XXVIII, 1904-1908.
- United States Fish Commission, Publications of the U. S. Fish Commission, Descriptive List of; Report, U. S. Fish Commission, VII, 1879, 781.

SPECIAL PAPERS.

- 1870: ABBOTT, C. C. Notes of Fresh-Water Fishes of New Jersey; Amer. Nat. IV, 99.
- 1874: ABBOTT, C. C. Notes on the Cyprinoids of Central New Jersey; Amer. Nat. VIII, 326.
- 1877: ABBOTT, C. C. Traces of a Voice in Fishes [Fresh-Water fishes]; Amer. Nat. XI, 147.
- 1878: AGASSIZ, A. On the Young Stages of Bony Fishes; Proc. Amer. Acad. XIV, 1878-79, 1.

- 1881: AGASSIZ, A. On the Young Stages of some Osseous Fishes; Proc. Amer. Acad, XVII, 1881-82, 271.
- 1885: AGASSIZ, A. and WHITMAN, C. O. The development of Osseous Fishes; Memoirs of the Museum of Comp. Zool. XIV, pt. 1.
- 1843: AYRES, W. O. Enumeration of the Fishes from Brookhaven, Long Island; Boston Jour. Nat. Hist. IV, 1844, 255.
- 1854: BAIRD, S. F. Fishes observed on the Coasts of New Jersey and Long Island, during the summer of 1854; Report Smithson. Inst. IX, 317.
- 1871: BAIRD, S. F. Natural History of the Food Fishes of Southern New England; Report, U. S. Fish Comm, I, 228.
- 1873: BAIRD, S. F. The Diminution of Food Fishes; Amer. Nat. VII, 423.
- 1891: BEAN, B. A. Fishes Collected by W. P. Seal in Chesapeake Bay at Cape Charles City, Virginia, from September 16 to October 3, 1890; Proc. U. S. Nat. Mus. XIV, 83.
- 1890: BEAN, T. H. Observations upon Fishes and Fish Culture; Bull. U. S. Fish Commission, Vol. X, 49.
- 1893: BEAN, T. H. The Fishes of Pennsylvania; Harrisburg, 1893.
- 1901: BEAN, T. H. Catalogue of the Fishes of Long Island; Report, Forest, Fish and Game Commission of New York, Vol. VI, p. 373.
- 1903: BEAN, T. H. Catalogue of the Fishes of New York; Bull. New York State Museum, 60, Zool. 9, 1903.
- 1870: BLAKE, J. H. Habits and Migrations of some Marine Fishes of Massachusetts; Amer. Nat. IV, 1870, 513.
- 1896: BRICE, J. J. Fishes found at Key West; Report, U. S. Fish Commission, XXII, 1896, 281.
- 1897: BRICE, J. J. Manual of Fish Culture; Report, U. S. Fish Commission, XXIII, 1.
- 1904: BRIDGE, T. W., and BOULENGER, G. A. Fishes, etc.; Cambridge Natural History, Vol. VII.
- 1894: BROOKS, W. K. The Origin of the Food of Marine Animals; Bull. U. S. Fish Commission, XIV, 87.
- 1908: BULLEN, G. E. Plankton Studies in Relation to the Western Mackerel Fishery; Jour. Mar. Biol. Ass., VIII, 1907-09, 269.
- 1898: BUMPUS, H. C. The Breeding of Animals at Woods Hole during the Month of March, 1898; Science, N. S. VII, 485.
- 1898: BUMPUS, H. C. The Breeding of Animals at Woods Hole during the Month of May, 1898; Science, N. S., VIII., 58.
- 1907: CORNISH, T. A. Notes on the Fishes of Canso; Further Contributions to Canadian Biology, 1902-1905. Report, Dept. Marine and Fisheries, 39, 1907, 81.

- 1896: CUNNINGHAM, J. T. Marketable Marine Fishes.
- 1891: CUNNINGHAM, J. T. On the Rate of Growth of Some Sea Fishes; Jour. M. B. L. Ass., Plymouth, II, 1891-92, 221.
- 1889: CUNNINGHAM, J. T. Reproduction and Development of Teleostean Fishes in the Neighborhood of Plymouth; Jour. M. B. L. Ass., Plymouth. 1. 1889-90, 10.
- 1887: CUNNINGHAM, J. T. Eggs and Larvæ of Teleosts; Trans. Roy. Soc. Edinburgh. Vol. 33, 97.
- 1895: DEAN, BASHFORD. Fishes, Living and Fossil.
- 1842: DEKAY, J. E. The Fauna of New York; Fishes, Part IV.
- 1905: EHRENBAUM, E. Eies und Larven von Fischen; Nordisches Plankton, 1909: 4te Lieferung 1T. 1905; 10te Lieferung 2T. 1909.
- 1901: EVERMANN, B. W. Bait Minnows; Report, Forest, Fish, and Game Commission of New York. Vol. VI, 307.
- 1896: EVERMANN, B. W., and BEAN, B. A. Indian River and its Fishes; Report, U. S. Fish Commission, XXII, 227.
- 1894: EVERMANN, B. W., and KENDALL, W. C. An Annotated List of the Fishes Known from the State of Vermont; Report, U. S. Fish Commission, XX, 579.
- 1903: FORBES, S. A. The Food of Fishes; Bull. State Lab. Nat. Hist., Ill., Vol. I, No. 3, p. 1.
- 1903: FORBES, S. A. On the Food of Young Fishes; T. C., p. 71.
- 1908: FORBES, S. A., and RICHARDSON, R. E. The Fishes of Illinois, State Laboratory of the Natural History of Illinois.
- 1889: FULTON, T. W. Biological Investigation of the Fishery Board of Scotland; Jour. M. B. L. Ass., Plymouth, I, 79.
- 1900: GARMAN, S. Deep Sea Fishes; Reviewed in Amer. Nat. Vol. 34, 663.
- 1871: GILL, THEODORE. Bibliography of East Coast Fishes; Report, U. S. Fish Commission, 1871-72, 815.
- 1874: GILL, THEODORE. Bibliography, 1738-1870, Synopsis of the Great Standard Works of Descriptive Ichthyology; Smithsonian Misc. Coll. XI, 247, 27.
- 1904: GILL, THEODORE. Flying Fishes and their Habits; Report Smithsonian Inst. 1904, 495.
- 1904: GILL, THEODORE. State Ichthyology of Massachusetts. Report, U. S. Bureau of Fisheries, 1904, 165. Science, XX, 1904, 321.
- 1905: GILL, THEODORE, Parental Care among the Fresh-Water Fishes; Smithsonian Report, Vol. 403.
- 1907: GILL, THEODORE. The Family of Cyprinids; Smithsonian, Misc. Coll. 48, 195.

- 1907: GILL, THEODORE. Life Histories of the Toadfishes, etc.; *Smithson. Misc. Coll.* Vol. 48, 388.
- 1907: GILL, THEODORE. Some Noteworthy Extra-European Cyprinoids; *Smithson. Misc. Coll.*, Vol. 48, 297.
- 1884: GOODE, G. B. The Natural History of Aquatic Animals; The Fisheries and Fishery Industries of the United States, Section 1, 1884.
- 1903: GOODE, G. B. American Fishes; New Edition, edited by T. Gill.
- 1895: GOODE, G. B., and BEAN, T. H. Oceanic Ichthyology; *Smithsonian Contributions to Knowledge*. No. 981.
- 1880: GÜNTHER, ALBERT. An Introduction to the Study of Fishes.
- 1880: GÜNTHER, ALBERT. Report on the Shore Fishes Collected by H. M. S. *Challenger* during the years 1873-1876; *Challenger Reports*, Pt. VI, Zoology I.
- 1887: GÜNTHER, ALBERT. Report on the Deep Sea Fishes collected by H. M. S. *Challenger* during the years 1873-1876; *Challenger Reports*, Pt. LVII, Zoology XXII.
- 1889: GÜNTHER, ALBERT. Report on the Pelagic Fishes collected by H. M. S. *Challenger* during the years 1873-1876; *Challenger Reports*, Part LXXVIII, Zoology, XXXI.
- 1902: GURLEY, R. R. The Habits of Fishes; *Amer. Jour. Psychol.* XIII, 408, Reviewed in *Amer. Nat.* Vol. 37, 72.
- 1889: HENSHALL, J. A. Report upon a Collection of Fishes made in Southern Florida during 1889; *Bull. U. S. Fish Commission*, IX, 371.
- 1894: HENSHALL, J. A. Notes on Fishes Collected in Florida in 1892; *Bull. U. S. Fish Commission*, XIV, 209.
- 1860: HOLBROOKE, J. E. Ichthyology of South Carolina.
- 1893: HOLT, E. W. L. On the Eggs and Larval and Post-Larval Stage of Teleosteans; *Scientific Transactions, Roy. Soc. of Dublin*. 2. s, Vol. V, 1.
- 1897: HOLT, E. W. L. Reproduction of Teleostean Fishes; *Jour. M. B. L. Ass.*, Plymouth, V, 1897-99, 107.
- 1865: HOLMES, E. On the Fishes of Maine; Report, Maine Board of Agriculture, Vol. 10, 1865, and Reports of the Commission on Fisheries to the Forty-Seventh Legislature of the State of Maine, Jan. 16, 1868.
- 1904: JOHNSTONE, J. Some Results of the International Fishery Investigations; *Jour. M. B. L. Ass.*, Plymouth, VII, 1904-06, 437.
- 1877: JORDAN, D. S. On the Distribution of Fresh-Water Fishes; *Amer. Nat.* XI, 607.
- 1888: JORDAN, D. S. Exploration Made in the Alleghany Region; *Bull. U. S. Fish Com.*, VIII, 97
- 1905: JORDAN, D. S. Guide to the Study of Fishes, 2 vols.

- 1907: JORDAN, D. S. Fishes; American Nature Series, New York.
- 1896: JORDAN, D. S., and EVERMANN, B. W. The Fishes of North and Middle America; Bull. U. S. Nat. Mus., No. 47.
- 1902: JORDAN, D. S., and EVERMANN, B. W. American Food and Game Fishes.
- 1894: KENDALL, W. C. Notes on the Fresh-water Fishes of Washington Co., Maine, Bull., U. S. Fish Com. XIV, 43.
- 1896: KENDALL, W. C. Notes on the Food of Four Species of the Cod Family; Report, U. S. Fish. Com. XXII, 177.
- 1902: KENDALL, W. C. Notes on Some Fresh-Water Fishes from Maine; Bull. U. S. Fish Commission, XXII, 353.
- 1908: KENDALL, W. C. List of the Pisces of New England; Occasional Papers of the Boston Society of Natural History, VII.
- 1908: KENDALL, W. C., and GOLDSBOROUGH, E. L. Fishes of the Connecticut Lakes and Neighboring Waters, with Notes on the Plankton Environment; U. S. Bureau of Fisheries Document, 633.
- 1882: KINGSLEY, J. S., and CONN, H. W. Observations on the Embryology of the Teleosts; Memoirs of the Boston Society of Natural History, III, 1882.
- 1844: LINSLEY, J. H. Catalogue of the Fishes of Connecticut; Amer. Jour. Sci. and Arts. Vol. 47, 1844, 71.
- 1899: LINTON, EDWIN. Parasites of the Fishes of the Woods Hole Region; Bull. U. S. Fish Commission, XIX, 405.
- 1899: LINTON, EDWIN. Fish Parasites Collected at Woods Hole in 1898; Bull. U. S. Fish Com., XIX, 267.
- 1904: LINTON, EDWIN. Parasites of Fishes of Beaufort, N. C.; Bull. U. S. Fish Commission, XXIV, 321.
- 1872: LYMAN, T. Fishes taken in the Waquoit Wier, April 18 to June 18, 1871; Report, Commissioners of Massachusetts Inland Fisheries, Vol. 6, 1872.
- 1904: MARSHALL, W. S., and GILBERT, N. C. Notes of the Food and Parasites of Some Fresh-Water Fishes from the Lakes at Madison, Wisconsin; U. S. Bureau of Fisheries, 513.
- 1895: MASTERMAN, A. T. On the Rate of Growth of Food Fishes; Report, Fishery Board of Scotland, XIV, 294.
- 1897: MCINTOSH, W. C., and MASTERMAN, A. T. The Life Histories of the British Marine Food Fishes.
- 1890: MCINTOSH, W. C., and PRINCE E. Life Histories of Food Fishes; Trans. Roy. Soc. Edinburgh, XXXV, Part II.
- 1896: MCINTOSH, W. C. Contributions to the Life History and Development of the Food and Other Fishes; Report, Fishing Board of Scotland, Vol. 14, 171.

- 1908: MEAD, A. D. A Method of Fish Culture and of Transporting Live Fishes. Prize Paper 4th International Fishery Congress, Washington, 1908; Reprinted in Report, R. I. Fish Comm., 39, 1908, 79.
- 1815: MITCHILL, S. L. The Fishes of New York; Trans. Litt. Phil. Soc. New York, I, 1815.
- 1817: MITCHILL, S. L. Memoir on Ichthyology. Supplement to the Preceding paper; Amer. Monthly Mag. and Crit. Rev. II, 1817-1818, 241.
- 1892: MOORE, H. F. List of Fishes collected at Sea Isle City, New Jersey, during the summer of 1892; Bull. U. S. Fish Commission, XII, 357.
- 1868: NORRIS, T. American Fish Culture, Philadelphia, 1868.
- 1895: PECK, J. I. The Sources of Marine Food; Bull. U. S. Fish Comm. XV, 1895, 351.
- 1907: PRINCE, E. E. The Eggs and Early Life History of the Clupeoids. Further Contributions to Canadian Biology. 1903-1905; Report, Dept. Marine and Fisheries, Vol. 39, 1907, 95.
- 1889: RATHBUN, R. Special Observations and Experiments; Report, U. S. Fish Commission, XVII, 1899-91, 155.
- 1882: RYDER, J. A. A Contribution to the Embryography of the Osseous Fishes; Report, U. S. Fish Commission, X, 455.
- 1884: RYDER, J. A. On the Origin of Heterocercy and the Evolution of Fins and Fin-rays of Fishes; Report, U. S. Fish Commission, XII, 981.
- 1885: RYDER, J. A. On the Development of Osseous Fishes, including Marine and Fresh-Water Forms; Report, U. S. Fish Commission, XIII, 489.
- 1900: SCOTT, G. G. Notes on the Marine Food Fishes of Long Island; Report, New York State Mus., Vol. 54, 214.
- 1886: SEELEY, H. G. The Fresh-Water Fishes of Europe.
- 1904: SHARP, B., and FOWLER, H. W. On the Fishes of Nantucket; Proc. Acad. Phila. LVI, 1904, 504.
- 1901: SHERWOOD and EDWARDS. Biological Notes, No. 2.; Bull. U. S. Fish Commission, XXI, 27.
- 1898: SMITH, E. Fishes of the Vicinity of New York City; Proc. Linn. Soc. of New York; Reviewed in Amer. Nat. 32, 207.
- 1892: SMITH, H. M. Economic and Natural History Notes on Fishes of the Northern Coast of New Jersey; Bull. U. S. Fish Commission, XII, 365.
- 1892: SMITH, H. M. Fishes of the Lower Potomac River; Bull. U. S. Fish Commission, XII, 63.
- 1895: SMITH, H. M. Notes on an Investigation of the Menhaden Fishery in 1894, with Special reference to the Food Fishes taken; Bull. U. S. Fish Commission, XV, 1895, 285.
- 1898: SMITH, H. M. The Fishes Found in the Vicinity of Woods Hole; Bull. U. S. Fish Commission, XVII, 85.

- 1898: SMITH, H. M. Fishes New to the Fauna of Southern New England, Recently Collected at Woods Hole; Science, N. S., VIII, 543.
- 1901: SMITH, H. M. Additions to the Fish Fauna of Woods Hole in 1900; Bull. U. S. Fish Com, XXI, 32.
- 1901: SMITH, H. M. Notes on the Subtropical Fishes Observed at Woods Hole in 1900; Bull. U. S. Fish Commission, XXI, 32.
- 1898: SMITH, H. M., and BEAN, T. H. List of the Fishes Known to Inhabit the Waters of the District of Columbia and Vicinity; Bull. U. S. Fish Commission, XXVIII, 179.
- 1896: SMITH, H. M., and KENDALL, W. C. Extension of the recorded Range of Certain Fishes of the United States Coast; Report, U. S. Fish Comm. XXII, 169.
- 1839: STORER, D. H. Reports on the Ichthyology and the Herpetology of Massachusetts.
- 1904: THOMPSON, J. S. Periodic Growth of Scales in Gadidæ as an Index of Age; Jour. M. B. L. Ass., Plymouth, VII, 1904-1906, 1.
- 1842: THOMPSON, ZADOCK. Fishes of Vermont; Included in the "History of Vermont, Natural, Civil and Statistical."
- 1906: TRACY, H. C. The Fishes of the Mackerel Family; Report, Rhode Island Fish Commission, Vol. 37, 33.
- 1906: TRACY, H. C. Rare Fishes taken in Rhode Island in 1906; Report, Rhode Island Fish Commission, Vol. 37, 65.
- 1907: TRACY, H. C. The Flat Fishes of Rhode Island; Report, Rhode Island Fish Commission, Vol. 38, 47.
- 1876: UHLER, P. R., and LUGGER, O. List of the Fishes of Maryland; Report, Commissioners of Fisheries of Maryland, 1876, 67; 1877, 57.
- 1871: VERRILL, A. E. On the Food and Habits of Some of our Marine Fishes; Amer. Nat. V, 397.
- 1902: ZIEGLER, H. E. Lehrbuch der Vergl. Entwicklungsgeschichte der niederen Wirbeltiere.

In the following list there are arranged in systematic order, by families, all species of fishes known to have been found in the waters of Rhode Island. In nomenclature and sequence of species, "The Fishes of North America," Bull. U. S. Nat. Mus. No. 47, 1896, by Jordan and Evermann, has been followed except in a very few cases where good authority seems to justify a change. The fishes enumerated belong to 199 species, 160 genera and 87 families. Of these species about 30 are important food fishes, and about 75 may be

said to be rare, as far as present records go. About 30 have been taken but once, as far as is authentically recorded. The type specimens of six, or perhaps seven, were taken in Rhode Island waters. Twenty-four of these species are exclusively fresh-water fishes, 175 are salt water forms, thirteen of which are anadromous. One species, the common eel, is katadromous, that is, it passes the greater part of its life in the fresh water and comes down stream and enters the ocean to spawn.

PETROMYZONIDÆ. The Lampreys.

- 1. *Petromyzon marinus* (Linnæus).** *Great Sea Lamprey; Lamprey Eel.*
- GEOG. DIST.: Atlantic coast of Europe and America, south of Chesapeake Bay. Common throughout New England and New York.
- MIGRATIONS: Ascends fresh-water streams in spring to spawn.
- SEASON IN R. I.: Rare, sometimes caught in traps in Narragansett Bay, a few in Taunton River in spring. DeKay in 1842 described specimens from Providence. (De Kay, New York Fauna, Fishes, 1842, 381.) Ripe lampreys taken during the latter part of month of May, 1898, at East Taunton (Bumpus: 1898).
- REPRODUCTION: Spawns in fresh water in May and June, dying after the process.
- FOOD: Parasitic on other fishes.
- SIZE: Three feet.
- REFERENCES:
- 1882: GOODE, Bull. U. S. Fish Com. XVII, 349:
- 1893: GAGE, Lake and Brook Lampreys, Wilder's Quarter Century Book, 421.
- 1897: SURFACE, Bull. U. S. Fish Com. XVII, 209.
- 1905: JORDAN, Guide to the Study of Fishes, I., 498.

GALEIDÆ. The Requiem Sharks.

- 2. *Mustelus canis* (Mitchill).** *Smooth Dogfish; Switchtail.*
- GEOG. DIST.: Common south of Cape Cod to Cuba, and in southern Europe. On the Massachusetts shore this species is occasionally taken as far north as Salem.
- SEASON IN R. I.: Very common from May to November. Small specimens, one foot long and over, common from August through the season. June 5, 1906, Hazard's Quarry trap, half dozen specimens, one of which was female with young.

REPRODUCTION: Viviparous.

FOOD: Crabs usually, also lobsters, squids, annelids and fishes.

SIZE: Three to five feet.

3. **Carcharhinus obscurus** (Le Sueur). *Dusky Shark; Shovel-nose.*

GEOG. DIST.: The Middle Atlantic. Occasional on Massachusetts shore; reported in Connecticut from Stratford (Linsley, 1844); occasional on shore of Long Island.

SEASON IN R. I.: Very common from May to November in outside waters; occasional in Narragansett Bay.

HABITAT: Surface of the open water.

FOOD: Fishes. Stomach contents have shown skates, squeteague, young mackerel, menhaden.

SIZE: Eight to fourteen feet, smallest at Woods Hole, 2½ feet. (Smith.)
(BAIRD, S. F. The Sea Fisheries of Eastern North America.
Report, U. S. Fish Comm. XIV, 1886, 3).

4. **Carcharhinus milberti** (Müller and Henle). *Blue Shark.*

GEOG. DIST.: Cape Cod to Florida. Reported from Woods Hole (Baird, 1873; Smith, 1898).

SEASON IN R. I.: De Kay describes a specimen 7 feet, 4 inches long, weighing 160 pounds, taken at Breton's Reef, September 1842. (De Kay, New York Fauna, Fishes, 1842, 354.) Small specimens two or three feet long occasionally taken in the fish traps in August and September.

FOOD: Fishes.

SPHYRNIDÆ. The Hammer-Headed Sharks.

5. **Sphyrna zygaena** (Linnæus). *Hammer-head.*

GEOG. DIST.: All warm seas. From Cape Cod and Pt. Conception southward. Reported occasionally on Cape Cod, northward to Provincetown; taken at Noank, Connecticut (Goode, 1879).

SEASON IN R. I.: Not common, but occasionally occurring from June to October. In 1905, a specimen three feet long taken August 2nd, in a fish trap in West Passage, and another reported about two weeks later. August 14, 1907, female 9 feet, 10 inches long, taken in trap at north end of Conanicut Island. A few specimens 3 feet long are taken in the traps each year in the lower part of Narragansett Bay.

REPRODUCTION. Viviparous. Thirty-seven embryos have been taken from the oviducts of a female 11 feet long. (Günther, 1880, p. 318.)

FOOD: Fishes, especially menhaden; squids. (Gudger, Science, 25, 1907, 1005.)

SIZE: Average 4 feet; specimens have been taken up to 13 feet in length.

ALOPIDÆ. The Thresher Sharks.**6. *Alopias vulpes* (Gmelin). *Swing-tail; Whip-tail; Thresher.***

GEOG. DIST.: Abounds in all warm seas, especially in the Atlantic and Mediterranean. Frequent on Pacific Coast.

SEASON IN R. I.: Rare in Narragansett Bay. June 25, 1908, at Quonset Point, specimen 15 feet long taken in fish trap. A common shark in outside waters, especially after the scup season. It is a great nuisance to fishermen. At Woods Hole it is present from April until late in the fall. (Smith.)

FOOD: Mackerel, menhaden, herring, and other small fishes.

SIZE: Sometimes as large as 300 pounds. From 4 to 20 feet long at Woods Hole.

CARCHARIDÆ. The Sand Sharks.**7. *Carcharias littoralis* (Mitchill). *Sand Shark.***

GEOG. DIST.: Atlantic coast, Cape Cod to Cape Hatteras.

SEASON IN R. I.: From May to November it is common, but is less so than the dogfish.

FOOD: Fishes, such as flatfish, menhaden, squeteague, butter-fish, scup. Also crabs and squids.

SIZE: Average $4\frac{1}{2}$ to 5 feet long, largest 12 feet long.

LAMNIDÆ. The Mackerel Sharks.**8. *Isurus dekayi* (Gill). *Mackerel Shark.***

GEOG. DIST.: Cape Cod to West Indies.

SEASON IN R. I.: Said to be more common of late years, but not abundant. Rare in Narragansett Bay. Taken at Tiverton and Point Judith. (U. S. Nat. Mus. 1887.)

FOOD: Small fishes, squids, mackerel, conger eel.

SIZE: They average 4 or 5 feet, the largest 10 feet, weighing up to 400 pounds.

9. *Lamna cornubica* (Gmelin). *Blue Shark; Mackerel Shark.*

GEOG. DIST.: Newfoundland to West Indies. Common on Massachusetts coast during mackerel season. In Maine, reported from off Monhegan, Casco Bay, off Cape Elizabeth; in Massachusetts, from Provincetown and Gloucester.

SEASON IN R. I.: Said by the fishermen to be more common than the mackerel shark (*Isurus dekayi*), but this species is probably confused with others. Specimen about 9 feet long taken in trap off Quonset Point, August 15, 1907.

SQUALIDÆ. The Dog-Fishes.**10. *Squalus acanthias* (Linnæus). *Dogfish; Spiny Dogfish.***

GEOG. DIST.: Atlantic, Nova Scotia (Cornish, 1907), south to Cuba and from the North Cape to the Mediterranean.

MIGRATIONS: Probably moves northward in spring a little after the mackerel, returning from September to November.

SEASON IN R. I.: The last of April or first of May to November. Rare in the Bay, but so common outside as to be a nuisance to the fishermen. Follows the school of scup in spring.

HABITAT: Open water, following schools of pelagic fishes. (Field, Report Mass. Fish and Game Comm., 1906.)

REPRODUCTION: Viviparous.

FOOD: Fishes, especially herring, mackerel, and scup. Also crustacea and jelly fishes.

SIZE: Two to three feet.

SQUATINIDÆ. The Angel Sharks.**11. *Squatina squantina* (Linnæus). *Angel Fish; Monkfish.***

GEOG. DIST.: Warm seas; common in the Mediterranean; rarely on Atlantic coast from Cape Cod southward; common on the coast of California, especially from San Francisco to Monterey. At Woods Hole, specimen taken in fish trap at Menemsha Bight, September 1, 1873, (Smith, 1898). One taken at same place a few years later. Not common in New York waters but occasionally seen at Gravesend Bay in summer. (Bean, 1903).

SEASON IN R. I.: Specimen in Agassiz Museum from Newport (Bean). Specimen taken West Passage trap, September 14, 1909.

REPRODUCTION: Viviparous, producing about twenty young at a time. (Bridge, 1904.)

SIZE: Two to five feet in length.

RAJIDÆ. The Skates.**12. *Raja erinacea* (Mitchill). *Summer Skate; Old Maid.***

GEOG. DIST.: Virginia to Maine.

SEASON IN R. I.: Abundant throughout the year. Specimens 4 inches long and upwards, taken in beam trawl south of Plum Beach Light, December 22, 1908.

REPRODUCTION: Eggs common in fish traps in August and September, July 22, 1908, eggs taken in abundance in dredge to eastward of Hope Island. Eggs found in Gravesend Bay, Long Island, in March. (Bean.) (Putnam, Skates Eggs and Young, Amer. Nat. III, 1869, 617.)

FOOD: Usually crustacea and annelids, but bivalve molluscs, squids, and small fishes are frequently found in the stomach.

SIZE: Average 1 to 2 feet. One young specimen, 2 inches long, taken in trap in Narragansett Bay, October 9, 1905.

13. *Raja ocellata* (Mitchill). *Big Skate; Winter Skate.*

GEOG. DIST.: Atlantic coast northward from New York.

SEASON IN R. I.: Rare in summer. Occasional from October until May. April 16, 1906, Dutch Island trap—dozen specimens. September 11, 1905, Sand Blow trap; September 11, 1905, Dutch Island trap; October 9, 1905, Dutch Island trap; December 22, 1908, several specimens taken in beam trawl south of Plum Beach Light.

FOOD: Squids, annelids, crustacea.

SIZE: Average, three feet.

14. *Raja lævis* (Mitchill). *Barndoor Skate.*

GEOG. DIST.: Nova Scotia to Florida. Frequently taken at Canso on the deep sea trawls of hooks. (Cornish, 1907.)

SEASON IN R. I.: Rare in summer when probably it is in deep water, but common in spring and from August to October. July 30, 1900, two were taken off Gay Head by the "*Grampus*" in 65 to 70 fathoms of water. These had lobsters in their stomachs. (Bull. U. S. Fish Comm. XV, 1899, 431.) August 23, 1905, Dutch Island trap, 3 dozen specimens (?); August 27, 1906, Dutch Island trap, 3 specimens; August 27, 1906, Hazard's Quarry trap, 3 specimens; September 17, 1906, Wild Goose trap, 2 small specimens.

REPRODUCTION: Eggs found occasionally in September.

FOOD: Crustacea. Lobsters have frequently been found in their stomachs.

SIZE: Four feet.

NARCOBATIDÆ. The Electric Rays.

15. *Tetranarce occidentalis* (Storer). *Torpedo; Crampfish.*

GEOG. DIST.: Cape Cod to Cuba. In Maine, reported from Casco Bay and off Sequin; in Massachusetts, from various localities on the Cape Cod coast and Woods Hole; in Connecticut, from Stratford (Linsley, 1844).

At Woods Hole they are most abundant in October and November.

SEASON IN R. I.: Caught off Sakonnet not uncommonly in midsummer.

FOOD: Fishes.

SIZE: Two to five feet long. Maximum weight, 200 pounds: average 30 pounds; small ones infrequent.

DASYTIDÆ. The Sting Rays.**16. *Dasyatis centrura* (Mitchill). *Sting Ray*.**

GEOG. DIST.: Coast of Maine to Cape Hatteras. Reported from Woods Hole (Storer, 1842, 1863), Chatham (Storer, 1857, 1863), Woods Hole (Baird, 1873 and Smith, 1898), also from Stratford, Connecticut (Linsley 1844). Formerly common at Gravesend Bay, but now rare. (Bean, 1903.)

SEASON IN R. I.: Said to have been very common formerly, but are small and few at present. Specimen three feet, four inches long, taken August 8, 1906, at Goose Neck, just south of Wickford Light.

REPRODUCTION: Moore records the birth of young in aquarium. Two broods were born, one of four young and the other of five, on August 10 and 15. In neither case did the mothers long survive the birth. The parents measured two feet across the "wings;" the young were about five or six inches across. After August 20, all the specimens taken were the young of the year. (Moore, 1892.)

FOOD: Large species of invertebrates such as crabs, squid, clams, sea snails. Sometimes small fishes and annelids.

SIZE: Reaches a length of ten to twelve feet.

17. *Dasyatis hastata* (De Kay).

GEOG. DIST.: West Indies north to Rhode Island.

The type specimen originally described by De Kay in 1842, was a female captured in September off the Rhode Island coast (De Kay, New York Fauna, Fishes, 1842, 373). Also reported from Massachusetts, Holmes Hole (Storer, 1842), and at Chatham (Storer, 1858).

18. *Pteroplatea maclura* (LeSueur). *Butterfly Ray; Angel-Fish*.

GEOG. DIST.: Woods Hole to Brazil. Woods Hole, is rare, and observed mostly in August and September (Smith). Reported from Saybrook and New Haven (Linsley, 1844). Rare at Gravesend Bay (Bean).

SEASON IN R. I.: Rare. The type specimen of this species described by LeSueur was taken in 1817. (LeSueur, Jour. Ac. Nat. Sci. Phila., 1817, 41.) In July, 1900, a specimen 23 inches long was taken in the southern part of Narragansett Bay by the Lewis Brothers of Wickford.

MYLIOBATIDÆ. The Eagle Rays.**19. *Myliobatis freminvillei* (LeSueur). *Sharp-headed Ray; Sting Ray*.**

GEOG. DIST.: Cape Cod to Brazil. Not common at Woods Hole (Smith, 1898). Found in Connecticut, Noank. (Garman, 1885.)

SEASON IN R. I.: Not very common. The original type specimen described by LeSueur was taken in 1824, from Rhode Island. (LeSueur, Jour. Ac. Nat. Sci. Phila., IV, 1824.) De Kay mentions specimens from Rhode Island. (De Kay, New York Fauna, 1842, 376.) Mr. John O. Lewis of Wickford says that several have been taken in traps in Narragansett Bay, near Saunderstown.

20. *Rhinoptera bonasus* (Mitchill). *Cow-nosed Ray; Sting Ray.*

GEOG. DIST.: Cape Cod to Florida. Taken at Woods Hole, (Smith 1898), and Nantucket, (Sharp and Fowler, 1904), and at Stratford, Connecticut (Linsley, 1844).

SEASON IN R. I.: An immense school of these fishes once seen off Block Island by Captain Mason, of Tiverton. Said to have been more common formerly.

REPRODUCTION: Viviparous, breeding season lasting over five or six months.

FOOD: Chiefly molluscs; also crustacea, crabs, and lobsters.

SIZE: 100 pounds.

ACIPENSERIDÆ. The Sturgeons.

21. *Acipenser sturio* (Linnæus). *Sturgeon.*

GEOG. DIST.: Ascends rivers of Atlantic coast of Europe and America; common from New England to Carolina. Reported from rivers and coast waters of Maine and Massachusetts and from Long Island Sound.

SEASON IN R. I.: Rather common in traps off Sakonnet from May to November. Said to have been more common formerly; 25 years ago 5 or 6 were caught in traps at a time. Small specimens two or three feet long now occasionally taken in summer in Narragansett Bay. Common at Block Island.

The Following Table Shows the Distribution by Months and Years of the Sturgeon Shipped from Rhode Island between 1903 and 1908.

	May.	June.	July.	August.	September.	October.	November.	Totals.
1903.....	3				1	7		11
1905.....	14	3	3			2	4	26
1906.....		6	5					11
1907.....	2	4	3		1		3	13
1908.....	2			1				3
Totals.....	21	13	11	1	2	9	7	64

REPRODUCTION: Ascends rivers to spawn in spring and summer. Eggs, 2.6 mm. in diameter. (For development and description of eggs and young, see Ryder. Bull. U. S. Fish Comm. VIII, 1881, 231, and Dean, Fishes, Living and Fossil, 1895, p. 202, 221; Brice, Report U. S. Fish Com. XXIII, 1897, 189. W. S. Tower, Pop. Sci. Mon., 73, 1908, 361.)

FOOD: Molluscs and crustacea, which it obtains by grubbing in the mud. (See Ryder, loc. cit.)

SIZE: Five to 12 feet, weighing 50 to 300 pounds.

22. *Acipenser brevirostrum* (LeSueur). *Short-nosed Sturgeon.*

GEOG. DIST.: Cape Cod to Florida, rare northward, extending further southward than other species. Reported from Boston Harbor, Waquoit, Rockport and Woods Hole, though none of the writers make very definite statements. Specimens taken at Gravesend Bay, May 13, 1896 (Bean, 1903).

SEASON IN R. I.: Occurs in company with the common sturgeon, which it resembles in habit. Ryder (Bull. U. S. Fish Comm. VIII, 1888, p. 231) has described the species and its natural history.

REPRODUCTION: In Delaware river, it spawns in May. Eggs are adhesive and deposited in depths of 1 to 5 fathoms in hard bottom in brackish water. Period of hatching is 4 to 6 days. (Dean, Zool. Anz. XVI., 1893, 473.)

FOOD: The young up to the third month feed on microscopic organisms in the water. Later, they feed on small crustacea, copepods, algæ, annelids, etc. The adults feed on crustacea, and molluscs.

SILURIDÆ. The Cat-Fishes.

23. *Felichthys felis** (Mitchill). *Sea Catfish; Gafftopsail Cat.*

GEOG. DIST.: Cape Cod to Texas, common southward. Specimens taken at Woods Hole (Baird, 1873), New Bedford (Goode, 1879), Menemsha Bight (Smith, 1898).

SEASON IN R. I.: Specimens from Newport in Powell Collection of the Boston Society of Natural History. (Kendall, 1908). Specimen taken at Brenton Reef Light Ship, September 16, 1898.

HABITAT: More common northward than *G. milberti* and more of a deep water fish than that species.

REPRODUCTION: Large eggs and similar in habit to *G. milberti* (Henshall). For an account of the incubation of the eggs of Marine Catfishes, see Pellegrin, (Comp. Rendu. French, Ass. Adv. Sci. 1907, and Sci. Amer., N. S. 64, 1907, 260.)

SIZE: 26 inches.

24. *Galeichthys milberti** (Linnæus). *Sea Cat-Fish.*

GEOG. DIST.: Cape Cod to Texas, common southward. Was formerly common in spring in Vineyard Sound, but now rare. (Smith.)

SEASON IN R. I.: Rare in R. I.; Narragansett Bay (R. I. Fish Com. 1894, 211).

HABITAT: Bottom fish along sandy coast.

REPRODUCTION: Eggs, large and incubated in the gill cavity of the male. (Henshall, Bull. U. S. Fish Comm. 1894, 211.)

FOOD: Omnivorous; chief diet worms and crustacea.

SIZE: 24 inches.

25. *Ameiurus nebulosus* (LeSueur). *Horned Pout; Bullhead.*

GEOG. DIST.: Great Lakes, Ohio Valley, to Maine, Florida and Texas; abundant in all New England States.

SEASON IN R. I.: Generally present in all fresh water ponds in Rhode Island. Reported from Mashapaug, Randalls, Benedict, and Fenners ponds; Poneganset Reservoir, Pocasset River (Kendall, 1908); ponds and streams in North Kingstown, Carolina, and Pascoag. Also from the

* These specific names are on the authority of Günther who examined Linneaus' collection of fishes. See Jordan, Amer. Nat, 34, 1900, 70.

following ponds: Roger Williams Park, Print Works, Spectacle, Dyers, Randall, Kings, Georgiaville, Olney, Scotts, Herring, Round, Wallum, Sucker, Bowdish, Keech, Moswansicut, Wordens, Hundred Acre, Thirty Acre, and Yawgoo; and from the following reservoirs: Slack, Sprague, Waterman, Wilson, Burlingame, Poneganset, Smith and Sayles, and from Silver Lake.

REPRODUCTION: Spawns in April and May, eggs $\frac{1}{8}$ -inch in diameter and are adhesive; they are deposited in shallow water and guarded by the parents.

FOOD: Feeds on all kinds of animal life, including young and ova of other fishes. (Kendall, Bull. U. S. Fish Com. 1902, 404.) Apparently feeds largely at night.

REFERENCES:

1883: RYDER, Bull. U. S. Fish Com. III., 225.

1890: DEAN, Report State Fish Com. N. Y., 19.

1901: EYCLESYMER, Amer. Nat. XXXV, 911.

1902: KENDALL, Bull. U. S. Fish Com., XXII., 401.

1902: SMITH and HARRON, Bull. U. S. Fish Com. XXII, 151.

1903: SMITH, Science, February 13th, 243.

CATOSTOMIDÆ. The Suckers.

26. *Catostomus commersonii* (Lacépède). *Common Sucker; Brook Sucker.*

GEOG. DIST.: Quebec and the Great Lakes to Montana, Colorado, Missouri, and Georgia. Abundant in ponds and streams of Maine, New Hampshire, Vermont and Massachusetts. (Kendall, 1908.) In Connecticut, mentioned by De Kay (1842), and by Linsley (1844).

SEASON IN R. I.: Probably common in R. I. Recorded from Larkins and Mashapaug Pond, Sucker Brook, Queens, Pawcatuck, and Moosup Rivers.

REPRODUCTION: Spawns in shallow, swift water, in May and June.

HABITAT: Fresh water streams and ponds.

FOOD: Insects, worms, molluscs, young fishes, and fish ova. The young feed on diatoms, desmids, and black fly larvæ. (Kendall and Goldsborough, Bureau of Fisheries Doc. 633, 1908, p. 24).

SIZE: Maximum, 22 inches.

27. *Erimyzon sucetta oblongus*.

GEOG. DIST.: Great Lakes and Mississippi Valley, eastward. Common in Maine, New Hampshire, Vermont, and Massachusetts. Reported from Connecticut at "Housatonic." (Kingsley, 1844.)

HABITAT: Very abundant in lakes and lowland streams.

SEASON IN R. I.: Reported from Larkins Pond, Queens River, and ponds and streams in North and South Kingstown.

FOOD: Crustacea, insect larvæ and aquatic plants.

SIZE: About ten inches.

CYPRINIDÆ. The Carps.

28. **Abramis crysoleucas** (Mitchill). *Golden Shiner; Roach; Dace.*

GEOG. DIST.: Nova Scotia and Maryland to Dakota and Texas.

SEASON IN R. I.: Reported from Benedicts, Mashapaug, Dyers, Cunliff, Sucker, Herring, Larkins, and Belleville Ponds, Queens and Pawtucket Rivers.

HABITAT: Fresh water. Sluggish species, frequently found in ponds and cutoffs, preferring those where the bottom is covered with aquatic plants. (Gill, Smithsonian Misc. Coll. 48, 1907, 307.)

REPRODUCTION: Spawns in May. The young reach 1½ inches long in December. (Bean, 1901.)

SIZE: Adult is from 6 inches to a foot long.

29. **Notropis cornutus** (Mitchill). *Shiner; Red-fin.*

GEOG. DIST.: Entire region east of Rocky Mountains, except South Atlantic States and Texas. Common throughout New England.

SEASON IN R. I.: Reported by R. I. Fish Commission, 1899. Probably present throughout the State; reported from Belleville and Larkins Ponds, Queens and Ten Mile Rivers.

HABITAT: Small streams.

REPRODUCTION: Spawns in spring and early summer; eggs are deposited in a hollow made in a gravelly shoal where the current is swift. (Kendall, 1908; Gill, Smithsonian Misc. Coll., 48, 1907, 301.)

FOOD: Carnivorous, feeding on all small aquatic animals and insects.

SIZE: Five to eight inches.

30. **Rhinichthys atronasmus** (Mitchill). *Black-nosed Dace.*

GEOG. DIST.: New England to Minnesota, Northern Alabama, and Virginia. Common throughout New England.

HABITAT: Fresh water. Abundant in clear brooks and mountain streams.

SEASON IN R. I.: Probably present throughout streams of the northern and western parts of the State. (R. I. Fish Com., 1899.)

REPRODUCTION: Spawns in spring and early summer. (Gill, Smithsonian Misc. Coll., 48, 1907, 308; Holder, Harper's New Monthly Mag., Dec. 1883, 100; Gregg, Amer. Nat. XIII, 1879, 321.)

FOOD: Feeds on small aquatic animals and insects; young specimens were found feeding on diatoms, entomostraca, small aquatic worms and insects. (Kendall, 1908.)

SIZE: Three inches.

31. *Carassius auratus* (Linnæus). *Goldfish*.

GEOG. DIST.: The goldfish or silverfish is a native of Asia, whence it was introduced into Europe and from there to America, where it now is one of the commonest aquarium fishes, and is abundant in many of our streams. De Kay says that the goldfish was introduced from China into Europe in the early part of the 17th century and probably shortly afterward found its way into this country.

HABITAT: Introduced into aquaria, fountains, reservoirs, ponds, and lakes. In many streams and ponds it has run wild and returned almost entirely to the original olivaceous type. In the fauna of the moraine ponds and in quarry holes, the goldfish stands first. (E. Smith, 1898.)

SEASON IN R. I.: This introduced species has run wild in certain ponds and streams of the State. Abundant in ponds in Roger Williams Park, in Easton's Pond, Providence, and in Railroad Pond, East Providence.

REPRODUCTION: It spawns early in the spring. The eggs are about 1.5 mm. in diameter and are laid singly upon weeds and other fixed objects. They hatch in 8 or 9 days after fertilization. (Ryder, Report, U. S. Fish Commission, XIII, 1885, 506.)

SIZE: It grows to a length of about twelve inches.

32. *Cyprinus carpio* (Linnæus). *The Carp*.

GEOG. DIST.: Native of Asia and introduced into Europe and America. (The history of the carp in Europe has been summarized by Cole, Report Bureau of Fisheries, 1904, 537.) Introduced into America by the U. S. Fish Commission in 1877.

HABITAT: Moderately warm, shallow waters with an abundance of aquatic vegetation and deeper places to which the fish can retreat are the most favorable conditions for the carp. They are very adaptable, however, and are often found, though in lesser numbers, in other places. During the winter they seek deep holes, where they remain in a semi-torpid condition.

SEASON IN R. I.: Abundant in Cunliff Pond, ponds in Roger Williams Park and connecting streams; found in Mashapaug Pond and vicinity; Slocum Pond and Queens River.

REPRODUCTION: The eggs are small, but laid in enormous numbers. The eggs sink; they are not laid in bunches or masses, but are scattered about

in the water; they are adhesive and become attached to the roots and stems of grass and other aquatic vegetation. The eggs develop rapidly and in temperate regions hatch in about 12 days, and from 2 to 6 days in the warm water of the south. (Cole, loc. cit.; Gill, Smithsonian, Misc. Coll., 48, 1907, 195.)

FOOD: Omnivorous, but vegetable matter normally forms the chief part of its diet. Much of its food the carp obtains by rooting in the mud. Often, however, they feed at the surface and eat small floating plants, insects and their larvæ, and vegetable material dropped or blown into the water.

SIZE: Growth depends on temperature and food supply. In temperate regions it normally reaches 3 pounds in three years. Sometimes weighs over 30 pounds.

ANGUILLIDÆ. The True Eels.

33. *Anguilla rostrata** (Rafinesque). *Eel*.

GEOG. DIST.: Gulf of St. Lawrence to Mexico. Ascends rivers east of Rockies and south of Canada.

MIGRATIONS: Adults move down the rivers into the ocean in the autumn to spawn. The young move from salt water into fresh in spring. Migration of young 2 to 3 inches long up Taunton, Warren, and Kickamuit Rivers takes place from about April 15 to May 15.

SEASON IN R. I.: Abundant throughout the year in both fesh and salt water, but are most numerous in the autumn when the females are descending the rivers. Reported at Newport by LeSueur in 1817. About April 15, 1905, the eels in Greenwich Bay, R. I., for a period of about three weeks, died in great numbers.

REPRODUCTION: Spawning takes place in the ocean in winter. The place of spawning is probably in water 500 fathoms or more deep, along the steep slope where the continental plateau shelves off into the great oceanic depths. The young when hatched are in a larval condition and known as *Leptocephali*, which require nearly a year for the metamorphosis into young eels. In the meantime they gradually approach the coast and enter the rivers in April and May, *i. e.*, in the spring a year after hatching. The young eels, two or three inches long, which can be seen moving up the rivers in the spring are thus a year and two or three months old. The mature eels which migrate down the rivers in the autumn to spawn are probably eight to ten years old (Gemzöe). They

* Baan. Science, May 28, 1909.

die after spawning. (For a general summary of the life history of the eel and reference to the most important modern work on the subject, see Gill, 1908, and Tracy, 1908.)

FOOD: The eel is an excellent scavenger, eating all kinds of dead animal matter. It also feeds on small fishes, shrimp, crabs, molluscs, worms, etc.

SIZE: Four or five feet. Young taken when ice breaks up in the spring, one to one and a half inches long. Professor Jenks found specimens 2½ inches long April 19th.

REFERENCES:

1864: GILL, Proc. Acad. Nat. Sci., Phila.

1881: GOODE, Bull. U. S. Fish Com., I., 71.

1886: DELARGE, Compte, Rendu. CIII, 690.

1897: MCINTOSH and MASTERMAN, British Marine Food Fishes, 434.

1908: GILL, Science, N. S. XXVIII, 845.

1908: TRACY, Report R. I. Fish Com., 43.

1909: EHRENBAUM, Nordisches Plankton, 10, 380.

LEPTOCEPHALIDÆ. The Conger Eels.

34. *Leptocephalus conger* (Linnaeus). *Conger Eel*.

GEOG. DIST.: Cosmopolitan, except not found in eastern Pacific.

MIGRATIONS: Moves into deep water for spawning; does not run into fresh water.

HABITAT: Salt and brackish water.

SEASON IN R. I.: Scattering specimens in spring and summer, common from August to November. Reported by Mitchill from Block Island, 1818. In the U. S. Museum are casts of two specimens taken at Block Island by the U. S. Fish Commission, September 26, 1874. One of these weighed eleven pounds. September 24, 1906, West Passage trap, two specimens; April 30, 1906, Dutch Island trap, one specimen; May 27, 1905, Dutch Island trap; June 5, 1906, Hazard's Quarry trap, three specimens; August 8, 1906, Goose Neck trap, three specimens; August 23, Dutch Island trap, specimen; August 27, 1905, Sand Blow trap, large specimen.

REPRODUCTION: Spawning takes place in deep off shore waters of the ocean, probably in late summer. On American coast, eggs taken by the "*Grampus*" in the beginning of August. Eggs are 2.4 to 2.75 mm. in diameter, have segmental yolk like Clupeoid eggs, and possess one to six oil globules. There is a larval stage and a metamorphosis, as in the case of the common eel. (For a brief statement of the life history of the

Conger eel, see McIntosh and Mastermann, *British Marine Food fishes*, 1897, 450; Ehrenbaum, *Nordisches Plankton*, 10, 1909, 384. For a description of eggs and larvæ, see Eigenmann, *Bull. U. S. Fish Com.* XXI, 1901, 37. For the American *Leptocephalus* forms, see Eigenmann and Kennedy, *Bull. U. S. Fish Com.*, XXI, 1901, 81.)

FOOD: Fishes, snails, shrimp, worms. According to the Lewis Brothers of Wickford, small lobsters are frequently found in stomachs of congers.

SIZE: Average, four to six feet. Smallest observed at Woods Hole are 15 to 20 inches long.

ELOPIDÆ. The Tarpons.

35. *Tarpon atlanticus* (Cuvier and Valenciennes). *Tarpon*.

GEOG. DIST.: Cape Cod to Brazil; common in the West Indies; on the coast this species is most abundant in Florida and Texas. Recorded from Massachusetts at South Dartmouth, Quisset, Menemsha (Smith 1898), Martha's Vineyard, Woods Hole (Sherwood and Edwards, 1901).

MIGRATIONS: On the southern coast of Florida it appears in February and increases rapidly in numbers in March, April and May; in Texas it appears early in March. About the first of December they disappear from Florida and Texas. In tropical seas, they may be found always; at Tampico, Mexico, they are most abundant from November first until April, which coincides with the time when they are absent from Florida and Texas.

HABITAT: Tropical waters; ascends streams in pursuit of small fry.

SEASON IN R. I.: Rare. Stragglers are reported by the fishermen. Several on record from Newport and Sakonnet, all of which were taken in the month of August so far as is known. Specimen taken August, 1874, at Newport, by Mr. Samuel Powell (photograph No. 398, in U. S. Nat. Mus.). In 1895, two tarpon taken in trap in Coddington Cove, Newport, one weighing over 100 pounds; later, one was caught at Bailey's Point, Middletown, and sometime after that another taken off High Hill, on Portsmouth shore of Sakonnet River; all these were taken in August (J. G. Costello, of the *Newport News*). Mr. J. M. K. Knowles, of Wakefield, is authority for the statement that a tarpon five feet long and weighing 30 pounds was taken near Dutch Island Harbor, Narragansett Bay, in 1900. On August 11, 1906, three tarpon caught in trap off Second Beach, near Purgatory, one weighing 97 pounds, and the other two together, 90 pounds; a few days later, two more were taken in the same trap, each somewhat smaller than the large one referred to just above.

About the first of August, 1906, a medium sized tarpon was taken in a trap in Mackerel Cove. (Costello).

REPRODUCTION: Does not breed north of Cuba. Its larva will probably be found like that of its relatives, elongated ribbon-shaped animal, transparent and with small head and fins. (Gill, *The Tarpon and Ladyfish and their Relatives*, Smithsonian Misc. Coll., 48, 1907, 31.)

FOOD: Schools of small fishes, especially mullets.

RATE OF GROWTH: On the coast of Florida only mature fish are taken; these average about six feet long, but sometimes weigh as much as 180 pounds. Everman and Marsh collected young $2\frac{1}{4}$ to $3\frac{1}{2}$ inches long in a mangrove swamp at Fajardo, Porto Rico, in February, 1899; also in a brackish pool they found specimens 4.7 to 11.5 inches long.

36. *Elops saurus* (Linnæus). *Ten Pounder; Big-eyed Herring.*

GEOG. DIST.: Tropical seas to Carolina, straying north to Cape Cod. In Massachusetts reported from Woods Hole (Baird, 1873), New Bedford, Woods Hole (Bean, 1880), Vineyard Sound, Buzzards Bay (Smith, 1898), Nantucket (Sharp and Fowler, 1904). Appears occasionally at Long Island in October. At Woods Hole, according to Dr. Smith, it is "Common in fall, none appearing before October."

SEASON IN R. I.: So rare that it is not usually recognized by fishermen. Specimen 14 inches long, taken in trap at Dutch Island Harbor, Narragansett Bay, October 29, 1905.

REPRODUCTION: Does not breed on our coast. The young are ribbon-shaped, long, thin and transparent, and pass through a metamorphosis like the fishes of the eel family. (Jordan and Evermann, *American Food and Game Fishes*, 1902, p. 86.)

HABITAT: Open seas.

FOOD: Shrimp and small fishes.

SIZE: Three feet. At Woods Hole, average length 18 to 20 inches.

ALBULIDÆ. The Lady-Fishes.

37. *Albula vulpes* (Linnæus). *Lady-fish.*

GEOG. DIST. Tropical seas on sandy coasts, north to Woods Hole. Specimens taken at Great South Bay, L. I., late in the fall (Bean, 1903). Reported at Woods Hole in 1871, by Baird, and rarely since then.

HABITAT: Shore fishes, feeding on muddy or sandy flats. (Gill, *Smithsonian Misc. Coll.* 48, 1907, 40.)

SEASON IN R. I.: Specimens are reported by fishermen. A specimen from

Newport is in the U. S. National Museum. (Proc. U. S. Nat. Mus., 1880, 107.)

REPRODUCTION: The young are transparent, band-shaped, and have a small head; they pass through a metamorphosis as do the eels and the ten-pounder. In the Gulf of California the young are abundant and are often thrown up by the waves on the beach in great numbers. (Jordan and Everman, loc. cit.)

FOOD: Shell fishes, especially small bivalve molluscs.

RATE OF GROWTH: In the metamorphosis they shrink from three or three and a half to two inches. (Gilbert). The adult reaches one and one-half to three feet.

CLUPEIDÆ. The Herrings.

38. *Etrumeus sadina* (Mitchill). *Round Herring*.

GEOG. DIST.: Cape Cod to Gulf of Mexico, on sandy shores; not rare southward. Reported at Woods Hole (Bean, 1880), Menemsha Bight (Smith, 1898). Apparently not rare on the southern coast of Long Island (Bean).

SEASON IN R. I.: Specimen in U. S. National Museum taken at Newport by Mr. Samuel Powell. (Bull. U. S. Nat. Mus., 1879, 59.)

RATE OF GROWTH: Young specimens $4\frac{1}{2}$ inches long taken at Gravesend Bay, July 30, 1896 (Bean). Adults are ten inches long.

39. *Clupea harengus* (Linnæus). *Sea Herring; Blue Back*.

GEOG. DIST.: North Atlantic Ocean, Europe, and America. South to Cape Hatteras, but not abundant south of Cape Cod.

SEASON IN R. I.: Winter herring arrive in October or November and remain until very cold weather. The spring run arrive in May, and the fishes of that run are larger and more numerous. April 16, 1906, Dutch Island trap, half a dozen large specimens and a few small ones, six inches; April 30, 1906, Sand Blow trap, a dozen specimens; April 30, 1906, Dutch Island trap specimens; May 27, 1905, Dutch Island Harbor trap, a few specimens; June 5, 1906, Hazard's Quarry trap, a few specimens; October 29, 1905, Dutch Island Harbor trap.

HABITAT: Surface of the water.

REPRODUCTION: Some schools spawn in the spring and others in the autumn. The fall schools spawn to west of Bay of Fundy, spring schools to the east of that point. Spawning takes place in Penobscot Bay, September and October; at Woods Hole, after middle of September; along the coast of Massachusetts, about October first; at No Man's Land,

for three or four weeks, beginning October 15; at Block Island, November. Spawning takes place at a temperature between 47° and 57° F., in the open coast waters not deeper than 30 fathoms. (H. F. Moore, Report U. S. Fish Commission, XXII, 1896, 40.) Eggs are 1-20 inch in diameter, adhesive, and are deposited on the bottom. They hatch in a period varying from nine to fourteen days, depending on the temperature of the water. The young are then 7-24 inch (5 to 7 mm.) long. At Woods Hole, according to Dr. Smith, "schools of large herring in a spawning condition appear about October 15, and remain till very cold weather sets in."

RATE OF GROWTH: At Woods Hole, in January, young herring one-fourth inch long are taken in tow nets, and in May they are 1 to 1¼ inches long; by August they have attained a length of 2½ to 3 inches. Fish three to five inches long are found from September 1st to the end of the season. About June 1st, for two weeks, there is large run of herring smaller than those of the fall run in Narragansett Bay. Schools of young, about two to four inches long, are common in April and May. Young specimens two inches long taken June 6, 1893 (Prof. Jenks). Young 4¾ to 6 inches taken in Gravesend Bay, November 23, 1897.

Masterman summarizes the life history of the young herring, as follows: "The young larva, hatched at about 5 to 7 mm. (¼ inch) in length, lives near the bottom till some 10 mm. (2-5 inch) is attained by a rapid increase in length. The attenuated post-larval herring then migrates upward through the mid-water to the surface, the mid-water stage lasting from 10 mm. to 23-24 mm., and the surface stage from 24 mm. to 27-28 mm. (1½ inch) when a movement shoreward takes place, and the littoral habit is acquired." (Masterman, 1896.)

FOOD: Small pelagic invertebrates, chiefly copepods, and larvæ of worms and molluscs.

REFERENCES:

- 1886: CUNNINGHAM, Trans. Roy. Soc. Edinburgh, 33, 97.
- 1890: McINTOSH and PRINCE, *ibid.* 35, 854.
- 1896: CUNNINGHAM, Marketable Marine Fishes.
- 1896: MASTERMAN, Report Fishing Board of Scotland, 14, 294.
- 1897: BRICE, Report U. S. Fish Com., XXIII, 225.
- 1897: McINTOSH and MASTERMAN, British Marine Food Fishes, 405.
- 1909: EHRENBAUM, Nordisches Plankton, 10, 361.

40. Pomolobus mediocris (Mitchill). *Hickory Shad.*

GEOG. DIST.: Florida to Bay of Fundy.

SEASON IN R. I.: Arrives in the spring; specimens are common from August first to November. April 30, 1906, Dutch Island trap; August 8, 1906, Goose Neck trap, half a dozen specimens; September 24, 1906, West Passage traps, half a dozen specimens; August 27, 1905, Sand Blow trap, two specimens; October 9, 1905, Sand Blow trap; also taken on August 10, September 11, October 2.

REPRODUCTION: The location of the breeding grounds is uncertain. Some authorities say that this species does not ascend rivers to spawn; others maintain that it spawns in fresh water under the same conditions as shad.

FOOD: Small fishes, crustacea, squids.

SIZE: Maximum, 24 inches.

41. *Pomolobus pseudoharengus* (Wilson). *Alewife; Branch Herring; River Herring; Buckie.*

GEOG. DIST.: Atlantic coast of the United States. Nova Scotia to Virginia.

MIGRATIONS: Arrives off Virginia and Maryland about March 1. Said to arrive at Cape Cod about April first, a month before the scup.

SEASON IN R. I.: This is one of the first fish to arrive in the spring, the traps at that time sometimes being full of them. Comes in March, running up into fresh water through March, April, and the first of May. After that, in May and June, a few stragglers are taken on their way back to salt water. The dates of their arrival in Taunton River, kept by Mr. Elisha Slade, from 1871 to 1883, show that their earliest appearance during that time was February 28, 1880, and the latest, March 28, 1875-April 16, 1906, Dutch Island trap, 1,700 specimens; April 30, 1906, Sand Blow trap, 1,200 specimens; September 24, 1906, West Passage, traps, a few specimens.

REPRODUCTION: Spawns during March and April in fresh water. Young taken all summer. (Bean). The eggs are 1-20 inch in diameter, adhesive, and deposited in shoal water. At hatching, the larvæ are 1-5 inch long (5 mm.). (For description of eggs and young, see Ryder, Report of U. S. Fish Com. XIII, 1885, 505, and Prince, Further Contributions to Canadian Biology, 1907, 95; also Brice, Report U. S. Fish Com. XXIII, 1897, 186.)

FOOD: Minute free-swimming crustscea. Sometimes young squids and small shrimp.

RATE OF GROWTH: The young hatched from the eggs in the spring, become three or four inches long before winter. August 8, 1908, specimens

taken at Cornelius Island in seine, $1\frac{1}{2}$ inches long (61 mm.; 63 mm.; 65 mm.) Bean took specimens in Great South Bay, Long Island, $2\frac{1}{2}$ to $3\frac{7}{8}$ inches long on August 8th; specimens $3\frac{1}{4}$ to $7\frac{1}{4}$ inches on August 9th, the larger ones probably being the young of the previous year; specimens $2\frac{3}{4}$ to 4 inches on August 23; specimens 2 to $4\frac{1}{2}$ inches in September, (Bean, 1901.). Young are hatched in June and treble their length in a month. Specimens from 3 to $6\frac{1}{2}$ inches (75 to 141 mm.) taken middle of August, St. John's Harbor, N. B. The largest may not have been the young of that season. (Prince, 1907. Plates and descriptions of young.)

42. Pomolobus æstivalis (Mitchill). *Glut Herring*; *Blackback*.

GEOG. DIST. Coast waters of United States north to Maine. Less abundant northward than the preceding species.

MIGRATIONS: Similar to the alewife (*P. pseudoharengus*), except that it appears later and remains in fresh water for a shorter time.

SEASON IN R. I.: It appears from two weeks to a month later than the alewife.

REPRODUCTION: Similar to the alewife, but about two weeks later. The spawning grounds are probably confined to brackish water in ponds, and in large streams not far above tide-water. July 20, 1905, young specimens two inches long seined at Cold Spring Beach; June 5, 1906, Hazard's Quarry trap, a few large specimens.

FOOD: Free-swimming crustacea.

43. Alosa sapidissima (Wilson). *Shad*.

GEOG. DIST.: From Alabama along the whole Atlantic coast. Introduced by the U. S. Fish Commission into the rivers of the Pacific coast.

MIGRATIONS: Probably lives in deep water in winter, or near Gulf Stream, coming into shore waters when the temperature reaches 60° F., running up rivers to spawn. When this process is completed they probably return to salt water. The young, when hatched, remain in rivers till autumn, then move into salt water. In Florida, shad ascends rivers in December; rivers of Georgia in January; the Potomac, April; rivers from the Delaware, northward to Canada, May and June. A month later the empty fish descend to the river in an emaciated condition, followed by the young somewhat later.

SEASON IN R. I.: Arrives last of March and runs for about six weeks. A large specimen taken August 3, 1905, at Rumstick Point. Specimen three inches long, taken October 29, 1905, Dutch Island Harbor; this was probably hatched from spawn of the previous spring, and was then

on its way to salt water. Dates of arrival in Taunton River from 1871 to 1883 range from March 10th, in 1880, to April 5th, in 1883. June 5, 1906, Hazard's Quarry trap, two specimens; in 1906, arrived at West Passage traps middle of March. Specimen taken in Warren River, March 23, 1910.

REPRODUCTION: Spawning takes place in fresh water in April and May. Spawns in May and June. The eggs after being laid roll loosely on the rocks, sand, or shelving flats, in non-tidal parts of the rivers. Eggs are semi-buoyant, non-adhesive, one-eighth inch in diameter (3.24 mm.), and take eight days to hatch in water 60°F. Larva at hatching are nine twenty-fourths inch (9.29 mm.) long. The shad returns to salt water after spawning, as is shown by the capture of spent fish, "Racers" on the opposite side of the net.

FOOD: Like other members of this family, its chief food supply consists of minute free-swimming crustacea.

RATE OF GROWTH: Young, six to eight inches long, are taken in large numbers in the fall at Long Island. (Bean, 1901.) Larva doubles its length in ten days after hatching, measuring 3-5 inch (15.73 mm.) in length; in 20 days it is 4-5 inches (19 mm.) long; in 40 days is 2 to 2½ inches (56.95 mm.) long. On the seventieth day it reaches three or four inches (75 to 100 mm.), in four months, five to seven inches (125 to 175 mm.). Shad, three to five inches long taken in rivers from September to February; in Potomac River specimens three inches long are abundant in November, at which time shad five to seven inches long are found in Maine rivers. Shad nine to thirteen and one-half inches are frequent in Canadian waters in October, which must be the young of the preceding year. (Prince, 1907.)

REFERENCES:

- 1872: YARRQW, Report U. S. Fish Com. I, 452.
- 1882: RYDER, Bull. U. S. Fish Com. II, 179.
- 1891: WORTH, Bull. U. S. Fish Com. XI, 201.
- 1897: BRICE, Report U. S. Fish Com. XXIII, 133.
- 1907: PRINCE, Further Contributions to Canadian Biology, 100.

44. *Opisthonema oglinum* (LeSueur). *Thread Herring.*

GEOG. DIST.: West Indian fauna, straying to Cape Cod. Taken at intervals at Buzzards Bay and Vineyard Sound, (Smith, 1898). Abundant in July and August at Gravesend Bay, (Bean.)

SEASON IN R. I.: The type specimen described in 1817 by LeSueur was taken at Newport. (Jour. Ac. Nat. Sci. Phila., I, 1817, 359.) In the

U. S. National Museum is a specimen taken at Newport by the U. S. Fish Commission. (Bull. U. S. Nat. Mus., 1879, 60.) A few have been taken very rarely since.

45. **Brevoortia tyrannus** (Latrobe). *Menhaden; Pogy; Bony Fish.*

GEOG. DIST.: Nova Scotia to Brazil.

MIGRATIONS: The migrations of the menhaden are largely determined directly by the water temperature; they enter the coast waters in the spring when the average harbor temperature reaches about 50° F., and leave in the autumn when the temperature falls below that point. The approximate time of the arrival of the first schools is given as follows, by G. Brown Goode: Chesapeake Bay, March and April; New Jersey, April and early May; south coast of New England, late April and May; Cape Ann, middle May; Gulf of Maine, last of May and June. They leave the Maine coast in September and October; Massachusetts, in October and November and December; Long Island Sound, November and December; Chesapeake Bay, December; Cape Hatteras, January; further south they remain throughout the year. It will be seen that they arrive somewhat later than the shad and alewife, about the same time as scup, and in advance of the squeteague and bluefish, and remain longer in the autumn than any of these, except possibly the two last-named species. This order of appearance is what would naturally be expected in view of the fact that the squeteague and bluefish are both carnivorous, and feed largely upon the schools of the menhaden. (Goode, History of the Menhaden, Report of the U. S. Fish Com. 1877.)

SEASON IN R. I.: They appear last of April or first of May and are present throughout the summer and fall. Most abundant in May when first arriving, and in October when falling temperature is driving them away from northern shores. They finally leave in November and December. October 29, 1905, Dutch Island trap, few specimens; April 27, 1906, menhaden fishery opened off southern Rhode Island shore, and the "Annie L. Wilcox" secured a small fare; April 16, 1906, Dutch Island trap, first specimen of the season; April 30, 1906, Dutch Island trap, six specimens; June 5, 1906, Hazard's Quarry trap, 100 large specimens; July 9, 1906, Sand Blow trap, half barrel, medium size; August 8, 1906, Goose Neck trap, few small specimens; September 11, 1906, Dutch Island trap, one-half barrel; September 17, 1906, West Passage traps, one-half barrel, very fat ones.

REPRODUCTION: Spawns in December, probably, and in May and June; the location of the spawning grounds is at present uncertain.

(See Smith, Bull. U. S. Fish Commission, XV. 1895, 301, Rathbun Reports, U. S. Fish Commission XIX, 1893, 38, and XX, 1844, 94 and XXI, 1895, 82. The latest discussion of this question is by Kendall, Bull. U. S. Bureau of Fisheries, XXVIII, 1908, 279.)

An examination of the condition of the reproductive organs of menhaden from different localities in this vicinity was undertaken in an attempt to answer the question: Do females about to spawn have any decided tendency to approach the shore? Too few have been examined to justify an answer, but the following data are given as a matter of record. Records of examination of the condition of the reproductive organs of menhaden; made by H. C. Tracy, off the south shore of Long Island, eight miles west of Montauk Point, May 22, 1906:

Time, noon. Weather, fair. Wind, southwest.

2 females, intermediate.

1 male, intermediate.

2 males, immature.

12 females, spent.

(These taken from a catch of 8,000 fish.)

Place, two miles off south shore of Long Island, five miles west of Montauk, 8 A. M., May 22, 1906.

22 females, spent.

35 males.

2 females, intermediate.

4 females, partly spent.

(Taken from catch of 3,000 fish.)

Date and place, as above. Time, 10 A. M.

21 males.

23 females, spent.

3 females, intermediate.

(A very few males had large testes.)

(Taken from haul of 2,000 fish.)

Records of examination of the condition of the reproductive organs of menhaden; made by H. C. Tracy, June 5, 1906. Dutch Island Harbor trap:

Time, 1 P. M. Weather, fair. Wind, southwest.

6 females, intermediate.

6 females, spent.

9 males, intermediate.

4 females, spent.

Date, the same; time, 11 A. M.; trap, at Hazard's Quarry.

20 females, intermediate.

8 females, spent.

6 males, spent.

6 males, spent.

FOOD: The whole food supply of this fish is obtained by filtering out from the surface stratum of water the organic life there suspended. The arrangement of the gill rakers forms a very effective filter of the water which the fish takes in by swimming actively in circles through the water with wide-open mouth and expanded gill-covers. The stomach generally appears comparatively empty, but usually has a small quantity of what appears to be a dark greenish or brownish mud, with a variable quantity of copepods and small crustacea intermixed. This may be demonstrated by observing the habits of the living fish, by the study of the gill rakers, and by collecting on a filter the organic matter suspended in a given quantity of surface water and by comparing the matter thus filtered out with the stomach contents of the menhaden. The following animals have been found: a few annelids, a few rotifers, the smaller crustacea, like *Gammarus* and young shrimp, Zoea larva, *Nauplius* larva, copepods. But the great majority of organisms were *Glenodinium*, *Perdinium*, Infusoria, and unicellular plants like diatoms, algal swarm spores, and bacterial masses. (On the Food of the Menhaden, by J. H. Peck, Ph. D., Bull. U. S. Fish Commission, 1893, 113.)

RATE OF GROWTH: Adults are the large fish fifteen to eighteen inches in length. Schools of fishes from two to five inches long arriving at New England in midsummer are probably hatched from spawn of the previous fall and spring. The seven to ten-inch fishes are two years old. The following specimens have been taken at Wickford: August 14, 1906, Sauga Point, seine, four specimens one inch; August 8, 1906, Mill Cove, with hoop net and lantern, at night, many specimens 1 to $1\frac{1}{4}$ inches (26 to 32 mm.); August 8, 1906, Point Wharf, seine, three specimens one inch; July 25, 1908, seine, 37 mm.; August 10, 1908, seine, 37 mm.; August 13, 1909, seine, Cornelius Island, 42 mm., 40 mm., 37 mm., 41 mm. Bean gives the following measurements of young taken at Great South Bay, Long Island: July 24th, specimens $2\frac{3}{4}$ inches; August 8th, $3\frac{3}{4}$ to $4\frac{1}{4}$ inches; August 21st, $3\frac{1}{2}$ to $4\frac{1}{4}$ inches; August 23rd, $5\frac{1}{4}$ inches; September 14th, $5\frac{1}{2}$ to $5\frac{3}{4}$ inches.

ENGRAULIDIDÆ. The Anchovies.**45. *Stolephorus brownii* (Gmelin). *Striped Anchovy; Anchovy.***

GEOG. DIST.: Cape Cod to Brazil. Abundant southward.

At Woods Hole: "Much the most numerous species of Anchovy" (Smith, 1898); from August to late in the fall, also reported there by Baird, 1873 (?), and Bean, 1880; not otherwise recorded from New England. Sometimes very abundant at Long Island (Bean, 1903).

SEASON IN R. I.: Specimen, $1\frac{1}{2}$ inches long, dredged by the "*Fish Hawk*" in Narragansett Bay, November, 1898. This species is undoubtedly rare in Narragansett Bay, but its abundance at Woods Hole would lead us to believe it to be common in outside waters.

REPRODUCTION: Young taken September first on Long Island (Bean).

FOOD: Annelids, copepods, sometimes univalve molluscs, foramenifera.

SIZE: Four to six inches.

46. *Stolephorous mitchilli* (Cuvier and Valenciennes). *Anchovy.*

GEOG. DIST.: Cape Cod to Texas. Reported from Casco Bay, Maine (Kendall, 1908), and from Massachusetts, at Provincetown (Storer, 1859), and Woods Hole (Smith, 1898). Abundant at Long Island (Bean, 1903).

SEASON IN R. I.: Abundant from May to October. Forms an important part of the so-called "white bait."

REPRODUCTION: Eggs and larvæ are very abundant in the tow in Narragansett Bay from about July 10th to August 15th. Eggs are pelagic, small (about .7 or .8 mm. in diameter), and have segmented yolk like almost all other Clupeoid fishes. Spawning probably takes place in the open waters of Narragansett Bay. Larvæ about 2.8 mm. long when hatched.

HABITAT: Sandy shores, entering rivers.

FOOD: Microscopic crustacea and marine larvæ; small shrimp amphipods.

SIZE: Adults are about two and a-half inches. Following are the lengths of anchovies taken in rearing cars of lobster plant at Wickford in 1908: July 22, specimens 4.7 mm., 4.5 mm.; July 25, specimens 17 to 18 mm., none larger; July 31, many specimens 24 mm.; August 1, 5.2 mm.; August 3, 4.8 mm., 5.3 mm., 6.6 mm., 7.8 mm., 9.7 mm.; August 3, several specimens 23 mm. to 25 mm.; August 4, very many specimens 8 to 26 mm.; August 4, many specimens 14 to 20 mm. 2,000 specimens (measuring 15 to 20 mm.) on August 8 came into rearing car during the night through one-half inch mesh screen put in August 7; October 6, sample specimens in cars measured 29,

26, 39, 42, 47, 33, 53 mm. Probably several of the larger sizes were lost in taking out. Young are found in abundance, the remainder of the season, until the last of October, when they reach a length of 40 mm. to 55 mm.

SALMONIDÆ. The Salmon Family.

47. *Salmo salar* (Linnæus). *Salmon*.

GEOG. DIST.: North Atlantic, ascending rivers between Cape Cod and Hudson Bay. Formerly south to Hudson River, and abundant in all New England States.

MIGRATIONS: Ascends New England rivers in May and June.

SEASON IN R. I.: Small fish, weighing two to three pounds, are taken in Sakonnet River in the spring nearly every year. May 8, 1907, a salmon weighing 22 pounds was caught by Captain Petty at Sakonnet Point.

REPRODUCTION: Eggs are about 1-5 inch in diameter and are laid from October to December in water not warmer than 50°; they are deposited in shoal water on sandy bottom in deep depressions made by the parent fish. The hatching period ranges from 140 to 200 days or more, depending on the temperature. When hatched the larva is about $\frac{3}{4}$ of an inch long and the yolk sac is absorbed in about a month or six weeks.

FOOD: The adult salmon in the sea feeds on herring, sand larvæ, smelt, and other small fishes, besides crustaceans, but during its stay in fresh water it takes no food.

SIZE: Fifteen to forty pounds, maximum sixty pounds. At the age of ten months the lava measures about $1\frac{1}{2}$ inches.

REFERENCES:

1890: McINTOSH and PRINCE, Trans. Roy. Soc. Edinburgh, Vol. 35, 886.

1898: BRICE, Report U. S. Fish Com. XXIII, 27.

1903: BEAN, Catalogue of the Fishes of New York, N. Y. State Museum Bulletin, 60, 246.

48. *Salvelinus fontinalis* (Mitchill). *Brook Trout; Speckled Trout*.

GEOG. DIST.: East of the Mississippi, Savannah to Labrador.

MIGRATIONS: In fall, where communication exists, enters salt water, remaining through the winter.

SEASON IN R. I.: Common in fresh-water streams throughout the State. Reported from brooks and small streams in Foster, Scituate, Gloucester (Moosquitohawk and Huntinghouse brooks), North Smithfield, Burrillville (Sucker and Brandy brooks), Coventry, West Greenwich, Exeter, and North Kingstown.

HABITAT: Clear, swift, fresh-water streams where the temperature does not exceed 68°.

REPRODUCTION: Eggs are one-fifth inch in diameter, varying in color from pale lemon to orange red. The spawning season varies with the temperature of the water, but usually takes place from the last of September to December. Eggs are deposited in cavities made in the gravel and covered with pebbles. Period of hatching ranges from 32 days in water of 54° to 165 days in water of 37°. Yolk sac absorbed in 30 to 80 days. (Bean, loc. cit., p. 274; Brice, Report U. S. Fish Com. XXIII, 1897, 91.)

FOOD: Carnivorous. Feeds on nearly any small living creature, including insects, other small invertebrates, small fishes, its own eggs and young, tadpoles, water newts, etc.

SIZE: Maximum eighteen inches, but average between eight and twelve inches.

ARGENTINIDÆ. The Smelts.

49. *Osmerus mordax* (Mitchill). *Smelt*.

GEOG. DIST.: The Atlantic coast, Virginia to the Gulf of St. Lawrence.

SEASON IN R. I.: Present throughout the year, but most abundant in March and April, especially at Narrow River where a commercial fishery of considerable importance exists. Abundant in Warren and Pawtuxet Rivers; also in the streams emptying into the salt water between Narrow River and Watch Hill. A few specimens taken in the seine throughout the summer and early fall on sandy shores in the vicinity of Wickford. July 17, 1906, six specimens about 6 inches long (150 mm.) seined at Cornelius Point. August 20, 1908, three specimens about 5½ inches long (140 mm., 135 mm., and 130 mm.) seined at Cornelius Point. They were unusually common in 1909, several being taken frequently in the seine from July to September.

REPRODUCTION: Spawns in February and March, in fresh-water streams and brooks. The eggs are 1-20 inch in diameter and adhere to stones, twigs, etc., on the bottom (Brice, 1897).

According to Ehrenbaum, the eggs are .9 mm. in diameter, contain numerous oil globules, and the period of incubation is four or five weeks.

The newly hatched larva is one-quarter inch long (5.5 to 6 mm.).

FOOD: Shrimp and other small crustacea.

SIZE: Maximum, 14 inches.

REFERENCES:

1886: CUNNINGHAM, Trans. Roy. Soc. Edinburgh, 33, 98.

1897: BRICE, Report U. S. Fish Comm. XXIII, 188.

1909: EHRENBAUM, Nordisches Plankton, 10, 343.

SYNODONTIDÆ. The Lizard-Fishes.**50. *Synodus foetens* (Linnæus). *Lizard-fish.***

GEOG. DIST.: Cape Cod to Brazil, common in deep water from South Carolina southward, moving into shallow water in summer. A few taken nearly every September at Woods Hole (Smith, 1898). Common on Long Island shore (Bean, 1903).

SEASON IN R. I.: Specimen from Narragansett Bay (R. I. Fish Com., 1899).

FOOD: A voracious fish, feeding on small fishes. (Holbrook, 1860.)

SIZE: Twelve inches.

LUCIIDÆ. The Pikes.**51. *Lucius americanus* (Gmelin). *Banded Pickerel.***

GEOG. DIST.: Massachusetts to Florida, east of the Allegheny Mountains. Not reported from Maine and New Hampshire, but common in Massachusetts. Found on Long Island.

HABITAT: Fresh water, in lowland streams and swamps.

SEASON IN R. I.: Present generally in muddy and sluggish rivers and ponds. Recorded from Pocasset River, Dyer's Pond, and Pawtuxet River.

FOOD: Small minnows.

SIZE: Twelve inches.

52. *Lucius reticulatus* (LeSueur). *Pickerel; Green Pike.*

GEOG. DIST.: Common everywhere east of the Allegheny Mountains, Maine to Florida, and to Arkansas and Louisiana. Common throughout the New England States.

HABITAT: Fresh water of rivers and ponds.

SEASON IN R. I.: Found nearly everywhere throughout the State. Recorded from Pocasset River, Pawcatuck River, Queens River; also from the following ponds: Dyer's, Sucker, Worden's, Beach, Blackmars, Mashapaug, Moswansicut, and Sneach; and from these reservoirs: Bowdish, Smith and Sayles, Waterman, Pascoag and Poneganset. Also present in fresh-water ponds on Block Island.

REPRODUCTION: Little known of its breeding habits except that it spawns in the spring. Mature female taken March 15, 1875, at South Framingham, Mass. (Amer. Nat. XI, 1877, 494). (Description and pictures of young specimens are given by Ryder, Report of U. S. Fish Com. XIII, 1885, 516. For eggs and development of the European pickerel (*Esox*

lucius) see Ehrenbaum, Nordisches Plankton, 10, 1909, 376; note on the spawning season, Walke, Bull. U. S. Fish Com. III, 1883, 245.)

FOOD: Voracious, carnivorous; feeds on other fishes of all kinds and on small aquatic animals. The young feed on insects and aquatic larvæ. (Sturtevant, Amer. Nat. V, 1871, 313.)

SIZE: Maximum, 27 inches.

POECILIIDÆ. The Killifishes.

53. *Fundulus majalis* (Walbaum). *Mayfish*; *Killifish*.

GEOG. DIST.: Massachusetts to Florida. Common along whole New England coast from Massachusetts southward.

HABITAT: Along shores, especially sandy beaches.

SEASON IN R. I.: Probably a permanent resident, but common in shore waters through April and May until late in the fall. Recorded from Providence River, Conimicut, Quonset, Wickford, and Plum Beach.

REPRODUCTION: Spawns in June and July. Eggs laid in the sand at high tide. (Newman, Biological Bull. XII, 1907, 314.)

FOOD: Small crustacea, especially shrimp and copepods; molluscs, and annelids.

SIZE: Four to six inches. Probably becomes mature in second year.

54. *Fundulus heteroclitus* (Linnæus). *Mummichog*; *Common Killifish*.

GEOG. DIST.: From Nova Scotia to the Rio Grande. Reported at Canso by Cornish (1907).

HABITAT: Shores and brackish waters, in eel-grass and on muddy bottoms, especially at the mouth of fresh-water streams.

SEASON IN R. I.: Most abundant of the mummichogs, and very common at all seasons along the whole shore.

REPRODUCTION: Spawns in June and July. Eggs are laid in the sand at high tide near the water's edge. They are large, adhesive, and are laid in masses. They require nine or ten days for hatching. Larval stages are mostly passed in the egg, so that soon after hatching, the yolk-sac is taken inside the body and the fish swims freely and effectually. Probably becomes mature in second year. (Newman, Biological Bulletin, XII, 1907, 314.)

55. *Fundulus heteroclitus macrolepidotus* (Walbaum).

This is a variety of the preceding. ¶ Very common everywhere in brackish waters from Maine to Virginia. Specimens from Newport described by LeSueur. (Jour. Ac. Nat. Sci. Phila. I, 1817, 133.)

56. *Fundulus diaphanus* (LeSueur). *Spring Minnow; Killifish.*

GEOG. DIST.: From Maine to Cape Hatteras. Common along the whole New England coast.

HABITAT: Around shores fed directly by fresh-water streams.

SEASON IN R. I.: Found throughout the year, but not so common as the other species of this family.

SIZE: Four inches.

ESOCIDÆ. The Needle-Fishes and Garfishes.**57. *Tylosurus marinus* (Walbaum). *Garfish; Billfish.***

GEOG. DIST.: From Maine to Texas. Frequently recorded along the whole New England coast.

HABITAT: Salt and brackish water around shores, sometimes entering rivers. Goode found specimens 30 miles up the Connecticut River, June, 1871. (Amer. Nat. V, 1871, 439.)

SEASON IN R. I.: Common from June to October. Specimens from Newport mentioned by LeSueur, 1821. Specimen two feet long in Roger Williams Park Museum taken July 26, 1897, at Rocky Point. August 28, 1905, several large ones were taken at the Cold Spring Beach, Wickford. On August 13, 1909, two specimens were taken in a seine at Cornelius Island, one had in its stomach three adult *Fundulus heteroclitus*; the other was a female, with the ovaries nearly spent, but containing a few large but immature eggs. Specimens, both adult and young, are occasionally seen swimming at the surface of inshore waters on calm days. In Mill Cove adults are sometimes speared at night like eels. July 25, 1908, with acetylene lamp, two specimens were taken in Mill Cove, 160 mm.

REPRODUCTION: Probably spawns in the bays in May and June. Grows very rapidly and probably is mature in the second year. Ryder, in July and August, found specimens of this species in abundance in a spawning condition at Cherrystone, Virginia, near the mouth of the Chesapeake Bay. Egg is about one-seventh inch in diameter. The eggs have a thick membrane covered with numerous filaments which fasten the eggs together in clumps and attach them to submerged objects. (Ryder, Bull. U. S. Fish Com., I, 1881, 283.)

FOOD: Fishes, especially *Menidia* and *Fundulus*; crustacea, shrimp, amphipods; annelids.

RATE OF GROWTH: July 9, 1909, a specimen swimming at surface, in alleyway of lobster rearing plant, measured one inch (24 mm.); it

was put in a filter car and on August 2nd measured $3\frac{1}{2}$ inches (85 mm.). Young specimen, 20 mm., found in alleyway of hatchery on the surface June 29, 1909. Specimen 25 mm., July 1, 1909, in similar place.

July 20, 1905, young specimens three inches long were taken from the seine at Cold Spring Beach, Wickford. July 27, 1908, a specimen 117 mm. was seined at Quonset Point; and a specimen $7\frac{1}{2}$ inches (185 mm.) was seined on August 8, 1908, at Cornelius Island; August 6, 1909, 75 specimens were taken in a seine in one haul on the north shore of Cornelius Island. They range from 5 to 8 inches (120 to 205 mm.). Average of 37 specimens was $6\frac{1}{3}$ inches (157 mm.). August 11, 1909, two specimens, 4 and 5 3-5 inches (98 and 140 mm.) were seined at Cornelius Island.

August 14, 1906, a dozen specimens three to eight inches long were taken in a seine in Viall's Creek. August 19, 1909, three specimens, 3 1-5 to $9\frac{1}{3}$ inches (180 mm., 200 mm., 233 mm.) were taken at Cornelius Island in a seine, and August 20, 1909, three specimens 5 to 8 inches long (200 mm., 125 mm., 190 mm.), were taken at the same place. Average of 6 specimens taken September 2, 1909, seine, Cornelius Island, was 125 mm., ranging from 107 mm. to 224 mm. Bean took a specimen on Long Island shore $2\frac{1}{2}$ inches long July 24. At Woods Hole a specimen 5 inches (123 mm.) was taken July 25th; a specimen 6 1-5 inches (155 mm.) was taken on August 2nd. (Eigenmann, 1901.)

Since all gradations in size from 3 or 4 inches to over 8 inches are common the last of August, it seems probable that most of these are the young of the year. Females with ripe ovaries are taken not much longer than the largest of these, and it is therefore probable that some individuals of this species become ripe in the second season.

HEMIRAMPHIDÆ. The Halfbeaks.

58. *Hyporhamphus roberti* (Cuvier and Valenciennes). *Halfbeak; Skipper.*

GEOG. DIST.: Coasts of America on sandy shores. Common at Vineyard Sound and Menemsha Bight. Occasionally on Long Island shore (Bean).

SEASON IN R. I.: Occasional in summer and early fall. The first specimen from Rhode Island was taken by Samuel Powell at Newport and described by Gill in 1862. Specimen from Newport mentioned by Cope, 1870.

HABITAT: Sandy shores.

FOOD: Almost exclusively algæ.

SIZE: Twelve inches. At Woods Hole taken from three to eight inches.

59. Euleptorhamphus velox (Poey).

GEOG. DIST.: West Indies, occasionally northward in the Gulf Stream to Massachusetts. Rare. Taken off Nantucket (Putnam, 1870).

SEASON IN R. I.: Specimen in the U. S. National Museum, taken at Newport by Mr. Brown. (Bull. U. S. Nat. Museum, 1879, 55.)

SIZE: Eighteen inches.

SCOMBERESOCIDÆ. The Sauries.

60. Scomberesox saurus (Walbaum). *Saury; Billfish.*

GEOG. DIST.: Common in schools in open seas north of Cape Cod and of France. Recorded several times from the coast of Maine and Massachusetts (Kendall, 1908). According to Dr. Smith this species is abundant north of Cape Cod. Rare at Woods Hole; recorded from Long Island Sound (Linsley, 1844).

HABITAT: Surface of north temperate seas. (For note on the habits of this species, see Bean, Fishes of New York, 1903, p. 329).

SEASON IN R. I.: Rare. One specimen is in possession of the commission, presented by Mr. J. M. K. Southwick, of Newport, and dated 1899. Two specimens presented by Mr. John Curran, taken off Sakonnet, about July 10, 1909.

REPRODUCTION: Spawning apparently takes place in the open sea near the surface. The eggs are pelagic, but are, nevertheless, provided with filaments. The spawning season is unknown. The youngest known larva is about three-fifths inch long (15 mm.). (Ehrenbaum, Nordisches Plankton, 4, 1905, 136.)

RATE OF GROWTH: Pelagic young up to $1\frac{1}{2}$ inches were taken in the Atlantic in March, April, and May by the "*Challenger*." Young specimen $13\frac{1}{2}$ inches in length was taken in St. Andrew's Bay in October. This was probably in its second year. (McIntosh and Masterman, British Marine Food Fishes, 1897, 403.) Adults reach a length of eighteen inches.

EXOCÆTIDÆ. The Flying-Fishes.

61. Parexocætus mesogaster (Bloch). *Black-wing; Flying-fish.*

GEOG. DIST.: Tropical seas, common in the East Indies and West Indies, and in the Hawaiian Islands. North in the Gulf Stream to Newport.

SEASON IN R. I.: Specimen reported by Goode from Block Island, 1879.

A specimen $5\frac{1}{2}$ inches long, from Newport, is in the Museum of the Academy of National Sciences at Philadelphia. (Jordan and Meek, Proc. U. S. Nat. Mus., 1885, 47.) Not otherwise recorded from New England or New York.

SIZE: Seven inches.

62. *Exocoëtus speculiger (Linnæus). *Flying-fish*.**

GEOG. DIST.: Open seas, north to the Grand Banks, southern Europe and Hawaiian Islands. Recorded from Vineyard Sound and Woods Hole (Baird, 1873, and Smith, 1898), where it is sometimes common; in Connecticut, from New Haven and Stonington (Lindsley, 1844).

SEASON IN R. I.: Specimen in U. S. National Museum, taken at Block Island by U. S. Fish Commission, August, 1874.

REPRODUCTION: Some eggs obtained near Naples in June and July, 1894, were identified as those of an exocoëtine, and described by Raffæls. They were found attached to floating bodies by means of filaments not unlike those of *Scomberesox*. (Gill, Report Smithson. Inst., 1904, 504.)

FOOD: Carnivorous; feeding on small fishes, crustaceans, and such molluscs as pteropods and janthinids.

RATE OF GROWTH: Young an inch long and upwards are often seen in mid ocean. At Woods Hole, young $1\frac{1}{2}$ to 4 inches in length are sometimes taken in the seine in the harbor in the latter part of September and the first of October. (Smith.)

63. *Cypsilurus heterurus* (Rafinesque). *Flying-fish*.

GEOG. DIST.: Atlantic Ocean, common southward on both coasts, straying northward to Banks of Newfoundland and to England. Recorded at Woods Hole and Menemsha Bight (Smith, 1900).

SEASON IN R. I.: Specimen from Block Island, mentioned by Goode, 1879.

SIZE: Fifteen inches.

64. *Cypsilurus furcatus* (Mitchill).

GEOG. DIST.: Common in warm seas, north to Cape Cod and Mediterranean.

SEASON IN R. I.: Two specimens from Newport, one $5\frac{1}{2}$ inches, the other six inches in length, are in the Museum of the Academy of Natural Sciences at Philadelphia. (Proc. U. S. Nat. Mus., 1885, 61.) These are apparently the specimens described by Jordan and Evermann, in "The Fishes of North America."

SIZE: Six inches.

*Gill, Report Smithson. Inst., 1904, 505.

65. *Cypsilurus gibbifrons* (Cuvier and Valenciennes).

Two specimens only are known; one, the type specimen nine inches long obtained by Dussumier in the Atlantic Ocean and presented by him to the Museum d'Histoire Naturelle at Paris; the other, a young specimen eight inches long, taken by Mr. Samuel Powell at Newport, R. I., and described by Jordan in 1886. (Proc. U. S. Nat. Mus., 1886, 528.)

GASTEROSTEIDÆ. The Sticklebacks.**66. *Pygosteus pungitius* (Linnæus). *Nine-spined Stickleback.***

GEOG. DIST.: Northern parts of Europe, and Atlantic coast of North America from Long Island to the Arctic Sea, also in tributaries of the Great Lakes and northward to the Saskatchewan and Alaska; fresh and brackish waters. (Jordan and Evermann, p. 745.) Common in Maine and Massachusetts and Long Island; reported from Connecticut from Housatonic (Linsley, 1844) and Hockanum River (Ayres, 1844).

HABITAT: Fresh-water streams, and land-locked ponds and lagoons (Bean).

SEASON IN R. I.: Specimens from Warwick, R. I., in Roger Williams Park Museum (identified by Mr. T. E. B. Pope).

REPRODUCTION: Spawns from May to July (Europe). Eggs are orange colored $\frac{1}{25}$ inch (1 mm.) in diameter, and laid in nests. Hatch in 12 days. (For description of eggs and young, see Ehrenbaum, Nordisches Plankton, 10, 1909, 319.)

FOOD: Said to be extremely destructive of the eggs of other fishes.

SIZE: Three inches.

67. *Gasterosteus bispinosus* (Walbaum). *Two-spined Stickleback.*

GEOG. DIST.: From Labrador to New Jersey.

HABITAT: Brackish and salt water; tidal creeks.

SEASON IN R. I.: Very common at all seasons.

REPRODUCTION: From May to August it spawns in nests guarded by the male. July 7, 1906, specimens two inches long, full of eggs, seined head of Mill Cove. Sexually mature individuals found at Falmouth in May, 1898 (Bumpus, 1898). (The young of the closely related species *G. aculeatus* has been described by A. Agassiz, Proc. Amer. Acad. XVII, 1882, 228, and by Ehrenbaum, Nordisches Plankton, 10, 1909, 318.)

FOOD: Small invertebrates; fish eggs and fry.

SIZE: Four inches.

68. *Apeltes quadracus* (Mitchill). *Four-spined Stickleback.*

GEOG. DIST.: From Maine to New Jersey. Common.

HABITAT: Fresh, brackish and salt water along the shores. Very common in salt marshes and at the mouths of rivers.

SEASON IN R. I.: Common at all seasons. Can be taken in the seine at all times of the year along muddy and weedy shores.

REPRODUCTION: Similar to the two preceding species. Sexually mature individuals taken at Falmouth May 1898, (Bumpus, 1898). Spawns in April, May, and June. Eggs are $\frac{1}{2}$ inch in diameter. They are laid in nests and adhere together in masses of 15 to 20, the number laid at one time. The nest is built by the male. (Ryder, Bull. U. S. Fish Com. I, 1881, 24; Ryder, Report U. S. Fish Com. XIII, 1885, 511.)

FOOD: Copepods.

SIZE: Two inches.

FISTULARIIDÆ. The Cornet-Fishes.

69. *Fistularia tabacaria* (Linnæus). *Trumpet-fish.*

GEOG. DIST.: West Indies north to Woods Hole. Common from New Jersey southward. Not common on Long Island (Bean). At Woods Hole a few observed every year (Smith). In Massachusetts recorded from Holmes Hole (Storer, 1839), Rockport (Goode and Bean, 1879), Woods Hole (Goode 1879), Buzzards Bay (Smith, 1898).

SEASON IN R. I.: Rare. Reported in Narragansett Bay by R. I. Fish Commission, 1899.

SIZE: Maximum length, six feet. The usual size at Woods Hole is seven or eight inches; the smallest, four inches; the largest, sixteen inches.

SYNGNATHIDÆ. The Pipe-Fishes.

70. *Siphostoma fuscum* (Storer). *Pipe-fish.*

GEOG. DIST.: The Atlantic coast of the United States, Cape Ann to Virginia. Common along the whole New England coast.

HABITAT: Brackish and salt water among eel-grass and sea-weed. Specimens taken in 1895, with menhaden, at all distances from the shore out to 3 and 5 miles. (Smith, Bull., U. S. Fish Commission, XV, 1895, 294.)

SEASON IN R. I.: Common throughout the summer in the eel-grass along the shores and in salt ponds. Two specimens were taken in offshore waters in purse seines, with menhaden, in July, 1904. August 13, 1906, many specimens dredged in upper Mill Cove.

REPRODUCTION: The breeding season extends from March to August. The reproductive habits of the pipe-fish have been described by Gudger (1906). There is a copulation in which eggs are transferred by the female into a brood pouch of the male, where they are retained until the young

are hatched and the yolk sac has been absorbed. The young when released from the brood pouch are from $\frac{1}{3}$ to $\frac{2}{5}$ (8 to 10 mm.) in length. 10 specimens hatched at Experiment Station June 13, 1910, averaged 8.5 m., ranging from 8 to 9.4 mm. (W. E. Sullivan.) The following specimens with eggs have been taken at Wickford:

May 30, 1910, 2 males, having eggs showing eye spots were taken in seine, Cornelius Island; hatched June 13. One male, with young taken with light at night, June 8, (Sullivan.) July 7, 1906, seine, north shore of Mill Cove, male and female specimens, each with eggs. July 7, 1906, Cornelius Island, seine, several males and females, each with eggs, those in male showing eye spots. July 17, 1908, male taken in seine; in its pouch were young which soon swam free. August 13, 1906, many specimens, each with eggs. Females with eggs were taken in Narragansett Bay March 22, 1907 (Bumpus, Science, VII, 1898, 485). Breeding pipe-fish seined from eel-grass on May 13, and have been found with pouches filled with egg as late as July 13 at Woods Hole (Bumpus, Science, VIII, 1898, 58).

FOOD: Small crustacea, amphipods and copepods.

RATE OF GROWTH: The rate of growth of specimens hatched in a filter car at the Wickford Station is shown by the following tables. These figures represent averages of measurements of several individuals taken out at irregular intervals. No food was given to them except that which came in with the water by means of the chain of buckets. (See Mead, 1908, 102.)

	Mm.		Mm.		Mm.
July 17.....	10.0	July 30.....	44.0	August 15.....	67.2
July 18.....	11.4	July 31.....	46.1	August 20.....	69.4
July 20.....	21.8	August 2.....	52.6	September 8....	†71.3
July 23.....	24.5	August 6.....	61.6	September 14....	†70.0
July 25.....	27.5	August 8.....	58.6		
July 27.....	26.5	August 11.....	67.4		

On August 21 the remaining specimens were transferred to another filter car with canvas lining, where they remained, alive and well, up to September 19.

On July 21 another pipe-fish was caught with a brood pouch full of young which measured 10 millimeters. These young were placed, together with the second lot of *Menidia*, in a filter car rigged with a chain of buckets, like the original one. These specimens lived and thrived equally well. No food was given them except on one or two occasions. The data of growth is as follows:

	Mm.		Mm.		Mm.
July 23.....	10.7	August 6.....	37.8	September 8.....	59.0
July 27.....	19.0	August 8.....	41.8	September 14....	62.8
July 30.....	24.0	August 11.....	41.9		
August 3.....	31.4	August 15.....	45.2		

During July and August a great number of young of all sizes from $\frac{1}{16}$ inch (10 mm.) to 6 inches (150 mm.) are found in the lobster rearing cars: July 23, 1908, 65 mm.; July 31, 1908, 100 mm.; August 1, 1908, 44 mm.; August 6, 1908, 105 mm.; August 7, 1908, 77 mm. and 114 mm.; August 8, 1908, 149 mm. and 139 mm.; August 14, 1908, 65 mm.; August 15, 1908, 37 mm.; August 21, 1908, 47 pipe-fish, ranging from 19 mm. to 33.7 mm., average, 28.8 mm.

Other similar specimens are taken in the seine through the summer:—August 10, 1908, 72 mm. and 155 mm.; August 13, 1907, seine at Rabbit Island, specimen 80 mm.; August 20, 1908, seine, Cornelius Point, fifteen specimens average 139 mm.; ranging from 93 mm. to 187 mm.; September 2, 1909, nine specimens were taken, averaging 88 mm., ranging from 80 to 145 mm. Since all sizes up to six inches in length are to be found, and since the pipe-fish has such a long breeding season, it is probable that all the sizes above mentioned are the young of the year. They probably become mature when about a year old.

REFERENCES:

- 1885: RYDER, Report, U. S. Fish Com., XIII, 508.
 1906: GUDGER, Proc. U. S. Nat. Mus., XXIX, 447.

71. *Hippocampus hudsonius* (De Kay). *Sea-horse*.

GEOG. DIST.: Atlantic coast, Cape Cod to Charleston, S. C. Recorded in Massachusetts from Holmes Hole (Storer, 1839 and 1853), Provincetown (Atwood, 1850), Massachusetts Bay (Goode and Bean, 1879), Vineyard Sound (Smith, 1898). Not otherwise reported from New England. Occur in moderate numbers on the New England and New Jersey coast during the summer months; varies in abundance considerably in different years (Bean).

HABITAT: In the eel-grass and sea-weed along shores and in salt marshes.

SEASON IN R. I.: Not common. Rarely found floating in gulfweed and rockweed. Also sometimes taken on the bottom in shallow water. Specimen taken in Greenwich Bay in the oyster tongs, September 29, 1909. Two others taken in the same locality during the fall of 1909, one of which came up in a scallop dredge.

REPRODUCTION: The breeding season is during the summer. At hatching the young are $\frac{1}{2}$ -inch in length (10 to 12 mm.)

REFERENCES:

- 1867: LOCKWOOD, Amer. Nat. I, 225.
 1881: RYDER, Bull. U. S. Fish Com. Vol. 1, 191.
 1887: LOCKWOOD, Amer. Nat. XXI, III.
 1905: GILL, Proc. U. S. Nat. Mus. XXVIII, 805.
 1909: EHRENBAUM, Nordisches Plankton, 10, 322.

ATHERINIDÆ. The Silversides.

72. Menidia gracilis (Günther). *Silverside*.

GEOG. DIST.: Woods Hole to Albemarle Sound, common in brackish waters.

From New England, this species is recorded only from Cape Cod, from Buzzards Bay, and from Narragansett Bay. At Woods Hole it is reported to be very abundant in summer, remaining longer than *M. menidia* (Smith).

SEASON IN R. I.: Present throughout the summer, but not nearly as common as *M. menidia notata*.

REPRODUCTION: Many ripe females taken during July at Woods Hole. (For note on reproduction of this species and that of *M. notata*, see Bumpus, Science, N. S., Vol. 8, 1898, p. 850.)

SIZE: Three or four inches.

73. Menidia menidia notata (Mitchill.) *Silverside; Brit.*

GEOG. DIST.: Atlantic coast northward, south to Florida. Abundant from Maine to Virginia.

SEASON IN R. I.: Present throughout the year, but is very abundant everywhere from April to December. Along sandy shores, bushels of them can often be taken in the seine almost unmixed with other fish. Used to a great extent as bait for eel pots.

REPRODUCTION: Spawns in May, June, and early July, on sandy beaches.

Ryder thought this species to be a nocturnal spawner. The eggs are held in clusters by means of filaments, a tuft of which is developed from the pole of each egg. The females are larger than the males and in a school seem to be more numerous. Out of 380 specimens of *M. menidia* which were examined from Woods Hole, there were 204 females and 146 males. The females averaged 4.05 inches, the males 3.67 inches in length (Kendall, Report U. S. Fish Com. XXVII, 1901, 241.) The eggs are yellowish in color, and about 1.5 mm. in diameter. They hatch in about ten days in the summer, and the larva when hatched is about 4 mm. in length.

FOOD: Minute animal and vegetable organisms, particularly small crustaceans. Several have been found with young lobsters $\frac{3}{4}$ -inch long in their stomachs. Copepods, other free-swimming crustaceans and insects, are frequently eaten. Often mud, algæ, and diatoms from the bottom are found in their stomachs. These facts indicate that they feed both at the surface of the water and at the bottom. Fishes and fish eggs are sometimes eaten. Kendall gives in detail the results of the examination of the stomach contents of several hundred specimens taken at Woods Hole at different times between April and December (Kendall, 1901).

RATE OF GROWTH: Growth of the young is very rapid. At time of hatching, July 26, 1908, average length of a large number of specimens was $\frac{1}{2}$ -inch (3.85 mm.). These were incubated in a filter car at the Wickford Experiment Station. On August 15th, the average of a large number of specimens from the same lot was $\frac{2}{5}$ inch (9.3 mm.). Average of specimens taken from another lot hatched at the same time was $\frac{1}{2}$ -inch (11.72 mm.) on the same date. (For complete figures see Report, R. I. Fish Com., 39, 1908, 100.)

Growth under natural conditions is probably much more rapid. Specimens from an inch or less in length up to individuals of nearly adult size are constantly present through August and September. This is doubtless the result of the long spawning season of the species. It also probably indicates that many *Menidia* may grow to adult size in one year. On August 11, 1909, seine, Cornelius Island, average of 45 specimens was $1\frac{1}{2}$ inches (45.9 mm.), ranging from 1 inch (26 mm.) to $2\frac{3}{8}$ inches (65 mm.). One specimen three inches long, (76 mm.). Two inches was the average of 58 specimens taken on August 12, 1909, in seine at Cornelius Island, ranging from $1\frac{3}{8}$ inches (35 mm.) to $2\frac{2}{5}$ -inches (60 mm.). Average of 77 specimens taken August 13, 1909, in seine at Cornelius Island was $1\frac{3}{8}$ inches (40.6 mm.) ranging from $\frac{1}{2}$ -inch (21 mm.) to 4 inches (100 mm.). Seal took specimens $1\frac{1}{2}$ to 5 inches at St. Jerome, Maryland, September 20, 1889. (Bean, 1891.)

MUGILIDÆ. The Mulletts.

74. *Mugil cephalus* (Linnæus). *Striped Mullet; Jumping Mullet.*

GEOG. DIST.: Atlantic coast, Cape Cod to Brazil. Pacific coast, Monterey to Chili. Reported from Maine, at Wolfsneck, Casco Bay (Kendall, 1903, and Smith, 1902), from Massachusetts, Provincetown (Storer, 1852 and 1853), Woods Hole (Baird, 1873, Bean, 1880, and Smith, 1898).

From Connecticut, Stratford (Lindsley, 1844). Great schools on Long Island shore in September and October (Bean).

SEASON IN R. I.: July to November. A few young specimens taken each year at Wickford in the seine. This species, in company with the white mullet, is sometimes very abundant. In the middle of October, 1904, 500 barrels were taken at one haul off Newport. A specimen from Newport is in the U. S. National Museum. (Proc. U. S. Nat. Mus., 1880, 120) August 8, 1908, Cornelius Island, seine, 65 mm. August 12, 1909, Cornelius Island, seine, 37 mm.

FOOD: Stomach contents show a greenish mud containing large numbers of diatoms, green algæ, copepods.

SIZE: One to two feet.

75. *Mugil curema* (Cuvier and Valenciennes). *White Mullet; Jumping Mullet.*

GEOG. DIST.: Cape Cod to Brazil, Magdalena Bay to Chili. In New England, reported only from Woods Hole (Bean, 1880, Smith, 1898) and from Narragansett Bay (R. I. Fish Com. 1898). Half-grown specimens abundant at Long Island in September and October (Bean).

HABITAT: Lives in fresh water during several months of the year. Frequent shallow mud flats and runs up small creeks.

SEASON IN R. I.: Same as the preceding species.

REPRODUCTION: Spawning season begins in summer and lasts until November. Takes place in fresh or brackish water in bayous, river mouths, or heads of bays where the proper combination of grass, sand, and mud can be found.

FOOD: Food consists of minute organisms embedded in the bottom mud and is sifted before entering the gizzard-like stomach by passing through a filter in the pharynx.

SIZE: The average length twelve inches, and weight one and a quarter pounds.

SPHYRÆNIDÆ. The Barracudas.

76. *Sphyræna guachancho* (Cuvier and Valenciennes). *Barracuda.*

GEOG. DIST.: West Indies to Pensacola, straying north to Woods Hole.

In New England, reported only from Woods Hole (Goode and Bean, 1880), Buzzards Bay (Smith, 1898).

SEASON IN R. I.: Rare. Reported in Rhode Island, Narragansett Bay,

by R. I. Fish Com., 1899. A young specimen, eight inches long, taken in seine at Willow Beach, near Wickford, on July 17, 1905.

SIZE: Two feet.

77. *Sphyræna borealis* (DeKay). *Northern Barracuda.*

GEOG. DIST: Atlantic coast of the United States from Cape Fear to Cape Cod. Rather common northward. Young common at Woods Hole.

SEASON IN R. I.: A small specimen seven inches long taken in seine near Hamilton, July 20, 1905.

RATE OF GROWTH: Specimens from two to six inches common at Woods Hole after July, sometimes appearing in large schools (Smith). Young appear to be common along the coast south to New Jersey.

Adults are about one foot, maximum eighteen inches.

AMMODYTIDÆ. The Sand Launces.

78. *Ammodytes americanus* (DeKay). *Sand Lance; Lant; Sand Eel.*

GEOG. DIST.: Newfoundland to Cape Hatteras. Abundant along the whole New England coast.

HABITAT: Burrows in the sand in shoal water. Its habits have been described by Ayers, (quoted by Bean, Report N. Y. Fish and Game Com., VI, 1901, 417.) This species is important as the food of cod, halibut, and mackerel.

SEASON IN R. I.: Appears at all seasons, but is most plentiful in the fall. Specimen nine inches long taken at Newport (J. M. K. Southwick, July 1, 1906).

REPRODUCTION: Spawning season is probably in the winter.

FOOD: Worms and small fry.

RATE OF GROWTH: Largest grow to 16 inches, but are generally smaller, seldom over five or six inches. Young from one-half inch long are found at Woods Hole (Bumpus, 1898).

HOLOCENTRIDÆ. The Squirrel-Fishes.

79. *Holocentrus ascensionis* (Osbeck). *Squirrel-fish.*

GEOG. DIST.: West Indies about rocks and reefs; accidental on the coast. Recorded from Massachusetts, Katama Bay (?) (Bean, 1899, and Smith, 1900).

SEASON IN R. I.: This species has been taken at Newport. (Bull. U. S. Nat. Mus., 1879, 44.)

SIZE: Two feet in length.

MULLIDÆ. The Surmulletts.**80. *Mullus auratus* (Jordan and Gilbert). *Surmullett*.**

GEOG. DIST.: Ranges from Cape Cod to Florida. Abundant on the Red Snapper Banks of Florida. A few taken at Woods Hole each year in September (Smith, 1898). Occasional on Long Island shore (Bean, 1901).

SEASON IN R. I.: One or two specimens taken at Wickford each summer. None of these are over three inches in length. July 14, 1908, Cornelius Island, seine, two specimens. July, 1907, Poplar Point, shrimp net, specimen. July 10, 1909, Cornelius Island, seine, 45 mm., placed in filter car, on August 3rd measured 65 mm.

REPRODUCTION: Moore records on the Jersey shore a specimen $2\frac{1}{2}$ inches long July 26th, and a specimen $2\frac{5}{8}$ inches on August 10th. He believed these to be the only recorded captures of the young of this species on our coast (Moore, 1892). (The eggs and young of the European *M. surmulletus* is described by Ehrenbaum, Nordisches Plankton, 4, 1905, 21.)

RATE OF GROWTH: Eight inches.

SCOMBRIDÆ. The Mackerels.**81. *Scomber scombrus* (Linnæus). *Common Mackerel*.**

GEOG. DIST.: North Atlantic, abundant on both coasts. North to Norway and Labrador, south to Spain and Cape Hatteras.

MIGRATIONS: Appear in the spring when the water reaches 45° F. At sea, off Cape Hatteras, March 20 to April 25; Norfolk, March 2 to April 30; the Capes of Delaware, April 15 to May 1; Barnegat and Sandy Hook, May 5 to May 25; appear at the same date along the whole coast of New England and Nova Scotia; Gulf of St. Lawrence, May and early June. That these are coastwise movements is not positively known, though it is claimed by fishermen that the mackerel can be followed by the boats from southern waters to the north. In 1898 they appeared at Sakonnet, Chatham, Mass., and at Yarmouth, N. S., on the same day, May 3. In 1901 they reached Chatham on April 29, and the next day were taken at Cuttyhunk and Menemsha Bight. (The migrations of the mackerel are discussed in detail by Allen, Jour. M. B. L. Ass., Plymouth, V., 1897, 91, and Garstang, *ibid*, 235.)

On January 30, 1906, a single specimen was taken in a tide-water pond at Saunderstown, R. I. The capture of mackerel in the winter is a rare,

but not unprecedented, occurrence. (See Goode, Nat. Hist. of Aquatic Animals, 1884, p. 284.)

- SEASON IN R. I.: Usually arrive at Rhode Island about May 1. In 1905 they arrived first in Sakonnet River on April 28. The first catch was on May 2 in the scup traps off Sakonnet. June 3 they appeared off the Cape Cod shore. June 5 at Newport marked the beginning of the big run of the season, which culminated June 19. The season closed there June 28. On June 22 was the best catch off Block Island. Scattering fishes are present all summer. On September 6 and 7, 1905, there was a very big run of "Tinkers" at Newport, the harbor being full of them. A similar run usually occurs about this time, although it was exceptionally large in that year. Mackerel finally leave in November.
- In 1906, four mackerel were caught off Newport, May 4. Twenty-five barrels were shipped from Newport May 14. By May 25, the shipments had increased to 300 barrels, and the large run commenced June 4 when 1,200 barrels were landed at Newport. The season ended near the last of July. The tinkers arrived June 4.
- In 1907, the first mackerel at Newport appeared May 2. The first recorded catch (294 barrels) was made May 17. The catches increased steadily after that date until June 14, when the fishing off Newport was said to be the best ever reported from that vicinity. The mackerel were taken in considerable numbers for several weeks after that. The tinkers arrived June 10.
- In 1908, the first mackerel in the scup traps off Newport were caught April 27. The number rapidly increased until May 25. Mackerel were present in considerable numbers until June 1. The first tinker was caught May 27.
- In 1909, the first mackerel from Newport were reported April 2. May 4, 42 barrels were shipped from Newport. The first big catch was on May 16, when 500 barrels were caught. May 24, 200 barrels were landed at Newport and from this time until the end of June the fish were abundant. Tinkers appeared June 17.

Calendar of Mackerel Season Off Newport, 1905-1909.

	1905.	1906.	1907.	1908.	1909.
First caught in traps.....	April 28.	May 4.	May 2.	April 27.	April 17.
First large shipment from Newport.....	May 14.	May 14.	May 17.	May 14.	May 4.
Most abundant.....	June 5 to June 19.	June 4 to June 30.	June 11 to July 5.	May 25 to July 1.	May 16 to July 1.
Record day.....	.....	June 4.	July 1.	June 20.	May 24.
Season ends at Newport.....	June 28.	Near end of July.	Near end of July.	Near end of July.	Near middle of July.

REPRODUCTION: Spawns the middle of May and June, in deep water along the coast from Long Island to the Gulf of St. Lawrence. Eggs are pelagic, 1-20 inch in diameter with large oil globule. Hatch in five days in water temperature of 55° to 58°. Yolk sac absorbed in six days. Larva 3.5 mm. long at hatching; 4.5 mm. when nine days old. (For description of eggs and young and bibliography, see Ehrenbaum, *Nordische Plankton*, 4, 1905, 31.)

FOOD: The mackerel strains the sea-water through its gill rakers as it swims open-mouthed through the water, taking in all kinds of small crustacea and the larvæ of marine invertebrates. They also feed on young fishes, especially in the latter part of the summer when these are abundant.

RATE OF GROWTH: Reach a length of two inches in 30 days from hatching, four inches in 45 days, seven inches before the autumn migration. The "blinks" are two years old, the "tinkers" three years, and the adult size of seventeen or eighteen inches is reached in the fourth year. (Report U. S. Fish Com., 1879, 32.) There are numerous observations on the rate of growth of the mackerel. In one month from hatching it is from .5 to .8 inch in length; in two months, 1.6 to 3.2 inches; in three months, 2.8 inches; in four months, 4 to 4.4 inches; in five months, 4.8 to 5.2 inches; in six months, 5.8 to 7.2 inches; in eight months, 6.8 to 7.2 inches; in twelve months, 8.4 to 9.6 inches (Allen, 1897-99). Bean reports specimens July 25, 2½ to 3¾ inches at Great South Bay, L. I. Also specimens 3¼ to 3¾ inches at Gravesend Bay, L. I., May 23, 1906.

REFERENCES:

1889: CUNNINGHAM, Jour. M. B. Ass., Plymouth, I, 25.

- 1891: CUNNINGHAM, *ibid*, II, 71.
 1891: HOLT, Jour. M. B. Ass., Plymouth, II, 325.
 1893: HOLT, Sci. Trans. Roy. Soc. Dublin, V, 10.
 1897: BRICE, Report, U. S. Fish Com. XXIII, 209.
 1897: HOLT, Jour. M. B. Ass., Plymouth, V, 112.
 1897: McINTOSH AND MASTERMAN, British Marine Food Fishes, 160.
 1898: MOORE, Report, U. S. Fish Com., XXIV, 1.
 1899: WILLIAMSON, Report, Fishery Board, Scotland, Vol. 17, 125.
 1906: TRACY, Report, R. I. Fish Com., Vol. 37, 33.
 1909: ALLEN, Jour. Mar. Biol. Ass., Plymouth, VIII, 394.

82. *Scomber colias* (Gmelin). *Chub Mackerel; Bull's-eye Mackerel.*

GEOG. DIST.: Atlantic and Pacific, widely distributed north to England, Maine, and San Francisco. Appears irregularly on our Atlantic coast.

SEASON IN R. I.: Rare, and occurring at irregular intervals. A specimen taken in Dutch Island trap June 15, 1909. According to the *Boston Herald*, of July 9, 1909, big schools of this species were found by the mackerel fleet for the first time in twenty years. These were taken on Georges Banks, vessels bringing in 50,000 to 100,000 each trip since the fourth of July. These fishes were small, running from five to seven hundred to the barrel. Dr. Seth E. Meek describes a peculiar fish taken at Block Island, September 16th, year not given, which was supposed to be a hybrid between this species and the common mackerel. (Jordan and Evermann, "The Fishes of North America," 866.)

SIZE: Fourteen inches.

83. *Auxis thazard* (Lacépède). *Frigate Mackerel; Bonito; Tunny.*

GEOG. DIST.: All warm seas, wandering northward to Cape Cod. Not known on our shores until 1880, when it arrived in countless numbers. (Bean, 1903).

SEASON IN R. I.: This species has been abundant in some years, but is usually rare or absent. Specimen 12½ inches long taken by Mr. Samuel Powell, at Newport. On August 23, 1880, twenty-eight barrels were taken in a mackerel seine ten mile east of Block Island. Immense schools were reported that year between Montauk Point and Georges Banks. (Proc. U. S. Nat. Mus., 1880.) One was reported taken at the mouth of Narragansett Bay in the autumn of 1904.

SIZE: Sixteen inches.

84. *Thunnus thynnus* (Linnæus). *Horse Mackerel; Tunny.*

GEOG. DIST.: Pelagic on all warm coasts. North to England, Newfoundland, San Francisco, and Japan.

SEASON IN R. I.: Plentiful some years; rare, others. Taken in autumn around Newport and Narragansett Pier, but more abundant at Point Judith. More rare formerly, but of late becoming more common. Forty to sixty have been taken in one trap at one time. Present in Rhode Island waters from May or June to November, but most numerous in July. Mr. Brownell, of Tiverton, says that in the autumn of 1904 he ran through an immense school of this species, extending for ten miles. Specimen taken at Quonset Point trap July, 1908. In the years from 1903 to 1908, 752 horse-mackerel were shipped from Newport. The following table shows their distribution by months and years:

YEARS.	May.	June.	July.	August.	September.	October.	November.	Totals.
1903.....			9	13	50	7		79
1904.....	5	130	119	40	31	9	2	336
1905.....		6	80	1	4			91
1906.....		20	2		10	8		40
1907.....		17	67	14	6	9		113
1908.....		15	29	13	18	11	7	93
Totals.....	5	118	306	81	119	44	9	751

REPRODUCTION: It is said to spawn in June.

FOOD: Menhaden, mackerel, dog-fish, and other small fishes.

RATE OF GROWTH: The recently hatched young, according to Yarrell, weigh $1\frac{1}{2}$ ounces, and grows to four ounces in August, and to thirty ounces in October (Bean, 1903). The largest ever taken weighed 1,500 pounds; the largest on record from Rhode Island, caught by Mr. Brownell, weighed 750 pounds.

85. *Sarda sarda* (Bloch). *Bonito*.

GEOG. DIST.: Atlantic Ocean of both coasts, north to Maine. The limit of its northern range is usually stated as Cape Cod or Cape Ann. Yet it has been reported from Maine, at Harpswell, Casco Bay (Bowdoin College, 1890). On Massachusetts coast, reported from many

localities (from Lynn to Nantucket). In Connecticut, from Stonington (Linsley, 1844) and Noank (Bean, 1880). Scarce on Long Island coast.

HABITAT: The open sea, approaching shores for food and spawning.

SEASON IN R. I.: Seen occasionally in the autumn. It is not distinguished by the fishermen from other species of this family. In the early seventies it was exceedingly abundant in the waters about Block Island, and the east end of Long Island. Since then it has been occasionally seen. It fluctuates greatly in numbers from year to year.

RATE OF GROWTH: Maximum, $2\frac{1}{2}$ feet. Some specimens two inches long once taken in July at Menemsha (Smith, 1898).

FOOD: Stomach contents have shown mackerel, menhaden, squids, and small crustacea.

86. *Scomberomorus maculatus* (Mitchill). *Spanish Mackerel*.

GEOG. DIST.: Both coasts of North America; appears in irregular schools in the Gulf of Mexico and off the Carolina coast. Ranges north to Maine and south to Brazil. Occasional along the whole coast of New England and Long Island shore.

MIGRATIONS: They reach the North Carolina coast in April, the Chesapeake about the twentieth of May, and from New Jersey to Cape Cod in July. They begin to diminish about the middle of September, and the end of October witnesses their disappearance north of the Carolinas.

HABITAT: A warm-water fish, preferring temperature of 70° to 80° F. Gregarious and migratory, travelling in immense schools scattered over large ocean areas. Prefers the surface; avoids fresh and brackish water.

SEASON IN R. I.: Not very common. A few dozen specimens taken each year between the middle of August and October, in Narragansett Bay. Fifty large ones taken in a trap by Mr. Easterbrooks at Price's Neck, Newport, August 15, 1905.

REPRODUCTION: Spawning season begins in April in the Carolinas and becomes later northward. Sixteen spawning specimens were taken by Ryder at New Point Comfort, Va., July 13, 1880. Eggs are from 1-22 to 1-28 inch in diameter, pelagic, and have an oil globule. A six-pound fish yields about 1,500,000 eggs. Spawning takes place in warm and very shoal waters. Eggs hatch in 20 to 26 hours. At hatching embryo is about 1-10 inch in length.

FOOD: It feeds on all small species frequenting the surface: alewives, butterfish, herrings, etc, and particularly the menhaden.

RATE OF GROWTH: Average size, twenty-four inches. Largest examples recorded weigh eight to nine pounds. Large specimens generally solitary. In Chesapeake Bay, not often exceed two or three pounds. It is believed that the species grows very little in the first two years of its life, not exceeding half a pound at the end of that time.

REFERENCES:

- 1880: EARLL, Report, U. S. Fish Com., VIII, 345.
 1881: RYDER, Bull. U. S. Fish Com., I, 135.
 1897: BRICE, Report, U. S. Fish Com., XXIII, 220.

87. **Scomberomorus regalis** (Bloch). *Cereen; Kingfish.*

GEOG. DIST.: Cape Cod to Brazil. Recorded from Woods Hole (Baird, 1873), Monomoy (Kendall coll. 1896), Vineyard Sound (Smith, 1898). Abounds in West Indies.

HABITAT: Pelagic in tropical waters. Little known of its habits.

SEASON IN R. I.: Rare in Narragansett Bay, taken usually in the autumn.

FOOD: Small fishes.

SIZE: Maximum, five to six feet.

TRICHIURIDÆ. The Cutlas-Fishes.

88. **Trichiurus lepturus** (Linnæus). *Cutlas-fish; Scabbard-fish.*

GEOG. DIST.: Warm seas, chiefly of western Atlantic; north to Maine. Reported from Maine (Monahegan, Storer, 1853) and from several places along the Massachusetts shore. Rare on Long Island (Bean, 1903).

SEASON IN R. I.: A few stragglers taken nearly every year. Specimen taken by Mr. J. M. K. Southwick, Newport, November 16, 1899. Specimen three feet long caught in a trap at Newport, 1901. This is the largest specimen recorded from New England waters. Several smaller specimens taken in the Bay the same year. Several specimens have been taken by the Lewis Brothers in their traps in Narragansett Bay at various times.

FOOD: Carnivorous.

SIZE: Five feet.

ISTIOPHORIDÆ. The Sail-Fishes.

89. **Istiophorus nigricans** (Lacépède).

GEOG. DIST.: West Indies and warmer parts of the Atlantic, north to Key West and France. Stragglers taken at Savannah, Newport, and Woods Hole. At Woods Hole reported by Baird (1873). Dr. Smith

(1898) says:—"taken only at Quisset Harbor, where during the past twenty-five years about half a dozen have been caught in a trap; all were about nine feet long."

SEASON IN R. I.: Very rare; specimen in U. S. National Museum taken off Newport in August, 1872. A specimen from Newport was reported by Goode (1884).

SIZE: Ten feet. (For description and pictures of young, see Lütken [translated by Bean,] Report, U. S. Fish Com., VIII, 1880, 375.)

90. *Tetrapturus imperator* (Bloch and Schneider). *Spearfish.*

GEOG. DIST.: West Indies north to Cape Cod. Reported from Woods Hole (Baird, 1873). Between 1885 and 1890 many were caught in Vineyard Sound and Buzzards Bay, during July and August.

SEASON IN R. I.: Very rare. Specimen seven feet long taken at Block Island in 1875 (Goode, 1880). Reported from Narragansett Bay (R. I. Fish Com., 1899).

SIZE: Seven feet is the usual length, weighs from 4 to 100 pounds.

XIPHIIDÆ. The Sword-Fishes.

91. *Xiphias gladius* (Linnæus). *Swordfish.*

GEOG. DIST.: Atlantic Ocean on both sides, most abundant between Cuba and Cape Breton. Common off Cape Cod and Newfoundland Banks. Common off Southern Europe and found in the Pacific. Common off whole New England shore, especially on Georges Banks and off Block Island.

MIGRATIONS: Appear in the vicinity of Sandy Hook about June first and fishing season continues off New England shore until the middle of September. Disappears southward as soon as cold winds begin to blow (Bean, 1903).

SEASON IN R. I.: In 1905 they began to reach Georges Banks about June 16. Twenty-two were taken in one day, sixty-one in a week. Began to reach Block Island June 26, when thirteen were taken. One seen off Sakonnet Point July 18. Leave Rhode Island waters in November. Abundant in the years 1905 and 1906. From 1896 to 1908, 3,503 swordfish were shipped from Newport. In the following table the catch of swordfish for each year, arranged according to months, is shown:

Table Showing Number of Sword-fish Shipped from Newport, 1897-1908.

	May.	June.	July.	August.	September.	October.	November.	December.	Totals.
1897.....			44	1					45
1898.....			14	7	1		52		74
1899.....	6	38	6	52	26	18	8	8	162
1900.....		101	65						166
1901.....	1	20							21
1902.....		5	1	173					179
1903.....		15	109	24	16				164
1904.....	15	160	300	47	9	23			554
1905.....		67	611	22	3	18	2		723
1906.....		472	274	65					811
1907.....		17	118	116	12				263
1908.....		85	81	30	1	1			198
Totals.....	22	980	1,623	537	68	60	62	8	3,360

REPRODUCTION: In the Mediterranean it spawns in spring and early summer, probably in the open ocean.

FOOD: Contents of the stomach show fishes like mackerel, menhaden, cod, hake, and squids.

SIZE: Ten feet, maximum sixteen feet. Young, 10mm and 37 mm., have been found by Lütken (Ehrenbaum, Nordishes Plankton, 4, 1905, p. 35; description and picture of 37mm. young). Specimen measuring two feet taken off Block Island, in July 1877 (Goode, 1880). Specimen taken in West Indies by the "Challenger," 1½ inches long. (For the natural history of the swordfish see Goode, Report, U. S. Fish Com., VIII, 1880, 289; Lütken, translated by Bean, loc. cit. 375. Young described by Günther, are referred to in Amer. Nat. X, 1876, 239.)

CARANGIDÆ. The Pompanos, Amber-Fishes, etc.

92. *Oligoplites saurus* (Bloch and Schneider). *Leather-jacket*.

GEOG. DIST.: Both coasts of tropical America, common in West Indies, north to Woods Hole and Menemsha Bight (Smith, 1898). Rare on Long Island (Bean, 1903).

SEASON IN R. I.: Very rare. Reported at Newport (Goode, 1884); specimen taken September 10, 1886, at Newport (Smith, 1898).

SIZE: Specimen $9\frac{3}{4}$ inches long taken in January 1896, at Gravesend Bay (Bean, 1903).

93. *Naucrates ductor* (Linnæus). *Pilot-fish*.

GEOG. DIST.: Pelegic fish found in all warm seas. Occasional on our Atlantic coast from West Indies to Maine. In Maine reported from near Seguin (Bowdoin College). In Massachusetts at Provincetown (Atwood, 1859) and Woods Hole (Baird, 1871, and Smith, 1898). In Connecticut at Stonington (Linsley, 1844).

SEASON IN R. I.: Taken rarely from July to October in Narragansett Bay. More common in outside waters.

REPRODUCTION: Young are developed in the open ocean and are so different in appearance that they have been described as a different genus.

FOOD: Omnivorous. Van Beneden found stomach contents to consist of portions of fishes, crustacea, fucoid plants, and, in one case, parings of potatoes (Amer. Nat. V, 1871, 436.)

SIZE: Two feet.

94. *Seriola zonata* (Mitchill). *Rudder-fish; Pilot-fish; Shark-pilot*.

GEOG. DIST.: Cape Hatteras northward from Cape Ann. Reported from several places in Massachusetts shore, from Long Island Sound (Linsley, 1844), and from Gravesend Bay, Long Island (Bean, 1903). Common at Woods Hole from July to October.

SEASON IN R. I.: Single specimens occasionally taken from July to October. A specimen in possession of the Commission is dated 1899. Three specimens from Newport are in the U. S. National Museum (Proc. U. S. Nat. Mus., 1880, 91). Specimen one and one-half inches long in Roger Williams Park Museum from Warwick, R. I.

FOOD: Stomach of one individual contained fragments of a butter-fish. At Woods Nole, they have been observed to feed for weeks chiefly on *Menidia* (Smith). Also feed on small killifish (Bean, 1903).

RATE OF GROWTH: Adults are two or three feet long. Young are common south of Cape Cod; specimens from $1\frac{1}{2}$ inches long up to six or seven inches at Woods Hole.

95. *Seriola lalandi* (Cuvier and Valenciennes). *Amber-fish*.

GEOG. DIST.: Brazil to Cape Cod. In New England reported from Woods Hole (Smith, 1898) and Narragansett Bay (R. I. Fish Com. 1899). One specimen from Gravesend Bay, L. I., July 15, 1896 (Bean, 1903).

SEASON IN R. I.: Rare. Taken in traps occasionally during summer months.

SIZE: Five or six feet long and up to 100 pounds weight.

96. *Decapterus punctatus* (Agassiz). *Scad; Round Robin; Cigar-fish.*

GEOG. DIST.: Cape Cod to Brazil. Taken at Woods Hole (Baird, 1873, Bean, 1880, Smith, 1898), at East Haven in Connecticut (1884); occasionally taken from August to October on Long Island (Bean, 1903).

SEASON IN R. I.: Taken in Narragansett Bay (R. I. Fish Com., 1899).

Three specimens, the largest measuring $4\frac{1}{4}$ inches, taken from the stomach of a horse mackerel (*Pelamys?*) at Newport, by Mr. Samuel Powell. (Fowler, Proc. Acad. Sci. Phil., LVI, 1904, 760).

RATE OF GROWTH: Only young and half-grown specimens are taken on Long Island and around Cape Cod (Bean, 1903). Adults reach a length of about one foot.

97. *Decapterus macarellus* (Cuvier and Valenciennes). *Mackerel Scad.*

GEOG. DIST.: Warm parts of Atlantic north to Nova Scotia. Cornish reports specimens at Canso (1907). Common every year in October at Woods Hole (Baird, 1873 Smith, 1898) and at Vineyard Sound (Smith, 1898). Taken in abundance at Southampton, Long Island, August 31, 1897 (Bean, 1903). Abundant along south Florida coast.

HABITAT: Shallow waters and harbors, moving in small schools.

SEASON IN R. I.: Occasional in October. Prof. Jenks is authority for the statement that none over six inches long are ever taken in our waters. Specimen in the U. S. National Museum, taken at Newport by Mr. Samuel Powell (Bull. U. S. Nat. Mus., 1879, 42).

FOOD: Copepods and annelids.

RATE OF GROWTH: Specimens over six inches long not reported in northern waters. Adults reach a length of one foot.

98. *Trachurus trachurus* (Linnæus). *Saurel; Gascon.*

GEOG. DIST.: North Atlantic, chiefly on coast of Europe, south to Spain and Naples. Taken also at Newport; Pensacola; Cape San Lucas, and Long Island. Only four American specimens are known, but it occurs in enormous schools on the European coasts. The Long Island specimen was taken October 16, 1898, in Clam Pond Cove, in company with young bluefish and menhaden (Bean, 1901).

HABITAT: Surface waters, with habits like mackerel.

SEASON IN R. I.: Goode describes specimen from Newport. (Proc. U. S. Nat. Mus. 1882, 269).

REPRODUCTION: Spawns in May in the English Channel; from June to August in the North Sea. The egg is 1-25 inch in diameter (.84 to 1.04 mm.), with segmented yolk and an oil globule. The larva at hatching is 1-10 inch (2.5mm.) long. (Egg and young are described by Ehrenbaum Nordisches Plankton, 4, 1905, 27.)

FOOD: Feeding habits, like blue-fish (Bean, 1903).

SIZE: One foot.

99. Trachurops crumenophthalmus (Bloch). *Big-eyed Scad; Goggler.*

GEOG. DIST.: Both coasts of tropical America, straying north to Nova Scotia. Two specimens taken at Canso in fish-traps by Cornish (1907). Reported from Woods Hole (Baird, 1873; Bean, 1880; Smith, 1898), where it is common every year from October fifteenth to November fifteenth. Common in all tropical seas and abundant in the Caribbean seas in winter. Taken the fall on Long Island shores (Bean, 1903).

SEASON IN R. I.: Common in October and November (Prof. Jencks). Specimen from Newport in the U. S. National Museum. (Proc. U. S. Nat. Mus., 1880, 84.)

RATE OF GROWTH: Most northern specimens are from four to six inches long. The adult reaches a length of about two feet.

FOOD: Annelids, shrimp, small fishes.

100. Caranx hippos (Linnæus). *Crevallè; Jack.*

GEOG. DIST.: Warm seas, both coasts of tropical America, north to Gulf of California and Cape Cod, also found in East Indies. Taken at Lynn Beach (Wheatland, 1852; Goode and Bean, 1879) and at Woods Hole (Baird, 1873; Bean, 1880; Smith, 1898). Abounds in Gulf of Mexico and East Florida and occurs throughout the West Indies.

SEASON IN R. I.: Occasionally taken from July to November. Specimen from Newport in U. S. National Museum (Proc. U. S. Nat. Mus., 1880, 90). Several specimens taken in West Passage during August and September of 1906. Usually associated with *C. Crysos*, but not so numerous as that species. September 24, 1906, specimen, West Passage trap.

FOOD: Fishes like mullet and menhaden; crustacea. Feeds in shallow water near the shore.

RATE OF GROWTH: Largest are two feet long. Young one inch long are taken at Woods Hole about July first. In Great Egg Harbor, N. J., small individuals are common in summer. Specimens from four to six and one-half inches taken at Ocean City and Longport late in August. The adult reaches about three feet and weighs thirty pounds.

101. *Caranx crysos* (Mitchill). *Hardtail; Yellow Crevallè.*

GEOG. DIST.: Gloucester to Brazil. Reported from several places on Massachusetts shore (Kendall, 1908).

SEASON IN R. I.: Not uncommon from August to November. Most of those caught in traps are small, about eight to ten inches long, but one very large specimen, about eighteen inches long, taken in trap near Saunderstown, Narragansett Bay, August 10, 1905. Specimen from Newport in the U. S. National Museum (Proc. U. S. Nat. Mus., 1880, 90). August 23, 1905, Dutch Island trap—specimen. August 27, 1905, Dutch Island trap, six specimens. August 27, 1905 Hazard's Quarry trap—specimen. September 24, 1906—West Passage trap, half-dozen small specimens.

REPRODUCTION: Probably spawns in West Florida in May in the salt-water bayous (Bean, 1903).

FOOD: Crustacea.

SIZE: Fifteen inches. Young one to two and one-half inches long, taken at Woods Hole in summer (Smith).

102. *Alectis ciliaris* (Bloch). *Cobbler-fish; Threadfish.*

GEOG. DIST.: Tropical America on both coasts, ranging north to Cape Cod. Reported from Woods Hole (Baird, 1873; Bean, 1880; Smith, 1898) and from Connecticut, at Stratford (Linsley, 1844). Occasional on Long Island shore (Bean, 1903).

SEASON IN R. I.: Rare. From June to November. The Commission is in possession of a specimen three and one-half inches long from Newport. Specimens from Newport are in the U. S. National Museum (Proc. U. S. Nat. Mus., 1880, 90.) Specimen in trap in West Passage, September 15, 1906.

SIZE: Three feet. Specimens from three to eight inches long at Woods Hole from June fifteenth to November first (Smith).

103. *Vomer setipinnis* (Mitchill). *Pug-nosed Shiner; Dollar-fish.*

GEOG. DIST.: Tropical America, both coasts. Common south, young occurring north in Gulf Stream, northward to Gloucester. Reported from various places in Massachusetts and in Connecticut from Greenwich (Linsley, 1844). Occasional on Long Island shore (Bean, 1903).

SEASON IN R. I.: Of various abundance in different years. Adults usually rare. Occasional specimens in August, September, and October. Usually much more frequent than *Selene vomer*. The first recorded of this species from Rhode Island was a young specimen described by

Cope in 1870 (Proc. Amer. Philos. Soc. Phila., 1870, 119). Specimens from Newport are in the U. S. National Museum (Proc. U. S. Nat. Mus., 1880, 89). An adult specimen taken in Narragansett Bay at Newport by Mr. J. M. K. Southwick in 1899. Young specimens taken August 23 and October 9, 1905.

In 1906 a remarkably large number of these fishes were present in Rhode Island waters, from the first of August until the last of September. In this season also, adults were numerous; the traps in West Passage were found at nearly every haul to contain from one to a half-dozen of these fishes. On August 8, 1906, a specimen was taken in Hazard's Quarry trap, and on September 17, 1905, two small specimens were taken at Wild Goose trap, where large size specimens were common for a month preceding.

REPRODUCTION: A male specimen taken in West Passage trap, Narragansett Bay, September 11, 1906, gave milt on gentle pressure.

SIZE: Maximum, one foot.

104. *Selene vomer* (Linnæus). *Lookdown; Dollar-fish.*

GEOG. DIST.: Tropical seas, northward to Maine. Reported in Maine from Casco Bay, in Massachusetts from Dorchester, Woods Hole, Nantucket, and New Bedford, and in Connecticut from Stratford and Long Island Sound, middle ground (Kendall, 1908). Occasionally on Long Island shore (Bean, 1903).

SEASON IN R. I.: Rare. Specimens sometimes taken in late summer and early fall. Specimen taken October 5, 1906, at Second Beach, Newport.

FOOD: Small crustacea, shrimp, gasteropods, lamellibranchs.

SIZE: Specimens on northern shores are usually from three to five inches long. Adults reach a weight of two pounds.

105. *Trachinotus falcatus* (Linnæus). *Round Pompano.*

GEOG. DIST.: Cape Cod to Brazil. Taken at Woods Hole (Baird, 1873, Smith, 1898) and at Nantucket (Sharpe and Fowler, 1904). Common about Cape Cod in summer, but no adults are seen. Common on Long Island shore (Bean, 1903).

SEASON IN R. I.: Reported in Narragansett Bay by Rhode Island Fish Commission, 1899.

RATE OF GROWTH: In northern waters they are never over three inches in length. Young from one-half to one inch long appear at Woods Hole in July; in September, when they disappear, they are two inches long (Smith, 1898). On Long Island shore specimens one inch to one and

three-quarters inches long were taken August 10th and 11th; September 2nd, specimen one and one-half inches long; September 30th, several specimens over two inches in length were taken (Bean, 1903). Adults reach fifteen inches.

106. *Trachinotus carolinus* (Linnæus). *Common Pompano.*

GEOG. DIST.: Abundant on South Atlantic and gulf coasts of United States, straying to Brazil and Cape Cod. Taken at Woods Hole (Baird, 1873; Bean, 1880; Smith, 1898). At Nantucket (Sharp and Fowler, 1904) and at Noank, Connecticut (B. S. N. H.). The young are summer and fall visitors on Long Island shore (Bean, 1903).

SEASON IN R. I.: Reported in Narragansett Bay by R. I. Fish Com., 1899.

REPRODUCTION: Probably spawn on east coast of Florida in April and May. Full of nearly ripe spawn in April on the coast of Florida (Henshall, 1889).

FOOD: Stomach contents: fishes, small crustacea, amphipods, lamelli-branch shells, diatoms, and vegetable debris. Often seen rooting or digging in the sand for food (Jordan and Evermann, 1902, p. 318).

SIZE: Eighteen inches. At Woods Hole, young from two to four inches in length appear between July 20th and August 1st and remain until September (Smith, 1898).

POMATOMIDÆ. The Bluefishes.

107. *Pomatomus saltatrix* (Linnæus). *Bluefish.*

GEOG. DIST.: Atlantic and Indian Oceans.

MIGRATIONS: Its migrations are probably more influenced by the presence of food than by temperature. They move along the coast from the south toward the north in the spring, following the schools of menhaden. Immense schools appear off the coast of Carolina in March and April; reaching the Jersey coast in the early part of May; Newport, middle of May to first of June. In October they leave the northern coasts and appear off the coast of Carolina about the middle of November, where a very extensive fishery exists until late in December. Their presence off the Carolina coast in autumn is preceded by schools of menhaden and marked by flocks of birds (Prof. Baird, Report U. S. Fish Com., 1873).

SEASON IN R. I.: Common but not abundant. They arrive about June first and remain until the last of November. These fishes are 10 to 14 inches in length. About the first of September, young about 5 inches

long are caught in the traps; they remain the rest of the season, constantly increasing in size, and are about 8 or 9 inches in length when they disappear. August 7 to October 15, young taken at Red Bridge, Seekonk River.

REPRODUCTION: Young less than one inch in length are never taken in coast waters; specimens about the same length appear along the whole coast at about the same time. This fact makes it appear probable that the bluefish spawns in the open ocean, in the winter or early spring, before they arrive on our shores. Well-developed spawn is found in a small proportion of the bluefish when they first arrive. (See Ehrenbaum, *Nordisches Plankton*, 4, 1905, 27.)

FOOD: A very voracious, carnivorous fish, feeding particularly on menhaden and squeteague. Stomachs also sometimes contain herring, cunners, squid, butterfish, marine worms, and crustacea. The young of the second year feed largely on schools of *Menidia* around the shores.

RATE OF GROWTH: The Fish Commission Steamer "*Albatross*," and the schooner "*Grampus*," have taken specimens under an inch long off shore. There seems to be little room for doubt regarding the usual rate of growth of the bluefish in northern waters, during its first two years. June 5, 1908, a specimen one inch long was taken in the Dutch Island Harbor trap. A specimen 26 mm. (one inch) long was taken in a seine at Cornelius Island on July 1, 1908. Specimens 1 to 2 inches are frequently seen in Wickford Cove in June and early July. Bean seined individuals $1\frac{1}{4}$ to $1\frac{1}{2}$ inches long at Ocean City, N. J., the last of August (Bean, 1903).

These small specimens probably grow to be from four to eight inches in August and September. On July 1, 1907, ten specimens were taken at Quonset Point which were 4 1-5 inches long. Five specimens were taken in a seine at Cornelius Point on August 7, 1908, which averaged 5 1-5 inches in length. The next day, August 8th, the average size of five specimens taken at Cornelius Point was $5\frac{1}{8}$ inches. On August 10, 1908, four specimens were seined at Cornelius Island that averaged 5 1-12 inches. On August 27, 1905, many specimens four to six inches long were found gilled in the meshes of the traps. A dozen five-inch specimens were taken in a West Passage trap on September 24, 1906. In the trap, Sand Blow, on Conanicut Island, two specimens 6 inches long were taken October 2, 1905. September 15, 1908, the average of several specimens was $7\frac{1}{2}$ inches.

At Woods Hole "young first appear early in July, being about three inches long" (Smith, 1898). Baird (1871), says that about the middle of

August, bluefish at Woods Hole are five inches in length and that by the end of September they are seven or eight inches long. Bean records the following specimens at Great South Bay, L. I., July 13, $3\frac{3}{4}$ to $3\frac{3}{8}$ inches; August 27, $7\frac{1}{4}$ inches; August 28, $3\frac{1}{4}$ inches; and August 29, $6\frac{3}{4}$ inches. Seal found young, 5 to 8 inches long in the Potomac River, September 20, 1899 (Bean, 1891).

In October they reach a length of six to eight inches or nine inches. When the fish return in June they measure from eight to twelve inches. A specimen thirteen inches was taken at Sand Blow trap on July 9, 1906. On July 24, 1905, a few specimens eight inches long were taken at Dutch Island trap. On August 23, 1905, many specimens ten inches long were taken in the Sand Blow trap, and in the Hazard's Quarry trap, on August 29, 1905, two specimens ten inches long were taken. Seven specimens taken in Dutch Island Harbor trap on August 16, 1909, were $12\frac{1}{2}$, $12\frac{3}{4}$, $12\frac{1}{4}$, 13, 12 1-5, $13\frac{1}{2}$, and 12 inches long. At the end of the season they are fourteen to eighteen inches in length.

The following is the record of certain feeding experiments carried on with bluefish confined in the rearing cars of the lobster plant at Wickford Experiment Station:

On August 8 and 10 a number of young bluefish were caught in the seine and were placed in one of the rearing cars which had been provided with coarse window screens of one-fourth inch mesh. When put into the car there were already present in the water several thousand young anchovies, about 20 to 25 millimeters in length. These the bluefish ate during the first day. On several occasions a few *Menidia* and *Fundulus* were given them to eat. On August 12, they were given as much raw meat as they could eat, and this they devoured ravenously. They were fed on meat again on August 15, and on *Menidia* two days later. The average size of these bluefish on August 18, about ten days after they were put into the car, was 140.8 millimeters, an average increase of about 10 millimeters. On September 1, they were measured again, having been fed meantime on several occasions with *Menidia*, *Fundulus*, and other small fishes. The average length on this date, September 1, was 174 millimeters. This measurement and the two which follow were taken from the nose to the end of the fin rays, whereas the previous measurements were taken from the nose to the base of the fin rays. Between September 1 and September 8, the specimens were not fed. On September 8 they measured 175.1 millimeters, showing an increase during seven days of 1.1 millimeters. On September 8 a quantity of

live fishes was put into the car to serve as food for the bluefish, and during the next seven days, the bluefish showed an average growth of about 10 millimeters, the average length being 184.3 millimeters.

NOMEIDÆ. The Nomeids.

108. *Nomeus gronovii* (Gmelin). *Portuguese Man-of-War-Fish*.

GEOG. DIST.: Tropical parts of the Atlantic and Indian Oceans in rather deep water, swimming near the surface, very abundant in the Sargasso Sea, common north to Florida and Bermuda, straying to Panama and Woods Hole. At Woods Hole reported only twice, in Vineyard Sound, 1889, and off Tarpaulin Cove in 1894 (Smith, 1898).

HABITAT: Found living under Portuguese man-of-war. Pelagic young are common in the tropics. Specimens $\frac{1}{2}$ to $1\frac{1}{2}$ inches long were taken by the "*Challenger*," September 16, 1875.

SEASON IN R. I.: Reported in Narragansett Bay by R. I. Fish Commission, 1899.

CENTROLOPHIDÆ. The Rudderfishes.

109. *Palinurichthys perciformis* (Mitchill). *Rudder-fish; Pole-fish*.

GEOG. DIST.: Atlantic coast of North American from Cape Hatteras to Nova Scotia. Reported from Canso (Cornish, 1907). Common at Woods Hole from June to November (Smith, 1898). Rare at Long Island, but common two or three miles off shore (Bean, 1903).

SEASON IN R. I.: Specimen from Newport in U. S. National Museum (Proc. U. S. Nat. Mus., 1886, 91). Reported by R. I. Fish Commission in 1899.

REPRODUCTION: Young in Atlantic under floating boxes and barrels (Bean).

FOOD: Small squids, snails, crustacea.

SIZE: One foot in length.

STROMATEIDÆ. The Butter-Fishes.

110. *Peprilus paru* (Linnæus). *Harvest-fish*.

GEOG. DIST.: Cape Cod to Jamaica. Usually rare at Woods Hole, but occasionally common (Smith, 1898); taken at Monomoy (Kendall coll., 1896). Not common along Long Island shore (Bean, 1903).

SEASON IN R. I.: Rare, only a few appearing each season in June or July

with the butter-fishes. A large specimen taken July 24, 1905, and on August 16, 1909, a specimen was taken in the Conanicut Point trap.

SIZE: Eight inches.

111. *Poronotus tricanthus* (Peck). *Butter-fish*.

GEOG. DIST.: Nova Scotia to Florida, rare south of Cape Hatteras. Common at Canso, Nova Scotia (Cornish, 1907). Abundant along whole New England coast. At Woods Hole in 1898 the first were taken in a trap at Cuttyhunk on May 11th, although reported at West Dennis on the 5th.

MIGRATIONS: Appears early in April off the Jersey coast.

SEASON IN R. I.: Appears toward the last of May, usually a little later than the scup. The height of the spring run is during the first two weeks in June. A few are present throughout the summer. In October occurs the fall run, and they finally leave in November.

In 1905 butter-fish first appeared May 22. A few specimens were taken on October 29, in a Dutch Island trap.

In 1906, off Newport, the butter-fish were first reported April 16, an unusually early date. Two specimens were taken in Sand Blow trap, West Passage, on April 30.

In 1907, the first reported from Newport were taken May 10. On May 24, 50 barrels were taken at one haul off Newport.

On July 29, 1908, at Hazard's Quarry trap they were very abundant and had been for several days preceding. Few squiteague were present, which fact may have accounted for the abundance of butterfish at this time.

In 1909 butter-fish appeared off Newport about April 21. First appearance of butter-fish in traps off Newport:

1905.	1906.	1907.	1908.	1909.
May 22.	April 16.	May 10.	April 28.	April 21.

REPRODUCTION: Spawns in June.

FOOD: Small fishes, small free-swimming crustacea, annelids.

RATE OF GROWTH: In Narragansett Bay young are frequently found in August living under the protection of the stringers of jelly-fishes. On August 2, 1908, specimens 1-5 inch (4.6 mm. and 5.5 mm.) were taken

at the surface near the lobster plant of the Wickford Experiment Station.

In the West Passage traps on October 2, 1905, half a barrel of specimens three or four inches long were taken, and two barrels were taken at Sand Blow trap on October 9, 1905. The maximum size is about 10 inches.

CENTRARCHIDÆ. The Sunfishes.

112. *Ambloplites rupestris* (Rafinesque). *Rock Bass*.

GEOG. DIST.: Vermont to Great Lake region and Manitoba, south to Louisiana, very abundant west of the Alleghanies. Found in many lakes and rivers in New York. Its geographical distribution has been much extended by artificial introduction.

SEASON IN R. I.: Taken at Newport (Mr. Southwick). This species is recorded from Vermont (Kendall, 1908), but not otherwise reported from New England. Probably the species has been artificially introduced into certain ponds and reservoirs near Newport.

REPRODUCTION: Spawns in May and June on gravelly shoals. (Brice, Report, U. S. Fish Com., XXIII, 1897, 159.)

FOOD: Small fishes, worms, crustacea, insect larvæ.

SIZE: Twelve inches.

113. *Lepomis auritus* (Linnæus). *Long-eared Sunfish*.

GEOG. DIST.: Maine to Louisiana, east of the Alleghanies. Recorded from ponds and streams throughout New England (Kendall, 1908).

HABITAT: Abundant in all fresh-water streams.

SEASON IN R. I.: Reported from Rhode Island (R. I. Fish Com., 1899).

REPRODUCTION: Spawns in early summer.

FOOD: Worms, insect larvæ, crustaceans, molluscs, and small fish.

SIZE: Eight inches.

114. *Eupomotis gibbosus* (Linnæus). *Sunfish; Pumpkin Seed; Kiver*.

GEOG. DIST.: Great Lakes region to Maine, and southward east of the Alleghanies to Florida. Occurs only in the northern part of the Mississippi Valley. Common everywhere in New England.

HABITAT: Clear brooks and ponds.

SEASON IN R. I.: Reported by R. I. Fish Com., 1899. Recorded from Mashapaug, Benedict, and Fenner's ponds (Pope coll., 1894-96), also from Old Reservoir, in North Providence; Larkin's Dyer's Benedict,

Cunliff, Blackmoor's, Sucker, and Belleville Ponds; Pawcatuck River and its branches; also common in ponds and streams of Block Island.

REPRODUCTION: Spawns in the spring in nests made by hollowing out with the fins a depression in the mud or sand. The nests are guarded by the male; the eggs are only about 1-32 inch in diameter, and not very numerous. (Gill, Parental Care Among Fresh-Water Fishes, Smithsonian Report, 1905, 403.)

FOOD: Similar to that of the preceding species. (For food of the sunfish see S. A. Forbes in Bulletins of the Illinois State Laboratory.)

SIZE: Eight inches.

115. *Micropterus dolomieu* (Lacépède). *Small-mouthed Black Bass.*

GEOG. DIST.: From Lake Champlain to Manitoba and southward on both sides of the mountains from James River to South Carolina and Arkansas. Indigenous to the upper parts of St. Lawrence basin, Great Lake region and Mississippi basin. East of the Alleghanies it is a native of the Ocurulgee and Chattahoochee rivers, but north of these streams it has been widely distributed by artificial introduction (Bean, 1903). Introduced throughout New England, where it is now common.

HABITAT: Clear cold waters of running streams.

SEASON IN R. I.: Introduced by R. I. Fish Commission into the following ponds: Westerly, Pasquiset, Quidnick, Fenner's, Chapman, and other small ponds throughout the State. (See Reports of the R. I. Fish Commission from 1897 to 1905.)

REPRODUCTION: Spawning season begins in March and ends in July. Incubation period lasts from seven to fourteen days. Eggs are adherent and laid in nests. Nest guarded by the male. (The habits of the basses are described by Henshall, Book of the Black Bass, 2d ed., 1904; and, More About the Black Bass, 1898; and by Reighard, The Breeding, Habits, Development, and Propagation of the Black Bass. Bull. Michigan Fish Com., No. 7, 1905.)

FOOD: Small fishes, insects, and their larvæ, fresh-water crustaceans.

SIZE: Twelve to fifteen inches; maximum, two feet.

116. *Micropterus salmoides* (Lacepede). *Large-Mouthed Black Bass.*

GEOG. DIST.: Rivers of United States from Great Lakes and Red River of the North to Florida, Texas, Mexico, everywhere abundant. Introduced into New England and Middle Atlantic States east of the Alleghanies.

HABITAT: Lakes, bayous, and sluggish waters.

SEASON IN R. I.: Introduced by the Rhode Island Fish Commission into the following streams and ponds: Richmond, One Hundred Acre, Roger Williams Park, Skinflint, Hospital, and Fenner's ponds; Quidnick Reservoir; Penicatuck and Pawcatuck Rivers.

REPRODUCTION: Spawns from April to July. Eggs are adhesive and are attached to stones during the incubation period, which lasts from one to two weeks. The larvæ remain in the nest a week or ten days, and at the age of two weeks will measure about three-quarters of an inch in length (Bean, 1903). (Lydell, Bull. U. S. Fish Com., XXII, 1902, 39; Brice, Report, U. S. Fish Com., XXIII, 1897, 159.)

FOOD: Carniverous, voracious; feeds on small fishes of all kinds, crawfish, frogs, insects, and all other aquatic animals of suitable size.

SIZE: Eighteen inches or more.

PERCIDÆ. The Perches.

117. *Perca flavescens* (Mitchill). *Yellow Perch*.

GEOG. DIST.: East of the Alleghanies and in the Great Lakes region. Abundant everywhere throughout New England (Kendall, 1908).

SEASON IN R. I.: Common in ponds and streams throughout the State. Reported from Benedict, Fenner's Mashapaug, Larkin's, Watchaug, and Roger Williams Park Ponds; reservoirs in North Providence, Poneganset Reservoir; Pocasset, Queen's, Ten Mile, and Pawcatuck Rivers.

REPRODUCTION: Spawns in March and April. Eggs hatch in eight to ten days in water 60°. Eggs are about 1-7 inch in diameter (3.5 mm.), and have a large oil globule. The eggs are laid in flat bands consisting of a single layer agglutinated together by an adhesive material. These bands of eggs somewhat resemble those of the goose-fish (*Lophius*), but they are not so large and do not float on the surface. (Worth, Bull. U. S. Fish Com., X, 1890, 331.) The larvæ just hatched are about 1-5 inch long (5 to 5.5 mm.). For a time it grows slowly, since a sixteen-day larva is only a little over ¼-inch (6 mm.) in length. (For a description of the eggs and young see Ryder, Report, U. S. Fish Com., XIII, 1885, 518; also Brice, Report, U. S. Fish Com., XXIII, 1897, 182; Ehrenbaum, Nordisches Plankton, 4, 1905, 11.)

FOOD: Small fishes, crustaceous insects, etc.

SIZE: Maximum, one foot. Perch spawns at the age of one year. (Seal, Forest and Stream, April 17, 1890.)

118. *Boleosoma nigrum olmstedii* (Storer). *Darter*.

GEOG. DIST.: Lake Ontario to Massachusetts, south to Virginia. Common in Massachusetts and Connecticut.

HABITAT: Among weeds of clear streams. (Jordan and Copeland, Amer. Nat. X, 1876, 335.)

SEASON IN R. I.: Reported from Rhode Island by R. I. Fish Commission, 1899.

FOOD: Insect larvæ, crustaceans, and small molluscs. (Forbes, Food of the Darters, Amer. Nat. XIV, 1880, 697.)

SIZE: Three and a half inches.

CHEILODIPTERIDÆ. The Cardinal Fishes.**119. *Apogon imberbis* (Linnæus). *King of the Mulletts*.**

GEOG. DIST.: Mediterranean and neighboring waters. Once taken at Newport and once recorded from the Island of Fernando de Noronha.

SEASON IN R. I.: A specimen taken at Newport was described by Cope in 1870. (Proc. Ac. Nat. Sci., Phila., 1870, 120.)

SERRANIDÆ. The Sea Basses.**120. *Roccus lineatus* (Bloch). *Striped Bass; Rockfish*.**

GEOG. DIST.: Atlantic coast of North America, Nova Scotia to Florida. Most common from Cape Cod to Cape May. Introduced into California. Common along the whole New England coast.

MIGRATIONS: It is said not to be migratory, but present along our coast in winter as well as summer. Taken through the ice in Long Island and Block Island Sounds in December (Goode, Nat. Hist. of Aquatic Animals, 425). At Woods Hole, arrives in May (Bumpus).

SEASON IN R. I.: Arrives the last of March with the shad. The dates of arrival in Taunton River from 1871 to 1883 range from March 15 in 1880 to April 6, 1883 (Bull. U. S. Fish Commission, 1883, 478). On September 17, 1906, twenty-four specimens were taken in Wild Goose trap, and on September 24, 1906, another specimen was taken in the same trap. In the Hazard's Quarry trap on June 5, 1906, a few specimens were taken, one of which weighed seven pounds.

REPRODUCTION: Spawns from April to June in rivers or brackish waters. Eggs are buoyant, non-adhesive, 1-7 inch in diameter, and hatch in three days in water 58°. A remarkable peculiarity of this fish is its ability to hybridize with other species. (White and yellow perch and shad, Ryder.)

FOOD: Voracious feeders, eating fishes, mollusks, and crustacea (Goode, loc. cit.).

RATE OF GROWTH: Largest ever taken weighed 112 pounds. Young found in June one inch long; in October these reach 4½-inches (Goode).

REFERENCES:

- 1882: AGGASSIZ, A., Proc. Amer. Acad. XVIII, 274.
 1885: RYDER, Report, U. S. Fish Com., XIII, 502.
 1897: BRICE, Report, U. S. Fish Com., XXIII, 185.
 1905: EHRENBAUM, Nordisches Plankton, 4, 17.

121. *Morone americana* (Gmelin). *White Perch*.

GEOG. DIST.: Atlantic coast, South Carolina to Nova Scotia. Common in fresh and salt water along the whole New England coast.

SEASON IN R. I.: Present the year around. Taken in traps in the Bay in October. Found in Mashapaug and Cunliff Ponds, Pawtuxet River, and in streams and ponds generally in the southern part of the State. Also found at Block Island. October 29, 1905, a specimen was taken in Dutch Island trap.

HABITAT: Shallow shore waters, brackish and fresh water of rivers and ponds connected with salt water. Sometimes land-locked.

REPRODUCTION: Spawns in April, May, and June, in fresh water. The eggs are 1-34 inch in diameter (.73 mm) and very adhesive. They sink to the bottom and hatch in six days in water of 51° to 53°. (See Ryder, Report, U. S. Fish Com., XIII, 1885, 518; Brice, Report, U. S. Fish Com., XXIII, 1897, 185.)

FOOD: Shrimp, fish spawn, insects, crabs, small fishes, and eels.

RATE OF GROWTH: At the time of hatching, the larva is about 1-11 inch in length (2.3 mm.); in the first day it grows to ½ inch (3 mm.). The adult grows to eight inches.

122. *Epinephelus niveatus* (Cuvier and Valenciennes). *Snowy Grouper*.

GEOG. DIST.: Brazil to West Indies, often straying north to Cape Cod. The first specimens recorded from Woods Hole were taken in 1895; eight or ten other specimens recorded in the vicinity in the same year; two of these were 2¾ and 1¼ inches long; others taken in 1897 and 1900. All of these were taken between August and October, were under three inches, and mostly taken in lobster pots (Smith, 1898).

SEASON IN R. I.: Two young specimens, two inches long, taken by Samuel Powell at Newport, 1860 (Proc. Acad. Nat. Sci., Phila., 1861, 98). Goode and Bean report the capture of another specimen at the same

place in 1877 (Amer. Jour. Sci. and Arts, XVII, 1879, 545). Also three other specimens of this species from Rhode Island are in the U. S. National Museum; one $2\frac{1}{2}$ inches long is from Tiverton, the other two, 3, and $3\frac{1}{4}$ inches long, taken at Point Judith.

123. *Centropristes striatus* (Linnæus). *Sea Bass; Black Bass.*

GEOG. DIST.: Atlantic coast, Maine (Matinicus Island) to Northern Florida. Common along Massachusetts, Rhode Island, and Connecticut shores.

MIGRATIONS: Probably spends the winter in a torpid state around rocky bottoms without extensive migrations (Goode). Appears on the Jersey coast in April, at Woods Hole about the first or second week of May. In 1898, arrived on May 10th, and were taken in large numbers on the 12th.

HABITAT: Rocky bottom in cavities and under stones.

SEASON IN R. I.: Arrives in May and is then most abundant. Leaves in October. June 5, 1906, Hazard's Quarry trap, a dozen specimens were taken. In 1907, first specimen in the traps off Newport was taken May 8; in 1908, first specimen taken May 5; in 1909, first specimen taken May 4.

REPRODUCTION: Spawns in June. Eggs are $\frac{1}{25}$ -inch in diameter, and hatch in 5 days in water of 60° . (Brice Report, U. S. Fish Com. XXIII, 1897, 223.) (For embryological development of this species see Wilson, Bull. U. S. Fish Com. IX, 1889, 209.) Sexual differences are very marked, especially during the breeding season.

FOOD: Bottom feeder. The various crustacea are its most important food; crabs, lobsters, shrimp; also squids, mollusks, small fishes.

RATE OF GROWTH: Young $\frac{3}{4}$ -inch long seined at Woods Hole, July 31. Young two or three inches long were taken in October. Eigenmann (1901) took the following specimens, July 24, 1899: nine, one inch long (ranging from 23mm. to 26 mm.); August 22, 1900, specimen $1\frac{3}{8}$ inches long (67 mm.); September 15, 1900, three specimens three inches long (ranging from 73 mm. to 82 mm.).

124. *Rypticus bistrispinus* (Mitchill).

GEOG. DIST.: South Atlantic coast of the United States in rather deep water, strays north to Newport, R. I.; not otherwise recorded north of the Carolinas.

SEASON IN R. I.: One specimen was taken at Newport by Samuel Powell and described by Cope in 1870. (Proc. Acad. Nat. Sci., Phila., 1870, 119.)

LOBOTIDÆ. The Triple-Tails.**125. *Lobotes surinamensis*** (Bloch). *Triple-tail; Flasher.*

GEOG. DIST.: All warm seas, Cape Cod to Panama. Recorded from Woods Hole (Baird, 1873; Smith, 1898), Menemsha Bight (Smith, 1898).

HABITAT: A bottom-fish of sluggish habits.

SEASON IN R. I.: The rarity of this species is shown by the fact that, according to the Report of U. S. Fish Commission, 1901, only six specimens had been recorded in northern waters in twenty years. Of late years, however, in Narragansett Bay, one or two specimens are usually reported each season. Specimen taken off Pine Hill, 1898. September 10, 1901, a specimen weighing six pounds, and 22 inches long was caught in a trap off Prudence Island. A specimen 18 inches long, was taken in a trap August 20, 1905, near Saunderstown. Another was reported by a fisherman in the upper part of Narragansett Bay about two weeks later. In 1906 a specimen was taken in a trap off Sauga Point, near Wickford. A specimen was taken in the Quonset fish-trap on August 1, 1908.

REPRODUCTION: Probably spawns in brackish water in the spring, as young three inches long were found in August in the eel-grass in Tuckahoe River, New Jersey (Goode).

FOOD: Small fishes, mussels, and shrimp.

SIZE: Three feet.

PRIACANTHIDÆ. The Catalufas.**126. *Priacanthus arenatus*** (Cuvier and Valenciennes).

GEOG. DIST.: Tropical Atlantic, south to Brazil; occasionally northward in the Gulf Stream to Newport and Woods Hole. Reported from Woods Hole and Quisset Harbor (Smith, 1898).

SEASON IN R. I.: Small specimens taken at Newport are in U. S. National Museum (Proc. Acad., Philadelphia, 1889, 159).

127. *Pseudopriacanthus altus* (Gill). *Big-eye.*

GEOG. DIST.: West Indies, in rather deep water, north to Marblehead. Reported from Marblehead Beach (Storer, 1867), Woods Hole, Achusnet River, New Bedford. (Smith, 1898).

SEASON IN R. I.: Very rare. A few have been taken at Woods Hole and vicinity. The type of this species described by Gill was a very young specimen taken in Narragansett Bay, near Conanicut Ferry, in Sep-

tember, 1860. (Proc. Ac. Nat. Sci., Phila., 1870, 120.) Specimen 27 mm. long taken at Lily Pond Beach, Newport, August 25, 1902.

REPRODUCTION: Two specimens $1\frac{1}{2}$ inches long taken at Woods Hole, November 28, 1885.

LUTIANIDÆ. The Snappers.

128. *Neomænis griseus* (Linnæus). *Gray Snapper; Mangrove Snapper.*

GEOG. DIST.: West Indies, ranging from New Jersey to Brazil, straying northward to Woods Hole.

SEASON IN R. I.: A snapper was taken in 1896 at Newport which was probably this species. Two young, 2 and $2\frac{1}{2}$ inches, were taken in September, 1897 (Smith).

SIZE: Eleven inches.

129. *Neomeanis blackfordi* (Goode and Bean). *Red Snapper.*

GEOG. DIST.: Cape Cod to the Carribean Sea. Recorded from Vineyard Sound, Menemsha and Woods Hole. (Smith, 1898). Recorded once from Long Island (Bean, 1901).

SEASON IN R. I.: Specimen taken near Block Island (Bean, 1901).

RATE OF GROWTH: Adult reaches a length of 30 inches. Nine specimens, the largest two inches long, taken at Woods Hole in September and October, 1900 (Smith, 1900). Specimen $4\frac{1}{2}$ inches long taken at Great South Bay, Long Island, October 26, 1887 (Bean, 1901).

SPARIDÆ. The Porgies.

130. *Stenotomus chrysops* (Linnæus). *Scup; Porgy; Scuppaug.*

GEOG. DIST.: Most abundant on south coast of New England. Ranges from Eastport, Maine, to South Carolina.

MIGRATIONS: They strike directly on the southern New England coast from their winter habitat in warmer water; they begin to leave about the middle of October. Cod have been taken on Nantucket shoals, late in November, filled with small scup.

SEASON IN R. I.: The first stragglers appear about the last of April; the first large run comes early in May, and consists chiefly of large breeding fish. A second or summer run comes after the breeders and is composed of small fishes without spawn. When entering our waters the scup are said to come in from the west and south. They are very abundant in May and June; stragglers remain all summer; they

finally leave the last of October. In 1900 the first arrival was April 21, reaching Cuttyhunk April 26, Woods Hole on May 1st. In 1901, the first arrival was April 26. The dates of the arrival of the scup in the Taunton River, from 1871 to 1883 range from May 27 in 1880 to June 1 in 1882. The earliest recorded appearance in Rhode Island is probably April 15, 1871. The greatest abundance of that year in Newport was on the 15th of May.

In 1905, Capt. Church, of Tiverton, caught a single scup on May 1st at Newport. On May 11th the sea fowl appeared outside Newport Harbor, the usual sign of the approach of the schools. First good catch was made on May 16th, small catches were made until June 4th, when for a few days the largest hauls of the season were made. The season ended June 25th in Narragansett Bay, while at Block Island it lasted until June 27. The season that year was poorer than usual, due, perhaps, to the fact that on May 16 and a few days following, there was an exceptionally large run of pollock along the whole shore from Brenton's Reef to Sakonnet Point.

In 1906 the first scup recorded from Rhode Island was taken off Coggeshall's Ledge, April 20. The main run off Newport lasted from May 1 to about June 15. Scup were taken in greatest abundance from May 5 to June 4. A run of pollock which lasted from the middle of May until about the 21st of that month greatly interfered with the abundance of scup.

In 1907 scup did not appear at Newport until May 2. Scattering specimens were taken until May 10, after which the number rapidly increased. The big run arrived about May 14 and remained until June 24.

In 1908 a scup was taken in Coddington Cove on April 23 and two off Coggeshall Ledge on the same day. The reported number of scup rapidly increased after that date until April 29, when the main run at Newport began. June 3 the catches began to decrease, and by June 9, only scattering individuals were being taken. Scup were very abundant this year, especially in Narragansett Bay, where more scup were caught than for many years.

In 1909 several scup were caught off Watch Hill April 19. The main body were present from about May 1 to June 14.

Calendar of Scup Season, off Newport, 1905-1909.

	1905.	1906.	1907.	1908.	1909.
First appearance.....	May 1.	April 20.	May 2.	April 23.	April 19.
Run commences.....	May 16.	May 1.	May 11.	April 29.	May 1.
Run ends.....	June 25.	June 15.	June 24.	June 9.	June 14.
Most abundant.....	June 1 to June 18.	May 5 to June 4.	May 21 to June 10.	April 29 to June 1.	May 10 to June 7.

In the summer and fall of 1909 numbers of scup were often observed at night, feeding near the edge of the water in Mill Cove, Wickford. One of these specimens, taken August 13, 1909, measured 5 2-5 inches. In 1909, no specimens taken in Wickford Cove after October 8th.

REPRODUCTION: The first runs consist largely of mature fishes filled with spawn. Fishermen say that the scup spawn when confined in the pounds; the eggs hatch in a very few days, and the young can often be seen swimming around on the surface with the yolk sac visible. As they grow older, they continue to remain in and around the pounds for some considerable time. Spawning season begins with the arrival of the first schools on our shores (last of April or the first of May), and continues until nearly the first of July. On April 30, 1906, 25 specimens were taken in Sand Blow trap, some of which had ripe eggs. Eggs taken from the female were artificially fertilized June 5, 1908. Eggs 1-27 inch in diameter with small oil globule. Eggs hatch in four days in water 62°. "The female fish of the second year not infrequently contains mature eggs" (Baird, 1871).

ENEMIES: Bluefish, cod, halibut, shark, squeteague.

FOOD: Invertebrates chiefly, though small fishes are sometimes found in the stomachs of large specimens. Mollusks, crustacea, annelids, squids, hydroids, and crepidulæ have been identified in the stomach contents. Stomachs of small specimens usually contain chiefly copepods and other small crustacea.

Peck found the food of the scup to be somewhat varied, but the animals upon which it feeds are the same general character as belong to the bottom fauna. He found "in fish taken by the hook and line, a great quantity of amphipods, some of the compound ascidians (*Leptoclinum*), many small lamellibranch molluscs, and at times very many of the sand-dollars (*Echinarachnius parma*) ground up with sand and deep black mud of the bottom from which they were feeding, just above

which the amphipods are usually abundant" (Peck, Bull., U. S. Fish Com., XV, 1895, 355.) Young specimens four to six inches long are often found feeding at night near the shores of coves and harbors feeding on schools of small fishes.

RATE OF GROWTH: In the lower part of Narragansett Bay young specimens two to three inches long are common everywhere in September, and are taken abundantly in the traps in the West Passage, and in seines along the shores in the neighborhood of Wickford.

September 2, 1909, two specimens, 45 and 53 mm., taken in seine, Cornelius Island. September 23, 1909, average of specimens taken in the seine on Cornelius Island, Mill Cove (sandy beach with eel-grass), was 2 inches (51.5 mm.). Average of 6 specimens taken at the same place, October 1, 1909, was 53.3 mm. At the same place, October 8, 1909, a dozen or more specimens taken ranging from 52 to 56 mm. These must be the young from eggs spawned in May and June.

At Woods Hole young specimens $\frac{1}{2}$ to $\frac{3}{4}$ inches in length were taken in July (Smith). Also specimens 1 1-5 inches (45 mm.) long taken July 25, and $2\frac{1}{2}$ inches (58 mm.) on August 2nd (Eigenmann, 1901).

Sherwood and Edwards (1901) give the following data regarding the growth of scup at Woods Hole: "July 3rd, length, 2 to 3 inches; September 29, 3 to 4 inches; November, 4 inches." At Nichols Point, Long Island, a number of young two inches long were taken September 1st (Bean, 1903): "Throughout the summer young fish of the spring spawning are to be seen floating around in the eel-grass and on the sandy bottoms, having attained a length of from $2\frac{1}{2}$ to $3\frac{1}{4}$ inches by the first of October" (Baird, 1871).

The first arrivals in the spring are large breeding scup, but this is soon followed by another run of small specimens, about four or five inches in length, which probably are the young of the preceding season.

When the scup re-appear in the second season, "thus completing one year of existence, they measure about six inches; and by the first of September attain an average length of eight inches (including the tail). (Twelve individuals measured on the 31st of August from 7.75 to 9 inches in length)" (Baird, 1871).

In August, besides a few large and apparently mature scup, sizes like the following are common in Narragansett Bay: August 13, 1909, Mill Cove, a specimen $5\frac{1}{2}$ inches long taken; August 15, 1909, specimens 5 to $5\frac{1}{2}$ inches long were taken in a seine in Mill Cove. August 16, 1909, about 200 specimens taken in a trap at Dutch Island Harbor

the average of eleven of these was 5 2-5 inches (133.9 mm.). On the Long Island shore, July 31 and August 13, 1901, specimens about six inches long taken in gill net (Bean, 1903).

"In the third year of existence, or at the age of two years, they have increased considerably, measuring on their re-appearance about ten inches. After this they grow more quickly. One hundred and ninety-nine, presumed to be three-years fish, weighed on the 6th of September, averaged $1\frac{1}{2}$ half pounds each and measured about twelve inches in length. It is in the fifth year, or after the lapse of four years from birth, that the scup presents its finest development; specimens believed to be of that age measured 14 or 15 inches with a weight of $2\frac{1}{2}$ to 3 pounds. They, however, still continue to grow, specimens being not infrequently even more. The dimensions may belong to fish of six or more years of age; more probably, however, of five years" (Baird, 1871-72, p. 228). (For an account of the natural history of the scup, see Baird, Report, U. S. Fish Com., I, 1871, 228).

131. *Lagodon rhomboides* (Linnaeus). *Sailor's Choice; Shiny Scup.*

GEOG. DIST.: Abundant from Cape Hatteras southward, straying north to Cape Cod. At Woods Hole, a few specimens usually taken each year from July to September (Smith, 1898). Occasionally taken on Long Island shores in summer (Bean, 1903).

SEASON IN R. I.: Not common. Specimen from Newport, collected by Mr. J. M. K. Southwick in 1899.

REPRODUCTION: Spawns in the Gulf of Mexico in winter or early spring. (Bean, 1903).

FOOD: Small fishes, and invertebrates, especially crustacea.

SIZE: Six inches.

132. *Archosargus probatocephalus* (Walbaum). *Sheepshead.*

GEOG. DIST.: Cape Cod to Mexico, abundant in the south. In Massachusetts, recorded from south of Cape Cod (Storer, 1839, 1853), and Vineyard Sound; in Connecticut, from Stratford (Linsley, 1844). On Long Island shore this species is now uncommon, but was formerly abundant (Bean, 1903).

HABITAT: Prefers rocky bottoms (Holbrook, 1860).

SEASON IN R. I.: Said to have been common formerly, but now rare north of New York. Sometimes taken at Newport (Mr. Southwick).

REPRODUCTION: Spawns in bays and mouths of rivers in summer in the Gulf of Mexico. "In August, 1887, the Sheepshead was known to

have been bred in Great Egg Harbor Bay, N. J." (Bean, 1903). The egg is pelagic and has a diameter of 1-32 inch; it hatches in forty hours in the warm water of the Gulf 76° or 77° (Brice, Report, U. S. Fish Commission, XXIII, 1897, 224).

FOOD: Barnacles, shell-fish.

RATE OF GROWTH: At Great Egg Harbor, N. J., twenty young individuals one inch to one and a quarter inches were seined between August 10 and September 9 (Bean, 1903).

KYPHOSIDÆ. The Rudder-Fishes.

133. *Kyphosus sectatrix* (Linnæus). *Rudder-fish*.

GEOG. DIST.: Common in West Indies and Key West, and east to the Canary Islands, straying to Cape Cod. At Woods Hole, not rare, in summer and fall; occasionally found in April (Baird, 1873; Smith, 1898). Rare on Long Island (Bean, 1903).

SEASON IN R. I.: Specimen in U. S. National Museum, taken at Newport by Mr. Samuel Powell (Bull. U. S. Nat. Mus., 1879, 46).

RATE OF GROWTH: Only young specimens up to six inches long secured at Woods Hole (Smith). Adult reaches a length of eighteen inches.

SCIAENIDÆ. The Drums.

134. *Cynoscion regalis* (Bloch and Schneider). *Squeteague; Weakfish*.

GEOG. DIST.: Abundant from Cape Cod to Florida, straying on the Gulf coast to Mobile, north to the Bay of Fundy. Recorded from coast of Maine by Holmes (1862). Abundant along remainder of New England and Long Island shore.

MIGRATIONS: Taken on the Jersey coast in April; first appear on the Rhode Island coast in the middle of May. The temperature of the water at the time of their arrival is about 50° F., though their movements may depend more on the presence of schools of menhaden and butter-fish, on which they feed, than on the temperature. It is thought that their abundance from year to year is affected by the presence of bluefish. De Kay (1842), Storer (1853), and Bean (1903) have stated evidence to show that when bluefish are abundant, squeteague are scarce, and *vice versa*.

SEASON IN R. I.: Scattering individuals are taken the middle or last of May, but the large run does not come until about June 10. Very abundant throughout the remainder of the season and is the most important food fish of the State after the end of the scup

season. They decrease considerably in numbers the latter part of July and August. They increase again the latter part of August and September, and finally disappear in October.

In 1905 the large run of squeteague first appeared off Newport on June 14. The first specimen taken in Providence River in 1905 was at Gaspee Point on June 16th. A catch of 70,000 pounds was made June 16th, 1905, by a Gloucester schooner off Block Island.

The following is the record of squeteague taken off Newport:

In 1906, the first reported squeteague was a straggler, taken May 4. Two days later, a half-barrel was taken. The big run was about June 10.

In 1907, two squeteague were caught May 21. On June 18, a few were reported, but the main run did not arrive until June 24. The largest reported catch was on June 27, when 300 barrels were taken in one haul off Newport. Fishing remained good for some weeks later.

In 1908, two squeteague were caught on May 7. The first barrel reported was taken June 6. June 11, the largest run arrived.

In 1909, a few large squeteague were taken May 19. The main run began about June 17.

Catch of Squeteague in Scup Traps off Newport, 1905-1909.

	1905.	1906.	1907.	1908.	1909.
"Stragglers" first appeared.	June 14.	May 4.	May 21.	May 7.	May 19.
Commencement of run.	June 21.	June 10.	June 24.	June 6.	June 17.

It is the common opinion of the fishermen that the scarcity of squeteague in Narragansett Bay in certain years, particularly in the summer of 1908, has been caused by the firing of heavy guns in the target practice at Fort Greble about the first of June, when the fish are entering the mouth of the Bay. A committee of the U. S. Bureau of Fisheries now has the matter under investigation. (See Report of R. I. Fish Com., 39, 1908, 12.)

HABITAT: Coast and still-water fish, running up tidal waters. Immense schools on surface have often been seen.

REPRODUCTION: Probably spawns around bays and inlets and at the mouths of rivers. The eggs are buoyant, 1-28 inch in diameter, and hatch in two days in water of 60° (Brice, Report of U. S. Fish Com., XXIII, 1897, 224). The spawning season in Rhode Island waters is

from the last of May, through June, and the early part of July (Tracy, Report, R. I. Fish Com., 38, 1907, 85.) In New York waters they spawn in May, and at Cape Cod about the first of June (Bean, 1903).

FOOD: Fishes, especially menhaden and butter-fish, are its staple articles of diet; also herring, scup, squids, shrimp. The young live exclusively on shrimp and young fishes (J. H. Peck, The Sources of Marine Food, Bull., U. S. Fish Com., 1895, 351). Specimens taken in traps in Narragansett Bay have *Fundulus* and small shore fishes in their stomachs.

RATE OF GROWTH: Young specimens ranging from $\frac{1}{8}$ inch (4.2 mm.) up to $1\frac{1}{2}$ inches (37 mm.) are taken each summer during July and August in the lobster rearing cars at the Wickford Experiment Station. Eleven specimens taken averaged $\frac{3}{4}$ -inch (18.9 mm.). On New Jersey coast specimens $1\frac{1}{8}$ inches taken in August (Bean, 1903). Eigenmann took specimens from various places in 1900: Seekonk River, India Point, Fields Point, Buzzards Bay, Wareham River, Hadley Harbor, and Vineyard Sound; five specimens taken in July ranged from $1\frac{1}{4}$ inches (32 mm.) to 2 4-5 inches (70 mm.), average 1 3-5 inches (40.5 mm.); in August, four specimens ranging from 3 3-5 inches (89.5 mm.) to 4 4-5 inches, averaged 4 1-5 inches (105.3 mm.); August 5, 1901, young squeteague abundant at Red Bridge, Providence River, 1.25 to 2.25 inches in length; in September, five specimens ranging from 3 1-5 inches (80 mm.) to 8 inches (200 mm.) averaged 4 3-5 inches (114 mm.); October fifth, a specimen 7 1-5 inches (180 mm.) taken; also on the same date, Edwards found specimens six to eight inches long abundant in New Bedford River.

At the beginning of the second season (June) young squeteague 8 to 10 inches begin to appear, though in Narragansett Bay they do not come in large numbers until after the first run of large fish. About the middle of August a large number of fish about 12 to 14 inches long are present. Definite measurements of the later stages are not yet made. At the end of the second season the squeteague are probably from 14 to 20 inches in length; the large breeding fish which appear in June about 18 to 25 inches in length are probably in the beginning of their third season (two years old). Larger specimens, 30 to 40 inches are fairly common; these are probably four or five years old. (For data regarding the rate of growth of the squeteague see Eigenmann, Investigations into the History of the Young Squeteague, Bull., U. S. Fish Com., XXI, 1901, 45; Tracy, loc. cit.).

135. *Bairdella chrysur* (Lacépède). *Yellowtail; Silver Perch; Madamoiselle.*

GEOG. DIST.: South Atlantic and Gulf coasts from Texas to Rhode Island.

This species has not been previously recorded from New England.

On Long Island shore, in September and October, the young are common and adults occasional (Bean, 1903).

SEASON IN R. I.: Five specimens were taken in the seine in Mill Cove, Wickford, about October 26, 1909. These specimens ranged from 1 4-5 to 2 2-5 inches (45 to 60 mm).

RATE OF GROWTH: Young one inch to 2½ inches long taken on New Jersey shore, early in August. Specimen 1¼ inches long taken at Gravesend Bay, L. I., September 8, 1896. (Bean, 1903).

136. *Leiostomus xanthurus* (Lacépède). *Spot; Goody.*

GEOG. DIST.: Cape Cod to Texas; abundant south. Recorded from Woods Hole (Baird, 1873; Bean, 1880; Smith, 1898), where it is common during the fall and from Connecticut at Bradford (Linsley, 1844). Common on Long Island shore (Bean).

MIGRATIONS: This species reaches the Jersey coast at Sea Isle City in July; north Jersey coast in August; Woods Hole in autumn, remaining through October, until the temperature falls below 45° F.

HABITAT: Bottom fish.

SEASON IN R. I.: Sometimes taken at Newport (Mr. Southwick).

REPRODUCTION: Spawns in the south in bays and inlets during November and December.

FOOD: Small molluscs and crustacea, annelids.

RATE OF GROWTH: Specimens three or four inches long are found on south Jersey coast; Woods Hole specimens are about six inches long. Seal found specimens 1½ inches long in the lower Potomac in May, 1899, and specimens three to six inches in September (Bean, 1891).

137. *Micropogon undulatus* (Linnæus). *Croaker.*

GEOG. DIST.: East coast of the United States from Cape Cod to Texas; not common north of the Chesapeake. Previously recorded only once from New England; a specimen fifteen inches long was taken on September 9, 1893, in a trap in Buzzards Bay (Smith, 1898). Very rare on Long Island shore (Bean, 1903).

SEASON IN R. I.: Specimen taken in trap in West Passage August 21, 1909.

RATE OF GROWTH: Seal found young, 1 to 1½ inches, in the Potomac

River in May, 1889, and specimens three to six inches in September, 1889 (Bean, 1891).

138. *Menticirrhus saxatilis* (Bloch and Schneider). *Kingfish; Sea-mink.*

GEOG. DIST.: Casco Bay to Pensacola. Common along the whole New England shore.

MIGRATIONS: Reaches Jersey coast in April, most abundant in May.

HABITAT: Deep channels, sandy bottoms, rarely approaching shore. Prefers sandy bottoms. Young are found in the same localities with young squeteague. In Narragansett Bay, apparently, it occurs singly, and not in schools.

SEASON IN R. I.: First appears in May. A few are present throughout the season until October. August 23, 1905, a specimen was taken in Sand Blow trap; and on June 5, 1906, a half a dozen specimens were taken in Hazard's Quarry trap. Scattering specimens were taken in traps all through the month of June, 1909. Two specimens were taken in the West Passage trap in September 24, 1906, and on September 4, 1909, a specimen was taken at the Hazard's Quarry trap. In traps off Newport, the first kingfish in 1908 was taken May 8; in 1909, the first was taken May 4.

REPRODUCTION: Specimens full of spawn taken early in June in Narragansett Bay. Ripe specimens are common in June at Woods Hole (Smith, 1898).

FOOD: Bottom feeders. Small crustacea, annelids, sometimes young fishes.

RATE OF GROWTH: Several young specimens were taken in a seine east of Quonset wharf on August 31, 1906, one 2 4-5 inches (70mm.), one 4 1-5 inches (105 mm.). These contained shrimp in stomachs. A specimen 1 3-5 inches (41 mm.) long was taken in lobster-rearing car at Wickford, August 4, 1908.

At Woods Hole the young one inch long appear in the middle of July on sandy beaches. These become four or five inches long in October (Smith, 1898). At Duncan Creek, Long Island, two specimens measuring $3\frac{3}{4}$ and 4 inches were seined September 4, 1901 (Bean, 1903). Young kingfish of the following sizes were secured by Eigenmann in 1900: July 12th, eleven specimens 1 1-5 inches long, ranging from 28 to 30 mm.; July 25, specimen $2\frac{2}{3}$ inches long (68.2 mm.); August 2nd, specimen $3\frac{1}{8}$ inches (97 mm.); August 5th, specimen $4\frac{1}{3}$ inches (107 mm.); August 22, specimen 5 inches (123 mm.).

139. Pogonias cromis (Linnæus). *Drum*.

GEOG. DIST.: Abundant on South Atlantic and Gulf coasts, rare north to Provincetown. In Massachusetts, recorded from Provincetown (Goode and Bean, 1879), Mystic River (B. S. N. H.), Woods Hole (Smith, 1898), from Connecticut, at Stratford (Linsley, 1844), specimens taken in Fisher's Island Sound July 10, 1874 (Goode, 1880). Occasional on Long Island shore (Bean, 1903).

HABITAT: Sluggish swimmers, living on the bottom.

SEASON IN R. I.: Very rare. Reported from Narragansett Bay by R. I. Fish Com., 1899.

FOOD: Bottom-dwelling invertebrates. This fish is especially destructive of oysters.

SIZE: In Great Egg Harbor Bay, N. J., the young were found by Prof. Baird in August. Average of adults, twenty pounds; maximum, eighty pounds.

POMACENTRIDÆ. The Demoiselles.**140. Abudedefduf saxatilis** (Linnæus). *Pintano; Cow-pilot*.

GEOG. DIST.: Tropical America, on both coasts, north to Florida. Abundant in West Indies.

SEASON IN R. I.: Gill, in 1870, mentioned a specimen of this species from Rhode Island (Proc. Acad. Nat. Sci., Phila., 1870, 120).

FOOD: Free-swimming crustacea.

SIZE: Six inches.

LABRIDÆ. The Wrasse-Fishes.**141. Tautogolabrus adspersus** (Walbaum). *Cunner; Chogset*.

GEOG. DIST.: Labrador to Sandy Hook. Abundant along the whole New England coast.

HABITAT: Very similar to that of the tautog, but cunners have a greater tendency to live in quiet inshore waters. The very young are found in eel-grass and sea-weed with young tautog. Half-grown cunners, three to six inches, are always very common in shoal water along the shores and especially around rocks and wharves. Larger specimens eight inches in length and upwards, are often taken in traps in Narragansett Bay and offshore waters.

SEASON IN R. I.: Extremely abundant the year around; hibernates in the mud during the winter. Many are often killed by the cold in extreme winters.

REPRODUCTION: Spawns in June and July. Eggs are like those of tautog, 1-26 inch in diameter and buoyant (Brice, Report, U. S. Fish Com., XXIII, 1897, 223.)

May 30, 1910, 11 specimens were taken in seine; these averaged 64.2 m., and ranged from 50 to 140 mm. Several of the females (56 to 66 mm.) had large ovaries, containing transparent, nearly ripe eggs. One male 65 mm. long had large testes with fluid milt. Probably nearly all these specimen were about a year old.

FOOD: Like that of tautog. Browses around wharves, piles, and similar places, eating fishes, tunicates, hydroids, annelids, small crustacea, univalve molluscs; said to be an important scavenger of harbors, feeding on all kinds of dead animal matter.

RATE OF GROWTH: Many specimens of larvæ and young up to 1½ inches long are taken in the lobster-rearing cars each year in July and August, but in somewhat fewer numbers than tautog. Specimens one to two inches long are frequently taken through August and September in seines on the eel-grass of Wickford Harbor. At Woods Hole, about August 1, young an inch long are observed (Smith, 1898). Cunnners from four to eight inches long are present throughout the summer and are probably those of the second season, one year old.

142. *Tautoga onitis* (Linnæus). *Tautog*; *Blackfish*.

GEOG. DIST.: Atlantic coast, New Brunswick to Charleston. Not common on the Maine shore, but abundant along the remainder of the New England coast. •

HABITAT: Shallow water on exposed shores about rocks and sea-weed.

The young apparently live chiefly in the eel-grass and sea-weed along the shores. But specimens one to two inches long are often taken in the seine from the bottom of coves and channels, in depths of eight to fifteen feet; such specimens are almost invariably found in the tufts of rock-weed and brown algæ scraped up from the bottom.

SEASON IN R. I.: Abundant from April to November, but taken in the greatest numbers from the middle of May until the middle of June. In the winter they seek deeper water, and probably hibernate among the rocks. A few have been taken in Rhode Island in midwinter with lines and in lobster pots (Goode.) There are instances of their death in great numbers during very cold winters. In February, 1857, after a very cold season, hundreds of tons of tautog drifted on the shores of Block Island; in 1841 the same thing occurred on the southern shores of Massachusetts and Rhode Island (Goode). In 1900 the

first specimen taken at Pawtuxet was on April 26, but on April 13, 1908, half a dozen specimens were taken in the trap at Dutch Island Harbor.

REPRODUCTION: Spawning season lasts from May to middle of July.

Eggs are $\frac{1}{36}$ inch in diameter, buoyant, without an oil globule. Larva 2.5 mm. in length at hatching (Agassiz, 1882; Brice, 1887). Probably spawns in the third season after hatching.

RATE OF GROWTH: During July and August of each year eggs, larva, and young of all sizes up to $1\frac{1}{3}$ inches (34 mm.) are found in considerable numbers in the lobster-rearing cars at the Experiment Station at Wickford. About the same time similar specimens are taken along the shores in seines. During the latter part of July and August, young are very common in the eel-grass and rockweed in shallow water. The following specimens have been taken in the seine: May 30, 1910, 15 specimens, averaging 86.3 m., ranging from 46 to 120 mm.; in none of these were the gonads at all developed; July 20, 1908, at Cornelius Island, three specimens—2 inches (51 mm.), $2\frac{1}{3}$ inches (58 mm.), 2 2-5 inches (61 mm.); August 10, 1908, at Cornelius Island, two specimens—3 1-5 inches (80 mm.), and 3 4-5 inches (95 mm.); August 20, 1908, Cornelius Island, four specimens—2 inches (51 mm.), $2\frac{1}{4}$ inches (56 mm.), $1\frac{3}{4}$ inches (44mm.), 2 inches (51 mm.); August 14, 1906, at Vial Creek, Quonset, a half-dozen specimens about one inch long; August 15, 1907, Rabbit Island, five specimens—2-5 inches (10 mm.) to 1 2-5 inches (35 mm.), and one specimen, 3 inches (75 mm.); August 5, 1909, Cornelius Island, 1 1-12 inches (28 mm.); August 13, 1907, Fishing Cove Gut, many specimens (16 mm.) to 1 3-5 inches (40 mm.); August 13, 1909, Cornelius Island, two specimens—3 2-5 inches to 3 3-5 inches; September 3, 1909, 9 specimens, average 46 mm., ranging from 35 m. to 61 m.

On account of the fact that specimens of all sizes are taken in the seine and traps during the latter part of the summer, the later rate of growth is difficult to determine without securing the average of a large number of specimens at different times. But it seems probable that specimens from three to six inches taken in the early part of the summer, and specimens from eight to twelve inches taken in the latter part of the summer are tautog of the second season, *i. e.*, a year old. August 19, 1907, specimen eight inches taken in the seine in Fishing Cove Gut.

EPHIPPIDÆ. The Angel-Fishes.

143. *Chætodipterus faber* (Broussonet). *Spade-fish; Angel-fish; Moon-fish.*

GEOG. DIST.: Cape Cod to Rio Janeiro, very abundant on our south

Atlantic coast. In New England, recorded only from Woods Hole (Smith, 1898) and Narragansett Bay. It has been taken at the east end of Long Island (Mitchill, 1815; De Kay, 1842).

HABITAT: On the Gulf coast it frequents wharves, rock piles, and wrecks. It forms in large schools in October and November preparatory to leaving the coast.

SEASON IN R. I.: Very rare. One specimen taken in Narragansett Bay is in the possession of the Commission.

REPRODUCTION: Spawns from June to August; the eggs are buoyant, 1-20 inch in diameter, have an oil globule, and hatch in 24 hours in water 78° (Brice, Report, U. S. Fish Com., XXIII, 1897, 247). Spawns in Chesapeake in June and July (Ryder, Report, U. S. Fish Com., XIII, 1885, 521). Larva measures 1-10 inch long (2.5 mm.) when newly hatched.

RATE OF GROWTH: All specimens recorded from Narragansett Bay and Woods Hole are about 16 or 18 inches in length. The species reaches a length of 2 or 3 feet. Fifty-three hours after hatching, the larva is $\frac{1}{8}$ inch (4 mm.) long. Specimens $\frac{1}{2}$ to $1\frac{1}{4}$ inches taken in Chesapeake Bay.

CHÆTODONTIDÆ. The Butterfly Fishes.

144. *Chaetodon ocellatus* (Bloch). *Parché*.

GEOG. DIST.: Common at West Indies, the young straying northward to New Jersey, Rhode Island, and Cape Cod. In New England, recorded only from Woods Hole (Smith, 1898) and Newport. At Woods Hole a few are taken nearly every year in October and November. Rare on Long Island.

SEASON IN R. I.: Gill describes a young specimen one inch long from Newport. (Proc. Acad. Nat. Sci., Phila., 1861, 99.) A specimen from Newport is referred to by Cope (1870).

RATE OF GROWTH: A specimen of this species $1\frac{1}{4}$ inches long was seined at Beesley's Point, N. J., September 2nd. A specimen about two inches long was taken near Clam Pond Cove, L. I., October 17, 1898.

BALISTIDÆ. The Trigger-Fishes.

145. *Balistes carolinensis* (Gmelin). *Trigger-fish; Leather-jacket*.

GEOG. DIST.: Tropical parts of the Atlantic north in the Gulf Stream to England and Nova Scotia. Specimen taken on Banquereau Banks, 50 miles southeast of Canso (Cornish, 1907). In Massachusetts it has been recorded from Squam River, Annisquam (B. S. N. H.), New

Bedford (Luce, 1883), Woods Hole (Smith, 1898). Occasional on Long Island shore (De Kay, 1842; Bean, 1903).

SEASON IN R. I.: Somewhat rare, but generally a few are taken each year. One specimen, taken in a trap in the West Passage, Narragansett Bay, August 1, 1905, and another October 9, 1905, with tautog, near the north end of Conanicut Island. Specimen from Newport in the U. S. National Museum (Proc. U. S. Nat. Mus., 1880, 77). This species is reported by Smith (1898) to be more rare at Woods Hole than the related species *B. vetula* (the Bluestriped Trigger-fish), but the latter species has never been reported from Rhode Island waters, while *B. carolinensis* is taken occasionally each year.

REPRODUCTION: Supposed to spawn in deep water.

FOOD: Molluscs, crustacea. The specimen 17 inches long, referred to above, had two squids in its stomach.

SIZE: One foot to eighteen inches.

146. *Balistes forcipatus* (Gmelin). *Powell's Filefish*.

GEOG. DIST.: Africa. Occasionally straying to American coasts.

This species has been identified with *Balistes powelli* (Jordan and Evermann, Fishes of North America, Bull. 47, U. S. Nat. Mus., 1898, p. 1702). Only one specimen has ever been recorded from northern waters; this was a young individual taken in September, 1867, at Newport, by Samuel Powell and described by Cope. (Proc. Acad. Nat. Sci., Phila., 1870, 120.)

MONACANTHIDÆ. The Filefishes.

147. *Monacanthus hispidus* (Linnæus). *Foolfish; Filefish*.

GEOG. DIST.: Lynn, Massachusetts, to Cuba, through the West Indies to Brazil. In Massachusetts this species is recorded from several places along the coast north to Lynn (Kendall, 1908), in Connecticut, reported from Stonington (Linsley, 1844). Rather common on the Long Island shore (Bean, 1903).

SEASON IN R. I.: A few specimens taken from Rhode Island waters, the maximum size being five or six inches. A specimen from Newport in the U. S. National Museum. (Proc., U. S. Nat. Mus., 1880, 76.)

REPRODUCTION: Ryder obtained ripe eggs of this species from females captured in pound nets near Cherrystone, Virginia, about the middle of July, 1880. The eggs are quite small and measure 1-36 inch (.7 mm.) in diameter. They are very adhesive and adhere to foreign objects; pale green in color, and have a number of small oil globules. (Ryder, Report, U. S. Fish Com., XIII, 1885, 511.)

FOOD: Small crustacea, annelids, lamellibranchs, small gasteropods.

RATE OF GROWTH: Adults, ten inches; only the young found in the north. Specimens at Woods Hole range from one to three inches.

148. *Ceratacanthus schœpfii* (Walbaum). *Foolfish; Filefish.*

GEOG. DIST.: Maine, to Florida and Texas. Recorded from Portland, Maine (Storer); from several localities on the Massachusetts shore (Kendall, 1908); and in Connecticut, from Long Island Sound, Stratford, and Stonington (Linsley, 1844). Common on Long Island shore (Bean, 1903).

SEASON IN R. I.: Occasionally taken in August and September. Specimens from Newport in the U. S. National Museum. (Proc. U. S. Nat. Mus., 1880, 76.) Four taken in traps in Narragansett Bay during August, 1905. October 9, 1905, a young specimen taken in a trap at Dutch Island, and August 23, 1905, a specimen was taken in a trap near the north end of Conanicut Island.

REPRODUCTION: Probably spawns in mid-ocean (Goode).

FOOD: Small crustacea, jelly-fishes, etenophores, hydroids.

RATE OF GROWTH: One specimen, four inches long, taken in a trap at Goose Neck, near Wickford, October 9, 1905. Young, one to four inches long, common under gulfweed in summer. Young rather common at Gravesend Bay, Long Island, from August to November; none over nine inches long (Bean, 1903). At Woods Hole, specimens from three to eighteen inches long are common in August and September (Smith, 1898). Adults reach a length of 24 inches.

OSTRACIIDÆ. The Trunkfishes.

149. *Lactophrys trigonus* (Linnæus). *Trunkfish; Shell-fish.*

GEOG. DIST.: West Indies north to Woods Hole. Reported from Marthas Vineyard (Storer, 1839); Holmes Hole (B. S. N. H.); Woods Hole (Smith, 1898). Recorded once on Long Island (Bean, 1903).

HABITAT: The young at Woods Hole mentioned by Dr. Smith may be seen on quiet days "singly or in scattered bodies, in the eel-grass about the wharves. They are taken under the gulf weed, in the surface tow-nets and in shore seines."

SEASON IN R. I.: Recorded from Narragansett Bay (R. I. Fish Com., 1899).

RATE OF GROWTH: Young specimens $\frac{1}{4}$ to 1 inch long are common from July to October at Woods Hole in eel-grass and around wharves (Smith). At Gravesend Bay a specimen $\frac{3}{8}$ -inch long was found in

August, 1897 (Bean, 1903). Specimens an inch to a foot long are taken at the Bermudas. (Goode, 1879.)

TETRAODONTIDÆ. The Trunkfishes.

150. *Lagocephalus lævigatus* (Linnæus). *Smooth Puffer*; *Puffer*.

GEOG. DIST.: Cope Cod to Brazil. Taken at Nantucket (Storer, 1842); Woods Hole (Baird, 1873); Buzzards Bay (Smith, 1898); in Long Island Sound (Linsley, 1844). Occasional on Long Island shore. (Bean, 1903).

SEASON IN R. I.: Somewhat rare. One specimen taken in Narragansett Bay, July 22, 1887. Three were taken in 1900, the largest weighing ten pounds, caught October 4 at Tiverton; one at Newport, collected by J. M. K. Southwick, and a third taken in a purse-net near Point Judith, September 28. A specimen, presented to the Commission by C. Abbott Davis, was caught by A. A. Wilbur, East Greenwich, August 25, 1906. This specimen had very large ovaries with ripe or nearly ripe eggs, but nearly spent.

REPRODUCTION: Said to breed near Pensacola in June and July.

RATE OF GROWTH: Specimen $4\frac{1}{2}$ inches long taken in West Passage trap in early August, 1905. This is an interesting specimen in view of the fact that Smith says that those specimens taken at Woods Hole are all about eleven or twelve inches long, small ones never being observed. Adults reaches a length of two feet.

151. *Spheroides maculatus* (Bloch and Sneider). *Swellfish*; *Puffer*.

GEOG. DIST.: Atlantic coast of United States, from Casco Bay to Florida. Very common along the southern New England shore. Appear at Woods Hole in latter part of May (Bumpus, 1898).

SEASON IN R. I.: Very common from May to October. May^t 29, 1905, Brenton's Reef trap, a specimen was taken. Common in seine on Quonset shore and Willow Beach, and occasionally on Cornelius Island; mostly young specimens taken on similar sandy shores. Adults often taken in the fish-traps in the West Passage, especially at Dutch Island Harbor.

REPRODUCTION: Spawns from June first to tenth (Smith).

FOOD: Bottom invertebrates; small crabs, hermit crabs, shrimp, mollusca, crepidulæ, annelids.

RATE OF GROWTH: Young specimens are often taken in August in rearing cars of the lobster plant at Wickford Experiment Station: Specimen $\frac{1}{8}$ inch (3 mm.) long taken July 9, 1908; specimen $\frac{1}{4}$ inch (4 mm.) long taken about July 15, 1908; specimen 2-5-inch (10 mm.) long taken

August 5, 1909; two specimens 3-5 inch (16.5 mm. and 18 mm.) long taken August 3, 1908. September 2, 1909, seine, Cornelius Island, 4 specimens ranging from 16 to 70 mm.

From July to October 15th, young $\frac{1}{2}$ inch to 1 inch long are very abundant at Woods Hole on sandy beaches. Many young specimens, an inch long and upwards, are taken in the seines on the shady beaches through July and August. The adult reaches a length of ten inches.

152. *Spheroides testudineus* (Linnæus).

GEOG. DIST.: West Indies north to Newport. Not recorded from New York waters.

SEASON IN R. I.: Has been taken at Newport. (Cope, Proc. Acad. Nat. Sci., Phila., 1870, 120.)

SIZE: Reaches a length of seven or eight inches.

153. *Spheroides trichocephalus* (Cope).

This species is known only from Cope's description of a small specimen four inches long taken by Mr. Samuel Powell in the Gulf Stream off Newport. Possibly the young of *Spheroides pachygaster*. (Cope, Proc. Acad. Nat. Sci., Phila., 1870, 120.)

DIODONTIDÆ. The Porcupine-Fishes.

154. *Chilomycterus schoepfii* (Walbaum). *Porcupine-fish; Swell-toad; Puffer.*

GEOG. DIST.: Cape Cod to Florida, abundant south in shallow water. In Massachusetts, reported in Massachusetts Bay (B. S. N. H.), Woods Hole (Baird, 1873, Smith, 1898); in Connecticut (Ayres, 1843), at Stratford, at New Haven (Linsley, 1844), Noank (Bean, 1880). Occasional on Long Island coast (Bean, 1903).

SEASON IN R. I.: Two specimens from Rhode Island are in the U. S. National Museum; one was taken at Newport (Proc. U. S. Nat. Mus., 1880, 75); the other was taken at Watch Hill by the U. S. Fish Commission, September 18, 1874. (Bull. U. S. Nat. Mus., 1879, 24.) In 1903, Mr. Fowler, of Wickford, took a specimen in a dredge in Narragansett Bay, opposite Hamilton.

FOOD: Crustacea, molluscs.

RATE OF GROWTH: Specimen three inches long seined at Longport, N. J. August 29, 1887 (Bean, 1903); specimens from 2 $\frac{1}{2}$ to 5 inches long at Woods Hole, in the latter part of September and October (Smith, 1898). Adults reach a length of six to ten inches.

MOLIDÆ. The Head-Fishes.**155. *Mola mola* (Linnæus). *Sunfish*.**

GEOG. DIST.: Tropical seas, north to San Francisco, Portland, Maine, and England. Taken off Portland, Maine (U. S. Nat. Mus., 1875), from many places along the Massachusetts shore (Kendall, 1908), from Connecticut, at Stonington (Linsley, 1844), and Noank (Goode, 1879). Specimen recorded from New York Bay by Mitchill (1815) and De Kay (1842).

HABITAT: Surface of the open water.

SEASON IN R. I.: Occasionally taken at Block Island in late summer.

REPRODUCTION: "The eggs of *Mola* are very probably pelagic, the larvæ having the same habit." (Ryder, Report U. S. Fish Com., XII, 1884, 1027; Ryder, On the Development of the *Mola*, Science, IV, 1884, 93.)

FOOD: Fishes, crustacea, ctenophores, jelly-fishes.

SIZE: Largest on record was taken at California: eight feet, two inches; weighing 1,800 pounds. Young, two inches long, described by Putnam (Amer. Nat. IV, 1874, 629). See also Ehrenbaum, Nordisches Plankton, 10, 1909, 314.

SCORPÆNIDÆ. The Rock-Fishes.**156. *Helicolenus dactylopterus* (De la Roche).**

GEOG. DIST.: Narragansett Bay and Chesapeake Bay. Common in deep water in the Mediterranean.

HABITAT: On rocky bottoms at considerable depths (100 to 250 fathoms).

SEASON IN R. I.: First discovered in America in 1880 off Narragansett Bay; by the "*Fish Hawk*." (Goode and Bean, Oceanic Ichthyology, 1896, 249.)

REPRODUCTION: In the Mediterranean, females full of eggs have been observed in the summer (Risso, quoted by Bean, 1903).

SIZE: Almost a foot in length. The "*Challenger*" secured two specimens 5 and 9 mm. long, April 26, 1876, off St. Vincent, Cape De Verde Islands.

COTTIDÆ. The Sculpins.**157. *Myoxocephalus æneus* (Mitchill). *Little Sculpin; Grubby*.**

GEOG. DIST.: Bay of Fundy to New Jersey. Common on coast of southern New England and New York.

SEASON IN R. I.: Common throughout the year. Specimen three inches long taken in seine at Willow Beach near Wickford, July 17, 1905.

August 14, 1906, three specimens were taken in seine at Sauga Point, and two specimens were taken in a seine on August 8, 1906, at Cornelius Island.

REPRODUCTION: Spawns in winter and spring; the eggs at that time may be seen sticking to nets and seaweed.

FOOD: Bottom invertebrates; annelids, copepods, shrimp, young flounders.

SIZE: Maximum, six to eight inches.

158. *Myoxocephalus groenlandicus* (Cuvier and Valenciennes). *Daddy Sculpin; Sculpin.*

GEOG. DIST.: New York to Greenland. Common on whole New England coast.

SEASON IN R. I.: Taken in winter from October to March, but not so common as the next species. Not often found in Narragansett Bay.

REPRODUCTION: Spawns in November and December. In the North Sea this species spawns from December to February; the eggs are laid in clumps at moderate depths and are 1-12 inch (1.5 to mm.) in diameter, and have numerous small globules. The egg hatches in about five weeks, when the larva is about $\frac{1}{3}$ inch long (7.4 to 8.6 mm.) The eggs are laid in a nest made from sea-weed and pebbles and are guarded by the male.

FOOD: Fishes, crustacea, worms.

SIZE: Maximum, 25 inches.

REFERENCES:

1882: AGASSIZ, Proc. Amer. Acad. XVII, 285.

1890: MCINTOSH AND PRINCE, Trans. Roy Soc., Edinburgh, 35, 675.

1896: MCINTOSH, Report, Fishery Board, Scotland, 14, 181.

1897: MCINTOSH AND MASTERMAN, British Marine Food Fishes, 122.

1905: GILL, Smithsonian Misc. Coll., XLVII, 348.

1905: EHRENBAUM, Nordisches Plankton, 4, 55.

159. *Myoxocephalus octodecimspinosus* (Mitchill). *Eighteen-spined Sculpin; Sculpin.*

GEOG. DIST.: Labrador to Virginia, common about Cape Cod.

SEASON IN R. I.: Common in winter from October to April. In Narragansett Bay often taken in winter in beam-trawls with flatfish. Much more common in Narragansett Bay than *M. groenlandicus*. April 30, 1906, a specimen was taken in Sand Blow trap, Conanicut Island, and October 29, 1905, a specimen was taken in Dutch Island trap.

REPRODUCTION: Spawns in November and December (Smith, 1898).

A clump of eggs, probably of this species, was taken in beam-trawl just south of Plum Beach Light, December 22, 1908.

SIZE: About a foot long.

160. Hemitripterus americanus (Gmelin). *Sea-raven; Red Sculpin.*

GEOG. DIST.: Atlantic coast, New York to Labrador.

SEASON IN R. I.: Common from September through the winter to May.

Specimen taken in Dutch Island trap May 1, 1909. Two specimens from Newport are in the U. S. National Museum. (Proc. U. S. Nat. Mus., 1880, 86.) October 9, 1905, a specimen taken north end of Conanicut Island. Several specimens from 8 to 20 inches long in beam trawl south of Plum Beach Light, December 22, 1908. May 28, 1906, a specimen taken with scup off Sakonnet (Mr. Fearney, of Providence).

HABITAT: Bottom fish in deep water in summer, moving in toward the shore in winter. Specimen taken in seine with menhaden two miles from shore in October, 1895 (Smith, 1895).

REPRODUCTION: Spawns in November. Eggs are 5-32 inch in diameter, not buoyant, and adhere in masses (Bean, 1903). Large specimen with ripe eggs taken in beam-trawl south of Plum Beach Light, December 22, 1908. (See Ehrenbaum, Nordisches Plankton, 4, 1905, 53.)

FOOD: All bottoms invertabrates; molluscs, crustacea, sea urchins, worms; also fishes. This species is a useful scavenger. Specimen taken April 13, 1908, in trap at Dutch Island Harbor, had a cunner five inches long in its stomach.

SIZE: Two feet.

AGONIDÆ.

161. Aspidophoroides monopterygius (Bloch). *Sea poacher; Alligator fish.*

GEOG. DIST.: From Greenland to Rhode Island, abundant in Massachusetts Bay and northward. This species frequently obtained from the stomach of the cod and haddock.

HABITAT: Cold water at moderate depths.

SEASON IN R. I.: In 1874 the head of a specimen of this species was dredged up on the Pecten Ground off Watch Hill (Goode and Bean, 1879).

SIZE: Reaches a length of six inches.

CYCLOPTERIDÆ. The Lump-Suckers.**162. *Cyclopterus lumpus* (Linnæus). Lumpfish.**

GEOG. DIST.: North Atlantic, south to France and Long Island. Common along the whole New England coast (Kendall, 1908). Found at Gravesend Bay in May (Bean, 1903).

SEASON IN R. I.: Fairly common from March to June. Specimen from Newport in the U. S. National Museum. (Proc. U. S. Nat. Mus., 1880, 83). Often taken in fyke nets with flatfish.

HABITAT: Rocky shores.

REPRODUCTION: Spawning season from January to March or April, near the shore. "The female then retires to deep water, leaving the male to watch the eggs which hatch among seaweed and eelgrass." (Garman, Mem. Mus. Comp. Zool. 14, 1892, 21; also McIntosh, 1896.) Eggs are 1-10 inch in diameter (2.2 to 2.6 mm). Length of larvæ on hatching is from 1-5 to $\frac{1}{4}$ inch (5.8 to 7.4 mm).

FOOD: Ctenophores, small jelly-fishes.

RATE OF GROWTH: The young specimens are often taken in the summer under drifting sea-weed. Young specimens caught in dip net May 30th, under floating rock-weed in Narragansett Bay. Adults sometimes reach twenty inches, but are generally less. In British waters, young from 11 to 30 mm. ($\frac{1}{2}$ to 1 1-5 inches) are found in July. In the second summer after hatching the following are found: 2 $\frac{1}{4}$ inches, July 1st; 5 $\frac{1}{4}$ inches in July; 7 inches in August; 6 1-16 inches in December; these latter are 18 or 19 months old (McIntosh, 1896).

REFERENCES:

1882: AGASSIZ, Proc. Amer. Acad., XVII, 286.

1887: CUNNINGHAM, Trans. Roy. Soc., Edinburgh, XXXIII, 104.

1890: MCINTOSH AND PRINCE, Trans. Roy. Soc., Edinburgh, XXXV.

1896: MCINTOSH, Report, Fishery Board, Scotland, 14, 173.

1897: MCINTOSH AND MASTERMAN, British Marine Food Fishes, 181.

1905: EHRENBAUM, Nordisches Plankton, 4, 116.

LIPARIDIDÆ. The Sea-Snails.**163. *Liparis liparis* (Linnæus). Sea-snail; Sucker.**

GEOG. DIST.: North Atlantic on both shores, north to Spitzbergen, south to Connecticut and France. Most abundant in North Europe.

HABITAT: Commensual, living within the shells of large scallops and often in company with a small crab.

SEASON IN R. I.: In the U. S. National Museum is a specimen taken by

the U. S. Fish Commission at Watch Hill Reef, August, 1874. Small specimens taken September, 1874, off Block Island, from the shell of a large species of scallop, *Pecten tenuicostatus*. (Goode, Nat. Hist. of Aquatic Animals, 234.) Common in winter on rocky bottoms (Smith).

REPRODUCTION: Found full of spawn in December and January (Smith).

Spawning season from November to February (Ehrenbaum). Eggs 1-11 inch (1.5 mm.) in diameter. The larvæ on hatching are 1-5 inch long (5.44 mm.). (For description of the eggs and young, and bibliography, see Ehrenbaum, Nordisches Plankton, 4, 1905, 113; McIntosh and Masterman, British Marine Food Fishes, 1897, 190.)

FOOD: Amphipods and shrimp have been found in the stomach (Bean 1903).

SIZE: Five inches.

TRIGLIDÆ. The Gurnards.

164. *Prionotus carolinus* (Linnæus). *Sea-robin; Common Gurnard.*

GEOG. DIST.: Casco Bay to South Carolina. Rare north to Cape Cod.

In 1896, between July 4th and 14th, over twenty-five specimens were taken in Casco Bay, Maine. At Woods Hole, in 1898, a thousand or more fish representing this species and *P. strigatus* appeared in a trap on May 13. Specimens examined on the 16th were not ripe, though the ovaries were large (Bumpus, 1898).

SEASON IN R. I.: Appears in April and is common until October. Two specimens from Newport in the U. S. National Museum. In 1906 the first specimens off Newport were taken April 13; April 30, three specimens were taken in the Dutch Island Harbor trap. In 1907, the first specimens from Newport were reported May 9; in 1908 they were first taken April 25.

REPRODUCTION: Spawns in June.

FOOD: Fishes; one specimen had four winter flounders in the stomach.

Also young clams, squids, molluscs, shrimp, annelids.

SIZE: Fourteen inches.

165. *Prionotus strigatus* (Cuvier and Valenciennes). *Sea-robin; Sculpin.*

GEOG. DIST.: Atlantic coast, Cape Cod to Virginia. Common on southern shore of New England.

SEASON IN R. I.: This species does not appear to be common in Narragansett Bay. Occasionally taken in traps from June to October. Two specimens from Newport in U. S. National Museum. September

17, 1906, a specimen was taken in Sand Blow trap, on Conanicut Island, and on September 24, 1906, another one was taken in a West Passage trap.

REPRODUCTION: Spawns in summer (Smith).

RATE OF GROWTH: At Woods Hole, young $\frac{3}{4}$ inch long and upwards are very common throughout the summer; by fall they have reached a length of four inches (Smith, 1898). Adults reach a length of eighteen inches.

CEPHALACANTHIDÆ. The Flying Gurnard.

166. *Cephalacanthus volitans* (Linnæus). *Flying Robin; Flying Gurnard.*

GEOG. DIST.: Atlantic Ocean, on both coasts north to Maine. A few taken every year at Woods Hole (Smith, 1898). Recorded from Maine (Holmes, 1862), from Woods Hole and vicinity (Storer, 1853; Baird, 1873; Bean, 1880; Smith, 1898, and from Long Island Sound (Linsley, 1844). Uncommon on shore of Long Island (Bean, 1903).

SEASON IN R. I.: Reported from Narragansett Bay (R. I. Fish Com., 1899).

REPRODUCTION: Spawns in the spring. Eggs and larvæ are pelagic (Gill, Report, Smithsonian Inst., 1904, 512).

FOOD: Small fishes; crustaceans, like shrimp, prawns, and small crabs.

RATE OF GROWTH: Young $\frac{1}{3}$ to 2 inches; differ much from the adult, and were formerly thought to belong to a different genus. Specimens $2\frac{1}{2}$, $6\frac{1}{2}$, and 7-10 inches in length were taken at Great Egg Harbor Bay in September, 1887. Adults reach a length of twelve inches.

ECHENEIDIDÆ. The Remoras.

167. *Echeneis naucrates* (Linnæus). *Shark Sucker; Remora.*

GEOG. DIST.: Warm seas, universally distributed, north to Salem, Massachusetts coast (Kendall, 1908), and from Long Island Sound (Linsley 1844). Not uncommon on the shore of long Island (Bean, 1903).

HABITAT: Very common in the tropics, attached to turtles or any large fish.

SEASON IN R. I.: In the warmer part of the summer they are occasionally found swimming around in the traps or attached to almost any fish. Taken in Narragansett Bay (R. I. Fish Com., 1899); also at Newport (Bean, 1880). Not as common as the next species.

FOOD: Carnivorous, feeding on smaller fishes.

SIZE: Mitchill (1815) describes a specimen 31 inches long.

168. *Echeneis naucrateoides* (Zuieww). *Pilot-sucker*.

GEOG. DIST.: Warm seas north to the Merrimac River. Reported from Hyannis (Storer, 1842), Collins Cove, mouth of Merrimac River (?) (Goode and Bean, 1879), Woods Hole (Baird, 1873; Smith, 1898).

SEASON IN R. I.: Occasionally taken in Narragansett Bay from June to October. More common than *E. naucrates*. Specimens from Newport in U. S. National Museum (Proc. U. S. Nat., 1880, 102). One taken in a trap in Dutch Island Harbor, October 2, 1905.

169. *Rhombochirus osteochir* (Cuvier). *Spearfish remora*.

GEOG. DIST.: West Indies, north to Cape Cod. Rare. Reported at Woods Hole (Baird, 1873; Smith, 1898).

HABITAT: Parasitic on spearfish (*Tetrapturus*).

SEASON IN R. I.: Very rare. Reported by R. I. Fish Com., 1899.

BATRACHOIDIDÆ. The Toadfishes.**170. *Opanus tau*. (Linnæus). *Toadfish; Toad-grunter*.**

GEOG. DIST.: Maine to Cuba.

HABITAT: Among rocks and weeds close to the shore; prefers temperature of 50° to 90° F.

SEASON IN R. I.: Common throughout the year in shallow water under stones and eel-grass.

REPRODUCTION: Spawns in May and June, the eggs being attached to the under sides of stones and other submerged objects. The insides of cans, old shoes, and large shells are also favorite places for the attachment of the eggs. The eggs are very large, 1-5 inch (5 mm.) in diameter; they hatch in about 20 days (June 21 to July 15 and 17), when the larva is about $\frac{1}{4}$ inch (5 to 6 mm.) in length. The yolk sac remains fixed to its attachment about four weeks (June 20th to July 22d, in one case, July 16 to August 19 in another case), until it becomes nearly absorbed, when the fish swims free. The larva is then about 3-5 inch (15 to 16 mm.) in length.

In June and July eggs and larvæ are frequently found in coves and along muddy and grassy shores, guarded by the male.

FOOD: Young fishes and all kinds of bottom invertebrates.

RATE OF GROWTH: On July 17, 56 young toadfish, measuring about 3-5 inch (15 to 17 mm.), which had been raised from the eggs in a small car, were transferred to a filter car. The following table of individual and average measurements shows their rate of growth:

July 17.....	15.0-17.0.....	56 specimens.
July 30.....	19.0	
July 31.....	22.5	
August 1.....	18.7-22.0.....	
August 11.....	26.0	
August 14.....	26.5	
August 21.....	19.0-33.7.....	39 specimens.

Young specimens are taken in the seine on the eel-grass at all times of the summer. The following specimens were seined on Cornelius Island, Wickford. May 30, 1910, specimens 75 and 78 mm. long. August 30, 1908, specimen 1 1-5 inches (30 mm.) long; August 20, 1908, two specimens 2 4-5 inches long (72 mm); August 10, 1908, specimen 4 3-5 inches (115 mm.) long. Specimens two to four inches long are often dredged up with oysters in winter. Goode found at Noank, Connecticut, numerous eggs on stones in water about two feet in depth on July 14th; on July 21st fishes $\frac{1}{2}$ inch long were plenty; on September 1, the average was one inch; he considered that toadfishes of three or four inches long were in their second year, and that maturity was reached in the third or fourth year. Adult reaches fifteen inches in length.

REFERENCES:

- 1867: STORER, Hist. Fishes, Mass., 105.
 1882: AGASSIZ, Proc. Amer. Acad., XVII, 279.
 1886: RYDER, BULL. U. S. Fish Com., VI, 4.
 1890: RYDER, Proc. Acad. Nat. Sci., Phila., 42, p. 407.
 1891: CLAPP, Jour. Morph., V, 494.
 1907: GILL, Life History of the Toadfishes, Smithsonian Misc. Coll., 48, p. 388.
 1908: GUDGER, Habits and Life History of the Toadfish, Bull. Bureau of Fisheries, XXVIII, 1908, 1073.

BLENNIIDÆ. The Blennies.

171. *Pholis gunnellus* (Linnæus). *Butter-fish; Rock Eel.*

GEOG. DIST.: North Atlantic, Labrador to New York, Norway to France. Common from Woods Hole northward. In Connecticut, reported from Bridgeport and Stonington (Linsley, 1844). Rare in New York waters (Bean, 1903).

HABITAT: Rocky shores among algæ; in deep water in winter.

SEASON IN R. I.: Occurring rarely in winter. Probably present in deep water throughout the year.

REPRODUCTION: Eggs, probably of this species, were taken among the oyster shells in Wickford Harbor the last of December, 1909. Eggs are about $\frac{1}{2}$ inch (2 mm.) in diameter, clear and glassy, with an oil globule; they are laid from November to January, and hatch a month or six weeks afterward. The larva when hatched is 2-5 inches in length (9 mm.). The yolk is absorbed in specimens a little over $\frac{1}{2}$ inch in length (13 to 14 mm.).

RATE OF GROWTH: Two specimens about four inches long (98 and 108 mm.) were taken among the oyster shells in Wickford Harbor, the last of December, 1909. The adult reaches a length of twelve inches.

REFERENCES:

- 1890: McINTOSH AND PRINCE, Trans. Roy. Soc., Edinburgh, XXV, 670.
 1891: McINTOSH, Report Fisheries Board of Scotland, 9, 326.
 1893: HOLT, Sci. Trans. Roy. Soc., Dublin, V, 42.
 1897: McINTOSH AND MASTERMAN, British Marine Food Fishes, 210.
 1905: EHRENBAUM, Nordisches Plankton, 4, 87.

172. *Ulvaria subbifurcata* (Storer). *Radiated shanny*.

GEOG. DIST.: Very rare in the North Atlantic, south to Newport. This species was taken by U. S. Fish Commission at Grand Manan and Halifax, and by Prof. Verrill off Anticosti (Bean, 1903). In New England, it was taken by Storer at Nahant (1839 and 1867). On the Maine coast it has been taken at Casco Bay (1874), and off Manticus (1906) (Kendall, 1908). It has been recorded from New York waters.

HABITAT: Cornish (1907) reports four specimens from Canso, one taken on the beach under stones, two were dredged in six to ten fathoms of water, and the fourth taken in a beam-trawl in the Bay in thirty fathoms of water.

SEASON IN R. I.: A single specimen was obtained off the mouth of Newport Harbor (Goode, Proc. U. S. Nat. Mus., 3, 1886, 477.)

SIZE: This species reaches a length of about six inches.

CRYPTACANTHODIDÆ. The Wry-mouths.

173. *Cryptacanthodes maculatus* (Storer). *Wry-mouth; Ghost-fish*.

GEOG. DIST.: Recorded from Labrador to Long Island Sound. Rarely on New England coast from Eastport, Maine (Kendall, 1893) to Bridgeport, Connecticut (Linsley, 1844). At Woods Hole a specimen eighteen inches long was taken on December 18, 1896, in a fyke net

in Great Harbor (Smith, 1898). There is an albino form of this fish, of which four specimens were found prior to 1879. (Bean, 1903).

SEASON IN R. I.: Specimen from Rhode Island (Goode, 1879).

SIZE: Twenty-four inches.

ANARHICHADIDÆ. The Wolf-Fishes.

174. *Anarhichas lupus* (Linnæus). *Wolf-fish; Catfish.*

GEOG. DIST.: North Atlantic south to Long Island and France. Found on coast of Maine and Massachusetts (Kendall, 1908). Frequent in deep waters of Massachusetts Bay (Bean, 1903).

SEASON IN R. I.: In the U. S. National Museum is a cast of a specimen taken by the U. S. Fish Commission at Coxswain's Lodge, R. I., July 25, 1875 (Bull. U. S. Nat. Mus., 1879, 32). Reported from Narragansett Bay by R. I. Fish Com., 1899.

REPRODUCTION: The spawning season is from November to January. The yellowish, opaque eggs are laid in masses on the bottom. They are the largest known marine fish eggs, their diameter being about $\frac{1}{4}$ inch (5.5 to 6 mm.). They have a large oil globule. The larva on hatching is about $\frac{1}{2}$ inch long (12 mm.). The yolk sac is absorbed in $3\frac{1}{2}$ months (middle of May), when the fish is $\frac{2}{3}$ inch long (17 to 20 mm.). (Ehrenbaum, Nordisches Plankton, 4, 1905, 92; McIntosh and Masterman, British Marine Food Fishes, 1897, 200; McIntosh and Prince, Trans. Roy. Soc., Edinburgh, XXV, 1890, 874.)

RATE OF GROWTH: Several specimens thirty inches long were taken in 65 fathoms south of Rhode Island. (Goode, 1880.)

ZOARCIDÆ. The Eel-Pouts.

175. *Zoarces anguillar* (Peck). *Eel-Pout; Sea-Pout; Ling.*

GEOG. DIST.: Delaware to Labrador. Common north of Cape Cod; caught in large numbers with cod off Sandy Hook (Bean, 1903).

HABITAT: Deep water.

SEASON IN R. I.: Taken frequently in November and December in beam-trawls with flatfish, especially in the deep water of the East Passage of Narragansett Bay. Also taken at Block Island. It is probably present the year round in deep off-shore waters.

REPRODUCTION: The nearly related European species, *Z. viviparus*, produces its young alive during the winter months of December, January, and February. The young are then about two inches long (40 to 50

mm.); they are not pelagic, but retire to the bottom among the stones and sea-weeds (Ehrenbaum, Nordisches Plankton, 10, 1909, 310).

SIZE: Twenty inches, and up to three feet.

176. *Lycodes reticulatus* (Reinhardt). *Eel-Pout*.

GEOG. DIST.: North Atlantic, south to Narragansett Bay. Reported from Vineyard Sound (Goode and Vean, 1896, Smith, 1898).

HABITAT: Deep water, 17 to 140 fathoms.

SEASON IN R. I.: The National Museum contains two specimens taken by the "Fish Hawk," in Narragansett Bay, in 17 fathoms, September, 1880 (Goode and Bean, Oceanic Ichthyology, 1896, 305).

SIZE: Fourteen inches.

177. *Lycenchelys verrillii*. (Goode and Bean).

GEOG. DIST.: Off Massachusetts in very deep water. Reported in the deep water of Massachusetts Bay (Goode and Bean, 1879).

SEASON IN R. I.: Specimen at Boston Society of Natural History, supposed to have been taken at Newport.

SIZE: Dwarf species of very small size.

MERLUCCIIDÆ. The Hakes.

178. *Merluccius bilinearis* (Mitchill). *Silver Hake; Whiting; Frost-fish*.

GEOG. DIST.: Coast of New England, northward to Straits of Belle Isle; south in deep water to the Bahamas.

SEASON IN R. I.: June 5, 1906, a few specimens were taken at Hazard's Quarry trap. June, 1907, this species was abundant until the latter part of the month. This season was particularly cold, which explains their abundance at a date much later than usual.

REPRODUCTION: In September and October, 1880, while exploring the ocean bottom off Newport and at the edge of the Gulf Stream, immense numbers of the young of this species, from $\frac{1}{2}$ to 3 inches in length, were taken on the bottom, in water 150 to 487 fathoms deep; with them were taken many adults, 12 to 18 inches in length, apparently in the act of spawning, some with ripe or nearly ripe ova, others which were evidently spent fish. The largest of these young must have been hatched from eggs shed in July.

Thus the spawning season must be somewhat extended, lasting well into the fall. In September an adult taken at Halifax, N. S., was full of

nearly ripe spawn (Goode, Nat. Hist. of Aquatic Animals, 242, and Proc. U. S. Nat. Mus., 1880, 337).

FOOD: This species is a fish of prey, coming to the surface to capture herring and other small fishes. Also feeds upon crabs and small crustacea.

RATE OF GROWTH: Young specimens $2\frac{1}{2}$ inches long are seined about Woods Hole in the fall (Smith, 1898).

GADIDÆ. The Cods.

179. *Pollachius virens* (Linnæus). *Pollock*.

GEOG. DIST.: North Atlantic, south on both coasts to New Jersey and France.

MIGRATION: Like the cod, appearing in New England shore waters in cool weather, leaving when temperature reaches 60° or 65° F. Reach Nantucket early in April.

SEASON IN R. I.: Not common in Narragansett Bay. A large run arrives in offshore waters in the middle of May, probably leaving in June. Comes in again in September and October and are present through the winter. A small specimen, fourteen inches long, taken September 11, 1905, Dutch Island Harbor. On May 15, 1905, and during the few following days, a large run of pollock took place all along the shore from Brenton's Reef to Sakonnet. This was the largest run for years and made havoc among the scup schools.

REPRODUCTION: Spawning takes place in November and December in the open water. The eggs are buoyant, have no oil globule, and are 1-22 inch (1.03 to 1.22 mm.) in diameter. They hatch in six days in water of 49° ; the yolk sac is absorbed in five days. The newly hatched larva is $\frac{1}{8}$ inch (3.4 to 3.8 mm.) in length.

HABITAT: Like the cod; a bottom and deep-water fish. But it is more often seen on the surface than the cod, congregating in large schools which roam from place to place preying on fishes of all sorts.

FOOD: Fishes of all kinds; scup, young codfish.

RATE OF GROWTH: In April, many young six or eight inches long are present. April 16, 1906, two specimens were taken in Dutch Island trap that were six inches long. One specimen was taken in the same trap on April 30, 1906. Schools of young at Woods Hole in April, 1 to $1\frac{1}{2}$ inches long; these are four inches long in June. In September there is a run of pollock seven or eight inches long.

REFERENCES:

- 1892: McINTOSH, Reports, Fishery Board, Scotland, 10, 287.
1893: McINTOSH, *ibid.* 11, 242.
1894: McINTOSH, *ibid.* 12, 218.
1897: BRICE, Report, U. S. Fish Com., XXIII, 222.
1897: McINTOSH AND MASTERMAN, British Marine Food Fishes, 266.
1909: EHRENBAUM, Nordishes Plankton, 10, 244.

180. *Microgadus tomcod.* (Walbaum). *Tomcod; Frost-fish.*

GEOG. DIST.: Virginia to Labrador.

SEASON IN R. I.: Present along the coast the year round; common in streams and near shores in winter.

REPRODUCTION: Spawns in shore waters in December. Eggs are heavy, adhesive, 1-15 inch in diameter and are agglutinated together in masses, the latter being usually attached to sea-weeds and stones at the bottom. They hatch in 35 days at temperature of 40°; yolk sac is absorbed in four days. The larva at hatching is 1-5 inch (5 mm.) in length (Brice, Report, U. S. Fish Com., XXIII, 1897, 223; Ryder, Report U. S. Fish Com., XIII, 1885, 523).

FOOD: Annelids, shrimp, amphipods, and other small crustacea.

SIZE: Rarely over twelve inches.

181. *Gadus callarias* (Linnæus). *Cod.*

GEOG. DIST.: North Atlantic, south to Virginia and France.

MIGRATIONS: Prefers a temperature of 35° to 42° F; therefore it remains on the offshore banks during the summer along the New England coast, keeping out of the cold Labrador current, which extends south inside the Gulf Stream, coming into more shallow water in winter. (For the results of an experiment in tagging of codfish, see H. M. Smith, Notes on the Tagging of Four Thousand Adult Cod at Woods Hole, Mass., Report, U. S. Fish Com., XXVII, 1901, 193.)

SEASON IN R. I.: Appears in October, height of season in November; present all winter. A spring run takes place in April. April 30, 1906, 100 specimens were taken in Sand Blow trap, Conanicut Island.

REPRODUCTION: The extreme length of the spawning period is from September to May. The spawning of each fish probably continues through a period of two months. The eggs are buoyant, 1-18 inch in diameter, hatch in fourteen days at 43°; the yolk sac is absorbed in 12 days at 38°.

FOOD: Feeds on all marine animals smaller than itself. Fishes: molluscs, crustaceans, echinoderms, etc. Many specimens of lobsters have been found in the stomach of the cod; a five-inch lobster was found in the stomach of a cod taken off Nantucket, November 1, 1900. The very young feed exclusively on copepods (Kendall, Bull. U. S. Fish Com., XVI, 1896, 177).

RATE OF GROWTH: At Woods Hole young, $\frac{1}{2}$ to 1 inch in length, are seined in March. These leave about June 15, 3 or 4 inches in length. Schools of young about two inches long were seen April 23, 1906. In Massachusetts the rate of growth of the cod has been shown to be as follows: specimen $1\frac{1}{2}$ to 3 inches long are about six months old; those 9 to 13 inches are $1\frac{1}{2}$ years old; those 18 are $1\frac{1}{2}$ year old; and those 22 inches long are $3\frac{1}{2}$ years old. The largest cod ever recorded from New England weighed $211\frac{1}{2}$ pounds, and was over six feet long; taken in a trawl in May, 1895 (Brice, 1897).

REFERENCES:

- 1873: Sars, Report, U. S. Fish Com., III, 213.
 1877: Sars, *ibid*, V, 612.
 1878: Earll, Report, U. S. Fish Com., VI, 685.
 1882: Ryder, Report, U. S. Fish Com., X, 455.
 1885: Ryder, Report, U. S. Fish Com., XIII, 489.
 1890: McIntosh and Prince, Trans. Roy. Soc., Edinburgh, XXXV, 812.
 1897: Brice, Report, of U. S. Fish Com., XXIII, 193.
 1897: McIntosh, Report, Fishery Board, Scotland, 15, 194.
 1897: McIntosh and Masterman, British Marine Food Fishes, 236.
 1901: Masterman, Trans. Roy. Soc. Edinburgh, 40, 1.
 1909: Ehrenbaum, Nordisches Plankton, 10, 224.

182. *Melanogrammus æglefinus* (Linnæus). *Haddock*.

GEOG. DIST.: North Atlantic, south to France and North Carolina; in deep water to Cape Hatteras.

SEASON IN R. I.: Taken in Narragansett Bay (R. I. Fish Com., 1899). Sometimes taken in East Passage in cold weather. Off Block Island (Collins and Rathbun, 1887).

REPRODUCTION: Spawning season is from February to May. The egg is buoyant, non-adhesive, without an oil globule; 1-17 inch (1.19 to 1.67 mm.) in diameter. The larva newly hatched is $\frac{1}{8}$ inch (4 mm.) in length.

FOOD: Like that of the cod, but more largely of invertebrates (Goode).
Fishes like cunners and herrings, crustaceans, annelids, molluscs, and echinoderms.

RATE OF GROWTH: In the North Sea, larva 1-5 to $\frac{1}{4}$ inch long (5.5 to 8.5 mm.) found in April; larvæ $\frac{1}{2}$ to 2 4-5 inches (11.25 to 43 mm.) in June and July. Adult reaches a length of nearly three feet.

REFERENCES:

- 1885: CUNNINGHAM, Quart. Jour. Micro. Sci., Vol. 26, 2.
1890: MCINTOSH AND PRINCE, Trans. Roy. Soc., Edinburgh, XXV, S22.
1893: HOLT, Sci. Trans. Roy. Soc., Dublin, V, 51.
1896: KENDALL, Bull. U. S. Fish Com., XVI, 177.
1897: BRICE, Report, U. S. Fish Com., XXIII, 222.
1897: MCINTOSH, Report, Fishery Board, Scotland, 15, 196.
1897: MCINTOSH AND MASTERMAN, British Marine Food Fishes, 245.
1909: EHRENBAUM, Nordisches Plankton, 10, 219.

183. *Urophycis regius* (Walbaum). *King Hake; Codling.*

GEOG. DIST.: Nova Scotia to Cape Hatteras, but nowhere common. Found most frequently in the neighborhood of Long Island. In Maine reported off Seguin Island, (Kendall, 1908); in Massachusetts at Woods Hole (Smith, 1898); in Connecticut from Long Island Sound, (Lindsley, 1844); off Stratford, Middle Ground, off Faulkners Island, (Kendall, 1908).

SEASON IN R. I.: From September to November; not common, but is sometimes taken in traps in the southern part of Narragansett Bay. Specimens taken in 155 fathoms of water off Newport by the "*Fish Hawk*," September, 1880.

HABITAT: Deep water.

SIZE: Average about ten inches.

184. *Urophycis tenuis* (Mitchill). *White Hake; Hake; Squirrel Hake.*

GEOG. DIST.: Banks of Newfoundland to Cape Hatteras, abundant northward in deep water, reaching a depth of 304 fathoms.

SEASON IN R. I.: April to November, not so common as the Red Hake (*Urophycis chuss*).

REPRODUCTION: Probably spawns in winter or early spring. Young specimens found in the shells of *Pecten tenuicostatus*, off Watch Hill, September, 1874 (Goode).

FOOD: Bottom feeding, fishes and crustacea.

SIZE: One to two pounds.

185. *Urophycis chuss* (Walbaum). *Hake; Red Hake.*

GEOG. DIST.: Atlantic coast, Gulf of St. Lawrence to Virginia. Common northward, reaching a depth of 300 fathoms.

SEASON IN R. I.: Comes in numbers about May first and is very common through May and June, but absent through the summer. Comes in again about October first and is abundant until December. Probably present throughout the winter. Reported from Rhode Island by Rafinesque (1818); from Point Judith, by Mitchill (1878).

HABITAT: Bottom fish.

REPRODUCTION: "It is believed that they spawn throughout the summer for the young are found through all the summer months. Specimens taken at a depth of 37 fathoms in a temperature of 41° F., contained well developed ova and were apparently ready to spawn. The young are frequently taken swimming on the surface on the southern coast of New England in the summer and numerous individuals have been found off Block Island and Watch Hill, seeking shelter between the valves of a large species of scallop (*Pecten tenuicostatus*) at a depth of 20 to 40 fathoms" (Goode and Bean, *Oceanic Ichthyology*, 1895, 359).

Observations at Wickford, however, lead the present writer to believe that this species is a winter spawner like other fishes of the cod family. The specimens from two to six inches long in June and July correspond in a general way with the length of cod and haddock at that time and indicate that the height of the spawning season is some months past. Of the very small specimens of the rearing cars of the lobster plant, the writer has never seen but three, although he has watched for them particularly for two or three summers. Probably, as occurs in other species, these small specimens were hatched from eggs spawned exceptionally late. If this species spawned in great numbers in summer in Narragansett Bay many young would appear in the lobster cars, as in the case of the other summer spawning species.

FOOD: Crustacea and small fry. A specimen three inches (73 mm.) taken in Wickford Cove June, 1908, had a stomach full of shrimp.

RATE OF GROWTH: Young specimens from 2.5 to 6 inches long are common in eelgrass along the shores during June and July. Young probably of this species are occasionally taken in the lobster rearing cars

of the Wickford Experiment Station. Specimen 28 mm. taken July 26, 1907; specimen 4 mm. taken July 8, 1908. May 30, 1910, 14 specimens taken in seine, Cornelius Island, averaging 66 mm., ranging from 47 to 90 mm.

186. *Enchelyopus cimbrius* (Linnæus). *Four-bearded Rockling*.

GEOG. DIST.: North Atlantic on both coasts, south in deep water to the Gulf Stream. Common in the deep waters of Massachusetts Bay. Taken by the "*Albatross*" and "*Fish Hawk*" off southern New England, in depths from 7 to 724 fathoms.

SEASON IN R. I.: Specimens taken by "*Fish Hawk*" in Narragansett Bay at a depth of 12½ fathoms (Goode and Bean, *Oceanic Ichthyology*, 1895, 384). Young specimens from Newport are described by A. Agassiz.

REPRODUCTION: Spawning season is from February to August. The egg is 1-33 to 1-25 inch (.66 to .98 mm.) in diameter and has an oil globule. The newly hatched larva is 1-12 inch long (2 mm.). (Ehrenbaum.)

RATE OF GROWTH: Young from ½ to 1½ inches taken at the Fish Commission Wharf at Woods Hole from June 27th to July 6, 1900. Specimens ten inches long taken in Eel Pond at Woods Hole, January 5th, 1889; a second specimen has been taken in Little Harbor in winter (Sherwood and Edwards, 1901.) Adult grows about a foot long.

REFERENCES:

- 1882: AGASSIZ, A., *Proc. Amer. Acad.* XVII, 294.
- 1885: AGASSIZ, A., AND WHITMAN, *Mem. Mus. Comp. Zool.* XIV, 39.
- 1890: BROOK, *Proc. Roy. Phys. Soc., Edinburgh*, X, 157.
- 1893: HOLT, *Sci. Trans. Roy. Soc., Dublin*, V, 95.
- 1897: MCINTOSH AND MASTERMAN, *British Marine Food Fishes*, 284.
- 1909: EHRENBaum, *Nordisches Plankton*, 10, 280.

187. *Brosme brosme* (Müller). *Cusk; Ling*.

GEOG. DIST.: North Atlantic, south to Long Island and Denmark; north to Iceland and Spitzbergen. Rare south of Cape Cod.

HABITAT: Deep water, inhabiting rocky ledges.

SEASON IN R. I.: Specimen taken off Newport, November, 1898.

REPRODUCTION: Spawns during April, May, and June. Eggs 1-20 inch in diameter (1.2 mm. to 1.5 mm.) with an oil globule. The larva on hatching is ¼ inch long (4 mm.). (For description of eggs and young, see Ehrenbaum, *Nordisches Plankton*, 10, 1909, 292. McIntosh and Masterman, *British Marine Food Fishes*, 1897, 299. McIntosh, *Report, Fishery Board of Scotland*, 10, 1892, 288.)

PLEURONECTIDÆ. The Flounders.**188. Hippoglossus hippoglossus** (Linnæus). *Halibut.*

GEOG. DIST.: In all northern seas. In water of moderate depth in North Atlantic, North Pacific, and Behring Sea; south in deep water to France, Sandy Hook, and San Francisco. Occasional on New England shore north of Cape Cod; was formerly more abundant. This species has been taken in Connecticut at Stonington (Linsley, 1844), and at Fisher's Island (Goode, 1880).

HABITAT: Cod banks of northern seas in water 32° to 45° F., from shoal water down to 250 fathoms or more.

SEASON, IN R. I.: In February, 1876, a few were taken about eight miles from the southern point of Block Island. On May 1, 1876, off Watch Hill an 80-pound halibut was taken, the first in that vicinity for many years. On April 16, 1900, a 100-pound halibut was brought to Newport; formerly quite common around Block Island and Vineyard Sound.

REPRODUCTION: Spawning season on the Scandinavian coast is from February to April. The eggs are unknown except as found in the ripe ovary; such eggs are $\frac{1}{8}$ inch in diameter (3.07 to 3.8 mm.), with no oil globule.

FOOD: Molluscs and crustacea, and fishes of all sorts.

RATE OF GROWTH: Youngest known larva is $\frac{1}{2}$ inch (13.5 mm.) in length.

Larva of this size up to 1 2-5 inches (34 mm.) are taken at the Faroe Island and in Danish waters from the end of May to the beginning of July. The smallest specimen from the American coast was about five inches long, dredged by Prof. Verrill in the Strait of Canso. (See Ehrenbaum, Nordisches Plankton, 10 1909, 177.)

REFERENCES:

1885: GOODE, A Brief Biography of the Halibut, Amer., Nat. XIX, 953.

1892: MCINTOSH, Report, Fishery Board, Scotland, 10, 285.

1893: MCINTOSH, *ibid*, 11, 244.

1896: CUNNINGHAM, Marketable Marine Fishes, 243.

1897: MCINTOSH AND MASTERMAN, British Marine Food Fishes, 315.

1909: EHRENBAUM, Nordisches Plankton, 10, 177.

189. Hippoglossoides platessoides (Fabricius). *Sand-dab; Rough dab; Rusty Flounder.*

GEOG. DIST.: North Atlantic, common in deep water south to southern New England and the coast of England and Scandinavia.

SEASON IN R. I.: It is often taken in beam-trawls in winter in the deep water of the East Passage, not far from Gould's Island. Not unusual in deep water off southern Massachusetts and Rhode Island, approaching the coast in winter (Proc. U. S. Nat. Mus., 1880, 471).

REPRODUCTION: The spawning period of this species is in March and April on the European coast. The egg has no oil globule and has a very large previtelline space. When first laid the egg is a little over 1-25 inch (1 mm.) in diameter; later the previtelline space absorbs water and expands to 1-20 inch (1.86 mm.) (McIntosh and Masterman, 1897). Ehrenbaum gives the diameter of the egg in the North Sea as 1.38 to 2.64 mm. and at Helgoland, 2.7 to 3.2 mm. The eggs hatch in about fourteen days.

RATE OF GROWTH: The larva at hatching is 1-5 inch long (4 to 5 mm.). Young from $\frac{1}{4}$ to $1\frac{1}{4}$ inch in length (7.2 to 31.5 mm.) are taken in the North Sea from the middle of May to the middle of July. Young specimens from the west coast of Ireland, three and four inches long (95 mm.) were supposed to be 15 to 16 months old; specimens eight inches long (181 to 214 mm.) are probably two years old; specimens twelve inches long (300 mm.), about three years old (Holt). On the east coast of Scotland the smallest ripe male found was five inches long, the smallest ripe female, seven inches (McIntosh). In American waters the maximum size of the adult is about 20 to 24 inches.

REFERENCES: '

- 1889: McINTOSH, Report, Fishery Board, Scotland, 7, 304.
 1890: McINTOSH AND PRINCE, Trans. Roy. Soc., Edinburgh, XXXV, 853.
 1895: McINTOSH, *ibid.* 13, 220.
 1896: CUNNINGHAM, Marketable Marine Fishes, 244.
 1896: McINTOSH, *ibid.* 9, 319.
 1897: McINTOSH AND MASTERMAN, British Marine Food Fishes, 319.
 1898: KYLE, Report, Fishery Board, Scotland, 10, 235.
 1905: EHRENBAUM, Nordisches Plankton, 4, 182.

190. *Paralichthys dentatus* (Linnæus). *Summer Flounder; Flounder; Fluke.*

GEOG. DIST.: Atlantic coast; Casco Bay to Florida.

MIGRATIONS: They are found northward in 2 to 20 fathoms of water; in winter they move into deeper water.

HABITAT: Sandy bottoms.

SEASON IN R. I.: May to the end of October. Much more abundant in summer than the winter flounder (*Pseudopleuronectes americanus*).

FOOD: Small fishes, especially butter-fish and scup; also crustacea, molluscs, squid, sand-dollars.

REPRODUCTION: Practically nothing is known of its breeding habits, but it is thought to spawn in deep water in winter, probably toward the southern part of its range.

RATE OF GROWTH: Specimens under nine inches are not taken in northern waters. Seal found specimens 1 to 1½ inches in length at Point Lookout, Maryland, in May, 1890, and in September, 1889, he took specimens five to ten inches long at St. Jerome, Maryland (Bean, 1891). The average length is from 16 to 30 inches, and the average weight about 2½ pounds. Exceptionally it reaches a length of three feet and a weight of fifteen pounds.

191. *Paralichthys oblongus* (Mitchill). *Four-spotted Flounder*; *Flounder*.

GEOG. DIST.: Coasts of New England and New York, inhabiting deeper water than the other species of this genus. Common on the coast of Cape Cod; rare in other places.

The limits of the geographical range of this species have never been very accurately determined. Its distribution is apparently very limited, since it is not recorded south of New York and has been taken very rarely north of Cape Cod. In 1877 a single specimen was captured at the mouth of Salem harbor by the United States Fish Commission.

SEASON IN R. I.: Common in May and June in the outside waters. Not common in Narragansett Bay. Specimens were taken off the Rhode Island coast by the "*Fish Hawk*," in September, 1880, at a depth of 100 fathoms. June 5, 1906, a half-dozen small specimens were taken in the Hazard's Quarry trap.

REPRODUCTION: Spawns in May. The eggs are buoyant, 1-26 inch in diameter, and hatch in eight days in water of 51° to 56° F.

FOOD: Crustacea, annelids, molluscs, small fishes.

RATE OF GROWTH: The young are rarely observed, but in the autumn of 1885 and 1886 large numbers two or three inches long were taken at Woods Hole (Smith, 1898). Adults reach a length of fourteen inches.

192. *Limanda ferruginea* (Storer). *Rusty Flatfish*.

GEOG. DIST.: Atlantic coast, Labrador to New York. Reported in Narragansett Bay by R. I. Fish Commission, 1899. De Kay reported this flatfish to be very rare and occurring only in deep water. Re-

ported from Casco Bay and on the Massachusetts shore in several places north of Buzzards Bay (Kendall, 1908).

SEASON IN R. I.: Probably common through the year in deep water. Specimens, have been taken on the Pecten ground, off Watch Hill, Rhode Island (Goode, 1880). Large specimen taken in beam trawl south of Plum Beach Light, December 22, 1908. Common in East Passage from December first through cold weather.

FOOD: Crustacea, molluscs, annelids, small fishes.

REPRODUCTION: Little is definitely known with regard to the reproduction of this fish. Stephen R. Williams, while collecting young flatfishes at Woods Hole in June, 1898 and 1899, found flatfish larvæ which at the metamorphosis, measured 13 to 14 mm., and which were bulky and much pigmented. These specimens were considered as possibly the young of the rusty flatfish (Williams, 1902).

SIZE: The average size is stated to be about 14 inches in length. The specimen described by De Kay was 18 inches long and 8.5 inches broad.

193. *Pseudopleuronectes americanus* (Walbaum). Flatfish; Winter Flounder.

GEOG. DIST.: Atlantic coast; Labrador to Chesapeake Bay.

MIGRATIONS: Moves very little with the change of season, but goes out into somewhat deeper water during the hot summer months.

HABITAT: Grassy and muddy bottoms.

SEASON IN R. I.: Present the year round. More abundant in late winter and spring while spawning, and in October. A few are taken in traps in the summer, but it is not so common at that time as the summer flounder (*Paralichthys dentatus*). A specimen five inches long was seined at Willow Beach near Wickford, July 17, 1905. A dark-bellied variety appeared in Greenwich Bay in 1897; apparently these have since disappeared (Bull. U. S. Fish Com., 19, 1898, 305).

REPRODUCTION: Spawns from February to April. The eggs are 1-30 of an inch in diameter and very glutinous. The average number of eggs in a single individual is 500,000. The eggs hatch in 17 or 18 days in water 37° or 38° F. (Smith, 1898). Brice, Report, U. S. Fish Com., Com., XXIII, 1897, 215; Williams, Bull. Mus. Comp. Zool. Camb., XL, 1902, 4.

RATE OF GROWTH: The later rate of growth cannot be readily determined except by taking the averages of a large number of measurements of flatfishes captured at different seasons. Larvæ 1-5 inch (4 and 5 mm.) in length taken in tow March 28, 1908. In each of the lobster-rearing

cars at the Wickford Experiment Station from about June 15th to July 1st, from a dozen to fifty specimens are found ranging from 2-5 to 4-5 inch (10 to 21 mm.) in length. In July and August specimens ranging from 1 $\frac{3}{4}$ to 5 inches are abundant near the shore. It is probable that these specimens were from spawn hatched at the beginning of the season.

On July 13, 1907, at Railroad Wharf, Wickford, in the seine, were taken fifteen specimens about 1 $\frac{3}{4}$ inches (ranging around 40 mm.); July 17, Willow Beach, seine, specimens three inches long; July 15, 1906, Cornelius Island, specimens three inches long; July 28, 1908, nineteen specimens were taken in a seine, ranging from 1 1-5 to 2 3-5 inches (30 to 60 mm.), averaging 47.3 mm.; August 8, 1908, five specimens, 3 $\frac{3}{4}$ inches long (120 mm., 110 mm., 102 mm., 92 mm., 92 mm.), were taken at Cornelius Island; and specimens 2 1-5 to 3 3-5 inches (55 mm., 90 mm.), were taken at the same place in a seine on the tenth of August. On the twentieth of August, 1908, at Cornelius Island, seine, specimens 4 3-5 to 5 2-5 inches (119 mm.; 114 mm.; 119 m.; 129 mm; 136 mm.) were taken.

Metamorphosis takes place in the early part of June at Woods Hole, and at the end of August they reach three inches (75 mm.) in length (Williams, loc. cit.).

In the early part of the year specimens from four to six or eight inches are often taken in the traps and fyke nets. Probably these are fish of the preceding season (one year old).

April 16, 1906, a few young specimens about six inches long, including many four inches long and upwards, were taken in a trap at Dutch Island Harbor.

The spawning fishes which are taken in fyke nets in the early spring (March and April), and which are eight to twelve inches in length, are probably three years old. The very large specimens which are taken in deep water in beam-trawls (East Passage of Narragansett Bay) are probably four years or older.

In spring of 1910, at the Experiment Station, several hundred fry were successfully reared through metamorphosis. The data regarding the experiment has been furnished by W. E. Sullivan:

“In a filter car (Mead, 1908), without paddle, were placed, on March 26, a considerable number of artificially fertilized eggs. These hatched April 12. On May 14 these were between 6 and 7 mm. in length. May 28 the average length was 6.5 mm., and the depth 3 mm.; they ranged from 5 to 8 m. in length, and from 2.5 to 4.8 in depth.

"In another car were placed mature males and females which spawned naturally April 15. The larvæ hatched April 22. On May 10 these ranged from 5.2 to 6.7 mm. in length.

"The larvæ of 5 mm. (11 days old) are externally symmetrical and, as far as can be seen, favor neither side in swimming. Between the lengths of 5 and 6 mm., some of the more critical changes take place. The left eye assumes a mediañdorsal position; the tail becomes heterocercal in shape; the fish, in swimming, begins to favor the left side. A fish between 5.5 and 6 mm., when at rest, will invariably rest on the left side.

"After reaching a length of 6 mm., the greatest growth is in depth, and while all larvæ of 5 mm. are about the same depth (1 to 1.1 mm.), those of 6 mm. vary from 1.2 to 3 mm. in depth. When the young fish has reached this stage, it is never seen near the top of the water unless the bottom of the car has been excessively disturbed."— (Quoted from notebook of W. E. Sullivan.)

194. *Liopsetta putnami* (Gill). *Eel-back Flounder.*

GEOG. DIST.: Atlantic coast of North America from Rhode Island to Labrador. Common along coast of northern Massachusetts and northward.

SEASON IN R. I.: The Museum of Comparative Zoölogy, Cambridge, has a specimen from "Providence."

REPRODUCTION: The remarkable sexual differences existing in this species have been described by Bean (Proc. U. S. Nat. Mus., 1878, 345).

SIZE: Ten inches.

195. *Lophopsetta maculata* (Mitchill). *Window-pane; Sand-dab.*

GEOG. DIST.: Atlantic coast of United States, Nova Scotia to South Carolina. Cornish (1907) reports specimens from Canso.

SEASON IN R. I.: Present the year round, abundant from April to October.

In Narragansett Bay this species is taken in considerable numbers in the beam-trawls in winter. Specimens taken December 22, 1908, just south of Plum Beach Light; January 1, 1907, near Gould's Island, East Passage. It is also taken in fyke nets with flatfish about the first of March.

REPRODUCTION: Spawns in May and June. The eggs are buoyant, non-adhesive, 1-24 of an inch in diameter, they hatch in eight days in water 51° to 56° F. (Smith, 1889).

FOOD: Fishes and crustacea.

RATE OF GROWTH: Young specimens up to $1\frac{1}{2}$ inches long are occasionally found in June and July in the lobster-rearing cars at the Wickford Experiment Station. Several were taken in 1909. June 13, one specimen $\frac{1}{4}$ inch (6 mm.), and another $1\frac{3}{8}$ inch (8 mm.) were taken; metamorphosis had not yet taken place. June 30, a specimen was taken 1 inch (25 mm.) long in which the eyes were as in the adult. August 2nd a specimen $1\frac{1}{2}$ inches (37 mm.) long was taken. Williams, 1898 and 1899, found many larval specimens at Woods Hole closely associated with the young of the winter flounder. Some of these specimens he kept for some time in artificial inclosures and observed their growth. They grew very rapidly, much more so than the flounders. One which measured 10 mm. (2-5) inch in length and 5 mm. (1-5 inch) in depth during eleven days grew to 22 mm. (9-10 inch) in length and 12 mm. ($\frac{1}{2}$ inch) in depth. Young specimens are rather common in shallow water with a sandy bottom. Specimens two and three inches long are often taken in the seine along sandy beaches after the middle of July. Specimens 4 inches long and upward are taken in beam trawls in December. The average length of the adult sand-dab is about eleven inches.

SOLEIDÆ. The Soles.

196. *Achirus fasciatus* (Lacépède). *Sole; Hog-choker; Black Flatfish.*

GEOG. DIST.: Coasts of the Atlantic and Gulf of Mexico north to Cape Ann. Common south of Susquehanna River.

SEASON IN R. I.: Taken occasionally throughout the year; not very common in Narragansett Bay. Specimens from Providence and from Newport are in the U. S. National Museum. Specimen taken August 14, 1905, in a trap in the West Passage. September 14, 1908, 3 specimens were taken in Wild Goose trap. On April 14, 1908, a specimen taken in fyke net outside Popular Point, Wickford. In Narragansett Bay this species is apparently most numerous in the spring, when it is often taken in fyke nets with flatfish.

REPRODUCTION: Specimens apparently ripe are taken the latter part of May at Woods Hole (Bumpus, 1898). One small specimen has been taken in fresh water, which may indicate that this species spawns in rivers (Bean, 1903).

FOOD: Eight specimens examined by Dr. Linton in 1899 had only vegetable debris (Fucus and eelgrass) in the alimentary canal.

SIZE: This is the smallest species of American flatfishes. It seldom exceeds five or six inches in length.

LOPHIIDÆ. The Fishing-Frogs.**197. *Lophius piscatorius* (Linnæus). Goose fish; Bellows-fish; Angler.**

GEOG. DIST.: North Atlantic, common on both coasts. Ranges southward along the shore to Cape Hatteras; in deep water as far as the Barbadoes, in 209 fathoms, and to Cape of Good Hope. North to Norway and Nova Scotia.

HABITAT: A sluggish, bottom-loving fish. Present in shallow water in spring and fall, retiring to deep water in both very warm and very cold weather. In the winter of 1904-1905 many of this species, about a foot in length, were frequently seen dead in Narragansett Bay and thrown up on the shores. This was probably caused by the excessive cold of that season.

SEASON IN R. I.: Common from April to July; apparently absent in summer, probably going into deeper water; common in shallow water again in October. In September, 1880, three specimens were taken in the tilefish area at depths of 120 to 365 fathoms. (Proc. U. S. Nat. Mus., 1880, 461.)

REPRODUCTION: Probably spawns from June to August in deep water. The eggs are buoyant, enclosed in a ribbon-shaped gelatinous mass about two or three feet wide and 25 to 30 feet long. The eggs are arranged in a single irregular layer, each arranged in a gelatinous envelope twice the diameter of the egg. The egg is $\frac{1}{4}$ inch in diameter (1.75 mm.), and has a large oil globule.

FOOD: Extremely voracious in its feeding habits, swallowing all kinds of fishes, including large numbers of its own species. It has been known to swallow live water-fowl, whence its common name. Dr. Linton found specimens whose stomachs contained large quantities of mud full of mollusca, small crustacea, and annelids.

RATE OF GROWTH: Specimen four inches long taken off the banks of Newfoundland in 1856. Young specimens have been found only at considerable depths. Adults are taken four feet in length.

REFERENCES:

1882: A. AGASSIZ, Proc. Amer. Acad., XVII, 280.

1885: A. AGASSIZ AND WHITMAN, Mus. Comp. Zool. Harv. Coll., XIV, 16.

1890: MCINTOSH AND PRINCE, Trans. Roy. Soc., Edinburgh, XXXV., 869.

1891: PRINCE, Report, Fishery Board, Scotland, 9.

1897: MCINTOSH AND MASTERMAN, British Marine Food Fishes, 149.

1903: FULTON, Report, Fishery Board, Scotland, 21, 186.

1905: EHRENBAUM, Nordisches Plankton, 4, 46.

1908: GILL, Report Smithson. Inst., 565.

ANTENNARIIDÆ. The Frog-Fishes.

198. *Pterophryne histrio* (Linnæus). *Marbled Angler; Sargassum Fish.*

GEOG. DIST.: Tropical parts of the Atlantic, north to Cape Cod in floating masses of gulf-weed. A specimen has been taken in Norway from sea-weed floating in the Gulf Stream. A number of specimens have been taken at different times at Woods Hole and Nantucket Shoals.

SEASON IN R. I.: Two specimens were taken in 1904 at the mouth of the Sakonnet River, one on September 6, the other about a week later.

HABITAT: Surface of tropical waters, chiefly under floating masses of gulf-weed.

REPRODUCTION: The spawning season extends from July to October. Several specimens in an aquarium at Woods Hole spawned in August. The eggs were in long bands like those of the goosefish. These bands are four or five feet long and two to four inches wide. The eggs are 1-25 inch in diameter without any oil globule. (Ehrenbaum, Nordisches Plankton, 10, 1909, 393; Gill and Gudger, Science, XXII, 1905; Gill, Smithsonian Report, 1908, 565.

This is one of the most interesting of our visitors from southern waters. It is usually found swimming under the bits of gulfweed which sometimes drift in from the Gulf Stream in summer and autumn during long east and southeast blows. This fish furnishes an interesting example of protective resemblance. The mottling of its body and the numerous filamentous appendages attached to its skin gives it such a resemblance to the gulfweed in which it floats that it must be very effectively hidden from its enemies. With regard to the habits of this species (Smith, 1898), speaking of some specimens in an aquarium at Wood's Hole, says: "While clumsy in their movements they were adepts at approaching and capturing other fishes. They are quite cannibalistic and one 6 inches long swallowed another 4 inches long, and they frequently bit off the fleshy dermal appendages of their fellows."

As far as is known the two specimens above referred to are the only members of this species ever taken in Rhode Island waters. Their presence here at that particular time is explained by the following data which has been kindly furnished by Mr. W. L. Day, Observer, Weather Bureau, Block Island. The direction of the wind during the two weeks

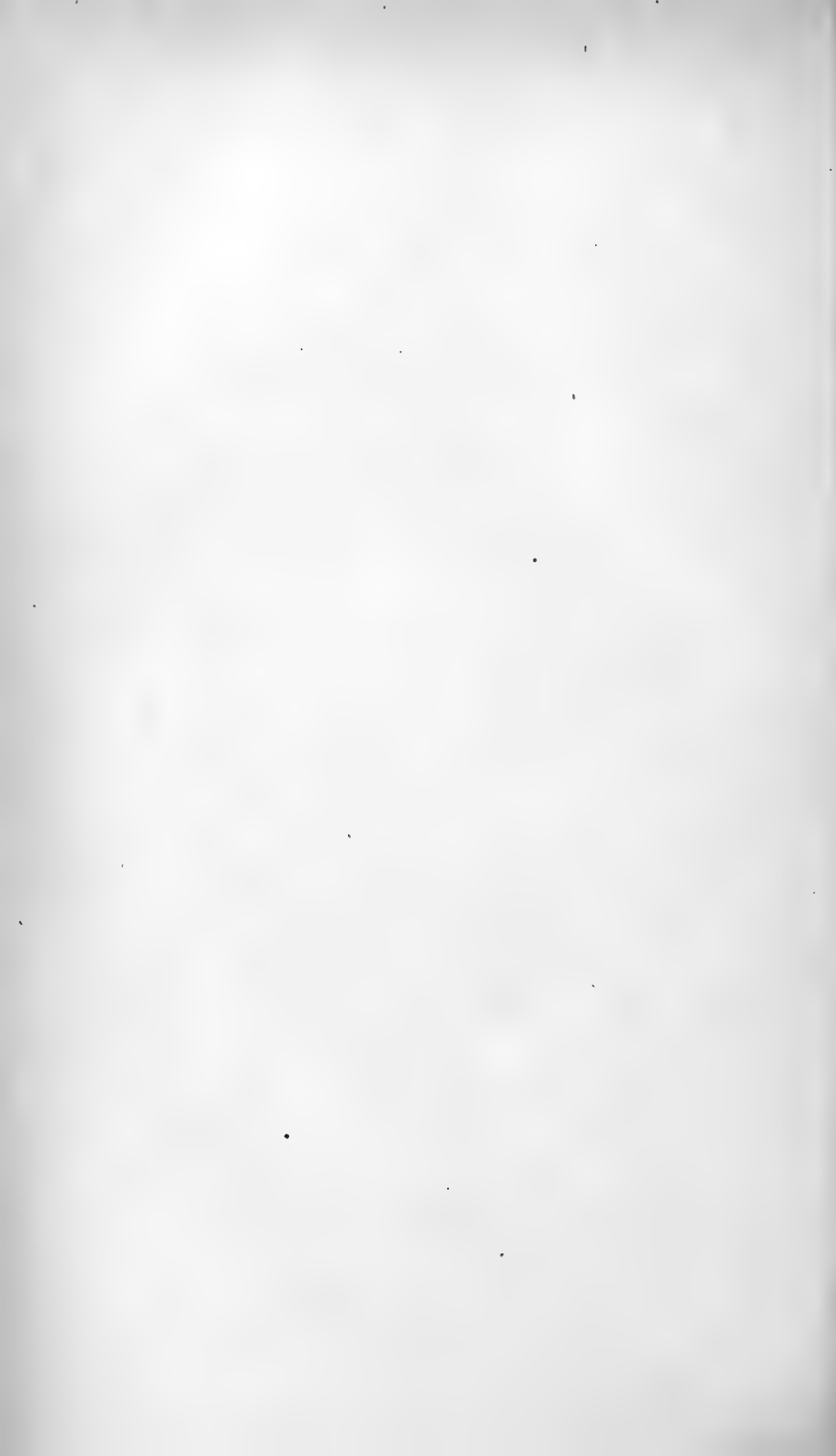
previous to September 6, 1904, was prevailing southwest for five days, east for three days, south for three days, northwest for three days. The mean velocity, moreover, for the two weeks under consideration was greater than the average by a difference amounting to about five miles an hour, the normal hourly velocity for August and September being 13 miles, and the average hourly velocity for the two weeks being 18. Remembering the general trend of the Atlantic coast and bearing in mind the fact that Cape Cod is less than 100 miles distant from the western edge of the Gulf Stream, it is easily seen that the drift of the Gulf Stream and the winds of the direction and velocity noted above would unite to form a resultant acting on the floating masses of gulfweed so as to drive them northward and into the huge "pocket" formed by the configuration of the southern New England coast.

OGCOEPHALIDÆ. The Bat Fishes.

199. *Dibranchius atlanticus* (Peters).

GEOG. DIST.: Deep waters of the Atlantic; very abundant in about 300 fathoms; north in the Gulf Stream to Rhode Island.

SEASON IN R. I.: Very many specimens have been taken in the tile-fish area at depths ranging from 100 to 500 fathoms. A single specimen was captured off Block Island in 1880 (Goode and Bean, *Oceanic Ichthyology*, 1896, 501). Specimens from Newport (?) (Jordan and Evermann, 1898). (Gill, *Smithsonian Report*, 1908, 565.)



APPENDIX.

A PARTIAL LIST OF FISHES OBTAINED IN THE GULF STREAM SOUTH OF RHODE ISLAND.

1. ***Psenes edwardsii*** (Eigenmann).

A single specimen, 90 mm. in length, was taken about July 28, 1900, by the schooner *Grampus* from under a Medusa 30 miles south of Newport. (Bull. U. S. Fish Commission, 21, 1901, 35.)

2. ***Lopholatilus chamæleonticeps*** (Goode & Bean). *Tilefish*.

GEOG. DIST.: Deep water of western Atlantic. Taken in water not less than 55 fathoms in depth directly to the south of Rhode Island, in the area between 69° and 73° W. longitude and 40° 20' to 39° 47' N. latitude. (Bull. U. S. Fish Commission, 1898, 321.)

FOOD: Preëminently a crab eater; there have also been found, in the stomach of many specimens, squids, molluscs, holothurians, spiny dogfish, eels, and fish bones.

The following fishes were dredged off the southern coast of New England, by the U. S. Fish Commission steamer *Fish Hawk*, September 1, 1899, 40° N. latitude, 70° W. longitude. (Bull. U. S. Fish Commission, 19, 1899, 240.) Those marked with a * have already been mentioned in the list of Rhode Island fishes given above. It is interesting to note their occurrence in the Gulf Stream, as it in part explains their occasional presence in Rhode Island waters nearer shore.

3. ***Seriola fasciata*** (Bloch). Range, West Indies to Charleston, S. C. One specimen.

4. ****Trachurops crumenophthalmus*** (Bloch). Range, Atlantic coast of United States. Two specimens.

5. ****Caranx crysos*** (Mitchill). *Hard-tail*. Range, Cape Cod to Brazil. One specimen.

6. ***Glossamia pandionis*** (Goode & Bean). Range, deep water off Chesapeake Bay. One specimen.

7. ***Abudefduf saxatilis** (Linnæus). Range, both coasts of tropical America. One specimen.
8. **Balistes vetula** (Linnæus). *Trigger-fish*. Range, tropical parts of the Atlantic, Gulf Stream to Woods Hole. One specimen.
9. ***Monacanthus hispidus** (Linnæus). *File-fish*. Range, Cape Cod to Brazil. Several specimens.
10. ***Lycenchelys verrilli** (Goode & Bean). Range, coast of Massachusetts and northward. One specimen.
11. ***Merluccius bilinearis** (Mitchill). *Whiting or Silver Hake*. Range, coast of New England and northward. Two specimens.
12. **Helicolenus maderensis** (Goode & Bean). Range, deep waters of Atlantic coast from New York to Florida. One specimen.
13. **Raja eglanteria** (Bosc). *Skate*. Range, Cape Cod, southward to Florida. One specimen.
14. ***Dibranchius atlanticus** (Peters). Range, Gulf Stream. Several specimens.

INDEX

OF THE COMMON AND SCIENTIFIC NAMES OF ALL FISHES INCLUDED IN THE PRECEDING LISTS.

A.

Abramis crysoleucas, 68
Abudefduf saxatilis, 135, 172
Achirus fasciatus, 166
Acipenser brevirostrum, 65
Acipenseridæ, 64
Acipenser sturio, 64
Agonidæ, 145
Albula vulpes, 73
Albulidæ, 73
Alectis ciliaris, 111
Alewife, 76
Alligator-fish, 145
Alopias vulpes, 60
Alopidæ, 60
Alosa sapidissima, 77
Amber-fish, 108
Amber-fishes, 107
Ambloplites rupestris, 118
Ameiurus nebulosus, 66
Ammodytes americanus, 98
Ammodytidæ, 98
Anarhichalidæ, 152
Anarhichas lupus, 152
Anchovies, 82
Anchovy, 82
Anchovy, striped, 82
Angel-fish, 61, 63
Angel-fishes, 137
Angel-sharks, 61
Angler, 167
Angler, marbled, 168
Anguilla rostrata, 70
Anguillidæ, 70
Antennariidæ, 168
Apeltes quadracus, 91
Apogon imberbis, 121
Archosargus probatocephalus, 129
Argentinidæ, 84
Aspidophoroides monopterygius, 145
Atherinidæ, 95
Auxis thazard, 102

B.

Balistes carolinensis, 138
Balistes forcipatus, 139
Balistes vetula, 172
Balistidæ, 138
Banded pickerel, 85
Barndoor skate, 62
Barracuda, 97
Barracuda, northern, 98
Barracudas, 97
Bass, black, 119, 123
Bass, black, large-mouthed, 119
Bass, black, small-mouthed, 119
Bass, rock, 118
Bass, sea, 123
Bass, striped, 121
Basses, sea, 121

Bat-fishes, 169
Batrachoididæ, 149
Beleosoma nigrum olmstedii, 121
Bellows-fish, 167
Big-eye, 124
Big-eyed herring, 73
Big-eyed scad, 110
Big skate, 62
Billfish, 87
Blackback, 77
Black bass, 119, 123
Black bass, large-mouthed, 119
Black bass, small-mouthed, 119
Blackfish, 136
Black flatfish, 166
Black-nosed dace, 68
Black-winged flying fish, 89
Blennidæ, 150
Blennies, 150
Blue-back, 74
Blue shark, 59, 60
Bluefish, 113
Bluefishes, 113
Bonito, 102, 103
Bony fish, 79
Branch herring, 76
Brevoortia tyrannus, 79
Brit, 95
Brook sucker, 67
Brook trout, 83
Brosme brosmæ, 159
Buckie, 76
Bullhead, 66
Bull's-eye mackerel, 102
Butterfish, 117, 150
Butterfishes, 116
Butterfly-fishes, 138
Butterfly ray, 63

C.

Carangidæ, 107
Caranx crysos, 111, 171
Caranx hippos, 110
Carassius auratus, 69
Carcharhinus milberti, 59
Carcharhinus obscurus, 59
Carcharias littoralis, 60
Carchariidæ, 60
Cardinal fishes, 121
Carp, 69
Carp, 68
Catalufas, 124
Cat-fish, 66, 152
Cat-fish, gaff-topsail, 66
Cat-fish, sea, 66
Cat-fishes, 66
Catostomidæ, 67
Catostomus commersonii, 67
Centrarchidæ, 118
Centropristes striatus, 123
Cephalacanthidæ, 148
Cephalacanthus volitans, 148

Ceratacanthus schœpfi, 140
Cereen, 105
Chætodipterus faber, 137
Chætodon ocellatus, 138
Chætodontidæ, 138
Cheilodipteridæ, 121
Chogset, 135
Chub mackerel, 102
Chub sucker, 67
Cigar-fish, 109
Clupea harengus, 74
Clupeidæ, 74
Cobbler-fish, 111
Cod, 155
Codling, 157
Cods, 154
Common killifish, 86
Common mackerel, 99
Common pompano, 113
Common sucker, 67
Conger eel, 71
Conger eels, 71
Cornet fishes, 92
Cottidæ, 143
Cow-nosed ray, 64
Cow-pilot, 135
Crampfish, 62
Crevallé, 110
Crevallé, yellow, 111
Croaker, 133
Cryptacanthodes maculatus, 151
Cunner, 135
Cusk, 159
Cutlas-fish, 105
Cutlas-fishes, 105
Cyclopteridæ, 146
Cyclopterus lumpus, 146
Cynoscion regalis, 130
Cyprinidæ, 68
Cyprinus carpio, 69
Cypsilurus furcatus, 90
Cypsilurus gibbifrons, 91
Cypsilurus heterurus, 90

D.

Dace, 68
Dace, black-nosed, 68
Daddy scalpin, 144
Darter, 121
Dasyatidæ, 63
Dasyatis centrura, 63
Dasyatis hastata, 63
Decapterus macarellus, 109
Decapterus punctatus, 109
Demoiselles, 135
Dibranchus atlanticus, 169, 172
Diodontidæ, 142
Dogfish, 58, 61
Dogfishes, 61
Dogfish, smooth, 58
Dogfish, spiny, 61
Dollar-fish, 111, 112

- Drum, 135
Drums, 130
Dusky shark, 59
- E.
- Eagle rays, 63
Echeneidæ, 148
Echeneis naucrates, 148
Echeneis naucratoides, 149
Eel, 70
Eel-back flounder, 165
Eel, conger, 71
Eel, lamprey, 58
Eel-pout, 152, 153
Eel-pouts, 152
Eels, rock, 150
Eels, true, 70
Eighteen-spined sculpin, 144
Electric rays, 62
Elopidae, 72
Elops saurus, 73
Enchelyopus cimbrius, 159
Engraulidæ, 82
Ephippidæ, 137
Epinephelus niveatus, 122
Erismyzon succetta, 67
Esocidæ, 87
Etrumeus sadina, 74
Euleptorhamphus velox, 89
Eupomotis gibbosus, 118
Exocoetus speculiger, 90
Exocoetidae, 89
- F.
- Felichthys felis, 66
Filefish, 139, 172
Filefish, Powell's, 139
Filefishes, 139
Fishing-frogs, 167
Fistularia tabacaria, 92
Fistulariidae, 92
Flasher, 124
Flatfish, 163
Flatfish, black, 166
Flatfish, rusty, 162
Flounder, 161
Flounder, eel-back, 165
Flounder, four-spotted, 162
Flounder, rusty, 160
Flounder, summer, 161
Flounder, winter, 163
Flounders, 160
Fluke, 161
Flying fish, black-winged, 89
Flying fishes, 89
Flying gurnard, 148
Flying robin, 148
Foolfish, 139
Four-spined stickleback, 91
Four-spotted flounder, 162
Frigate mackerel, 102
Frog-fishes, 168
Frost fish, 153, 155
Fundulus diaphanus, 87
Fundulus heteroclitus, 86
Fundulus heteroclitus macro-lepidotus, 86
Fundulus majalis, 86
- G.
- Gadidæ, 154
Gadus callarias, 155
Gaff-topsail cat-fish, 66
Galeichthys milberti, 66
Galeidæ, 58
Garfish, 87
Garfishes, 87
Gascon, 109
Gasterosteidæ, 91
Gasterosteus bispinosus, 91
Ghost fish, 151
Glossamia pandionis, 171
Glut herring, 77
Goggler, 110
Golden shiner, 68
Gold fish, 69
Goody, 133
Goosefish, 167
Gray snapper, 125
Great sea lamprey, 58
Green pike, 85
Grouper, snowy, 122
Grubby, 143
Gurnard, common, 147
Gurnard, flying, 148
Gurnards, 147
- H.
- Haddock, 156
Hake, 157
Hake, king, 157
Hake, red, 158
Hakes, 153
Hake, silver, 153, 172
Hake, squirrel, 157
Hake, white, 157
Halfbeak, 88
Halfbeaks, 88
Halibut, 160
Hammer-head, 59
Hammer-headed sharks, 59
Hardtail, 111, 171
Harvest fish, 116
Head fishes, 143
Helicolenus dactylopterus, 143
Helicolenus maderensis, 172
Hemiramphidæ, 88
Hemirhamphus americanus, 145
Herring, 74
Herring, big-eyed, 73
Herring, branch, 74
Herring, glut, 77
Herring, river, 76
Herring, round, 74
Herring, sea, 74
Herring, thread, 78
Herrings, 74
Hickory shad, 75
Hippocampus hudsonius, 94
Hippoglossoides platessoides, 160
Hippoglossus hippoglossus, 160
Hog-chocker, 166
Holocentridæ, 98
Holocentrus ascensionis, 98
Horned pout, 66
Horse mackerel, 102
Hyporhamphus roberti, 88
- I.
- Istiophoridae, 105
Istiophorus nigricans, 105
Isurus dekayi, 60
- J.
- Jack, 110
Jumping Mullet, 96
- K.
- Killifish, 86
Killifish, common, 86
King hake, 157
King of the mullets, 121
Kingfish, 105, 134
Kiver, 118
- Kyphosidæ, 130
Kyphosus sectatrix, 130
- L.
- Labridæ, 135
Lactophrys trigonus, 140
Lady-fish, 73
Lady-fishes, 73
Lagocephalus lævigatus, 141
Lagodon rhomboides, 129
Lamna cornubica, 60
Lamnidae, 60
Lamprey eel, 58
Lamprey, great sea, 58
Lampreys, 58
Lant, 98
Large-mouthed black bass, 119
Launce, sand, 98
Leather-jacket, 107, 138
Leiostomus xanthurus, 133
Lepomis auritus, 118
Leptocephalidæ, 71
Leptocephalus conger, 71
Limanda ferruginea, 162
Ling, 159
Liopsetta putmani, 165
Liparididæ, 146
Liparis liparis, 146
Little sculpin, 143
Lizzard fishes, 85
Lobotes, surinamensis, 124
Lobotidæ, 124
Long-eared sunfish, 118
Lookdown, 112
Lophiidæ, 167
Lophius piscatorius, 167
Lopholatilus chamaeleonticeps, 171
Lophopsetta maculata, 165
Luciidæ, 85
Lucius americanus, 85
Lucius reticularis, 85
Lumpfish, 146
Lump-suckers, 146
Lutianidæ, 125
Lycenchelys verrilli, 153, 172
Lycodes reticulatus, 153
- M.
- Mackerel, bull's-eye, 102
Mackerel, chub, 102
Mackerel, common, 99
Mackerel, frigate, 102
Mackerel, horse, 102
Mackerels, 99
Mackerel scad, 109
Mackerel shark, 60
Mackerel sharks, 60
Mackerel, Spanish, 104
Madamoiselle, 133
Mangrove snapper, 125
Man-of-war, Portuguese, fish, 116
Marbled angler, 167
Mayfish, 86
Melanogrammus æglefinus, 156
Menhaden, 79
Menidia gracilis, 95
Menidia menidia notata, 95
Menticirrhus saxatilis, 134
Merlucciidæ, 153
Merluccius bilinearis, 153, 172
Microgadus tomcod, 155
Micropogon undulatus, 133
Micropterus dolomieu, 119
Micropterus salmoides, 119
Mink, sea, 134
Minnow, spring, 87
Mola mola, 143

- Molidae, 143
 Monacanthidae, 139
 Monacanthus hispidus, 139,
 171
 Monkfish, 61
 Moon-fish, 137
 Morone americana, 122
 Mugil cephalus, 96
 Mugil curema, 97
 Mugilidae, 96
 Mullet, jumping, 96
 Mullet, 96
 Mullet, king of the, 121
 Mullet, striped, 96
 Mullet, white, 97
 Mullidae, 99
 Mullus auratus, 99
 Mummichog, 86
 Mustelus canis, 58
 Myliobatidae, 63
 Myliobatis freminvillei, 63
 Myoxocephalus aeneus, 143
 Myoxocephalus grœnlandicus,
 144
 Myoxocephalus octodecimspi-
 nosus, 144
- N.
- Narcebatidae, 62
 Naucrates ductor, 108
 Needle-fishes, 87
 Neomænis blackfordii, 125
 Neomænis griseus, 125
 Nine-spined stickleback, 91
 Nomeidae, 116
 Nomeids, 116
 Nomeus gronovii, 116
 Northern barracuda, 98
 Notropis cornutus, 68
- O.
- Ogcocephalidae, 169
 Old maid, 61
 Oligoplites saurus, 107
 Opisthonema oglinum, 78
 Opsanus tau, 149
 Osmerus mordax, 84
 Ostraciidae, 140
- P.
- Palinurichthys perciformis,
 116
 Paralichthys dentatus, 161
 Paralichthys oblongus, 162
 Parché, 138
 Parexocœtus mesogaster, 89
 Peprilus paru, 116
 Perca flavescens, 120
 Perches, 120
 Perch, white, 122
 Perch, yellow, 120
 Percidae, 120
 Petromyzonidae, 58
 Petromyzon marinus, 58
 Pholis gunnellus, 150
 Pickerel, 85
 Pike, green, 85
 Pikes, 85
 Pilot-fish, 108
 Pilot sucker, 149
 Pintano, 135
 Pipe-fish, 92
 Pipe-fishes, 92
 Pleuronectidae, 160
 Pœciliidae, 86
 Pogonias cromis, 135
 Pogy, 79
 Pole-fish, 116
 Pollachius virens, 154
- Pollock, 154
 Pomacentridæ, 135
 Pomatomidae, 113
 Pomatomus saltatrix, 113
 Pomolobus æstivalis, 77
 Pomolobus medioeris, 75
 Pomolobus pseudoharengus,
 76
 Pompano, common, 113
 Pompano, round, 112
 Pompanos, 107
 Porcupine-fish, 142
 Porcupine-fishes, 142
 Porgies, 125
 Porgy, 125
 Poronotus tricanthus, 117
 Portuguese man-of-war fish,
 116
 Pout, horned, 66
 Powell's filefish, 139
 Priacanthidae, 124
 Priacanthus arenatus, 124
 Prionotus carolinus, 147
 Prionotus strigatus, 147
 Psenes edwardsii, 171
 Pseudopleuronectes ameri-
 canus, 163
 Pseudopriacanthus altus, 124
 Pterophryne histrio, 168
 Pteroplatea maclura, 63
 Puffer, 141, 142
 Puffer, smooth, 141
 Puffers, 141
 Pug-nosed shiner, 111
 Pumpkin seed, 118
 Pygosteus pungitius, 91
- R.
- Radiated shanny, 151
 Raja eglanteria, 172
 Raja erinacea, 61
 Raja levis, 62
 Raja ocellata, 62
 Rajidae, 61
 Ray, butterfly, 63
 Ray, cow-nosed, 64
 Ray, sharp-headed, 63
 Ray, sting, 63, 64
 Rays, eagle, 63
 Rays, electric, 62
 Rays, sting, 63, 64
 Redfin, 68
 Red hake, 158
 Red sculpin, 145
 Remora, 148
 Remoras, 148
 Remora, spearfish, 149
 Requiem sharks, 58
 Rhinichthys atronasus, 68
 Rhinoptera bonasus, 64
 Rhombochirus osteochir, 149
 River herring, 76
 Roach, 68
 Robin, flying, 148
 Roccus lineatus, 121
 Rockbass, 118
 Rock eel, 150
 Rock fish, 121
 Rock fishes, 143
 Rockling, four-bearded, 159
 Rough-dab, 160
 Round herring, 74
 Round pompano, 112
 Round robin, 109
 Rudder fish, 116, 130
 Rudder fishes, 116, 130
 Rusty flatfish, 162
 Rusty flounder, 160
 Rypiticus bistrispinus, 123
- S.
- Sail-fishes, 105
 Sailor's choice, 129
 Salmon, 83
 Salmon family, 83
 Salmonidae, 83
 Salmo salar, 83
 Salvelinus fontinalis, 83
 Sanddab, 160, 165
 Sand eel, 98
 Sand launce, 98
 Sand shark, 60
 Sand sharks, 60
 Sarda sarda, 103
 Sargassum fish, 168
 Saurel, 109
 Sauries, 89
 Saury, 89
 Scabbard-fish, 105
 Scad, 169
 Scad, big-eyed, 110
 Scad, mackerel, 109
 Scienidae, 130
 Scomber colias, 102
 Scomberesocidae, 89
 Scomberesox saurus, 89
 Scomberomorus maculatus,
 104
 Scomberomorus regalis, 105
 Scomber scombrus, 99
 Scombridae, 99
 Scorpanidae, 143
 Sculpin, 144
 Sculpin, daddy, 144
 Sculpin, eighteen-spined, 144
 Sculpin, little, 143
 Sculpin, red, 145
 Sculpins, 143
 Scup, 125
 Scup, shiny, 129
 Scuppaug, 125
 Sea bass, 121, 123
 Sea basses, 121
 Sea cat-fish, 66
 Sea herring, 74
 Sea-horse, 94
 Sea lamprey, 44
 Sea mink, 134
 Sea poacher, 145
 Sea raven, 145
 Sea robin, 147
 Sea snail, 146
 Sea snails, 146
 Selene vomer, 112
 Seriola fasciata, 171
 Seriola lalandi, 108
 Seriola zonata, 108
 Serranidae, 121
 Shad, 77
 Shad, hickory, 75
 Shanny, radiated, 151
 Shark, blue, 59, 60
 Shark, dusky, 59
 Shark, mackerel, 60
 Shark, sand, 60
 Shark-pilot, 108
 Sharks, hammer-headed, 59
 Sharks, mackerel, 60
 Sharks, requiem, 58
 Sharks, sand, 60
 Sharks, thresher, 60
 Shark-sucker, 148
 Sharp-headed ray, 63
 Sheephead, 129
 Shellfish, 140
 Shiner, 68
 Shiner, golden, 68
 Shiner, pug-nosed, 111

- Shiny scup, 129
 Short-nosed sturgeon, 65
 Shovel-nose, 59
 Siluridae, 66
 Silver hake, 153, 172
 Silverside, 95
 Silversides, 95
 Silver perch, 133
 Siphostoma fuscum, 92
 Skate, barndoor, 62
 Skate, big, 62
 Skate, summer, 61
 Skate, winter, 62
 Skates, 61, 172
 Skipper, 88
 Small-mouthed black bass, 119
 Smelt, 84
 Smooth dogfish, 58
 Snapper, gray, 125
 Snapper, mangrove, 125
 Snapper, red, 125
 Snappers, 125
 Snowy grouper, 122
 Sole, 166
 Soleidae, 166
 Spade-fish, 137
 Spanish-mackerel, 104
 Sparidae, 125
 Spearfish, 106
 Spearfish remora, 149
 Speckled trout, 183
 Spheroides maculatus, 141
 Spheroides testudineus, 141
 Spheroides trichocephalus, 141
 Sphyræna borealis, 98
 Sphyræna guachancho, 97
 Sphyrænidæ, 97
 Sphyrnidæ, 59
 Sphyrna zygena, 59
 Spiny dogfish, 61
 Spot, 133
 Spring minnow, 87
 Squalidae, 61
 Squalus acanthias, 61
 Squatina squatina, 61
 Squatinidae, 61
 Squetegue, 130
 Squirrel fish, 98
 Squirrel hake, 157
 Stenotomus chrysops, 125
 Stickleback, four-spined, 91
 Stickleback, nine-spined, 91
 Stickleback, two-spined, 91
 Sticklebacks, 91
 Sting ray, 63, 64
 Sting rays, 63
 Stolephorus brownii, 82
 Stolephorus mitchilli, 82
 Striped anchovy, 82
 Striped bass, 121
 Striped mullet, 96
 Stromateidæ, 116
 Sturgeon, 64
 Sturgeon, short-nosed, 65
 Sturgeons, 64
 Sucker, 146
 Sucker, brook, 67
 Sucker, chub, 67
 Sucker, common, 67
 Sucker, shark, 148
 Suckers, 67
 Summer flounder, 161
 Summer skate, 61
 Sunfish, 118, 143
 Sunfish, long-eared, 118
 Sunfishes, 118
 Surmullet, 99
 Swellfish, 141
 Swelltoad, 141
 Swing-tail, 60
 Switchtail, 58
 Swordfish, 106
 Sygnathidæ, 92
 Synodontidæ, 85
 Synodus fœteus, 85
- T.
- Tarpon, 72
 Tarpon atlanticus, 72
 Tarpons, 72
 Tautog, 136
 Tautoga onitis, 136
 Tautogolabrus adspersus, 135
 Ten-pounder, 72
 Tetranarce occidentalis, 62
 Tetraodontidæ, 141
 Tetrapturus imperator, 106
 Thread fish, 111
 Thread herring, 54
 Thresher, 60
 Thresher sharks, 60
 Thunnus thynnus, 102
 Tilefish, 171
 Toadfish, 148
 Toadfishes, 148
 Toad-grunter, 148
 Tomcod, 155
 Torpedo, 62
 Trachinotus carolinus, 113
 Trachinotus fulcatus, 112
- Trachurops crumenophthalmus, 110, 171
 Trachurus trachurus, 109
 Trichiuridæ, 105
 Trichiurus lepturus, 105
 Trigger-fish, 138, 171
 Trigger-fishes, 138
 Triglidæ, 147
 Triple-tail, 124
 Triple-tails, 124
 Trout, 83
 Trumpet fish, 92
 Trunkfish, 140
 Trunkfishes, 140
 Tunny, 102
 Two-spined stickleback, 91
 Tylosurus marinus, 87
- U.
- Ulvaria subbifurcata, 151
 Urophycis chuss, 158
 Urophycis regius, 157
 Urophycis tenuis, 157
- V.
- Vomer setipinnis, 111
- W.
- Weakfish, 130
 Whip-tail, 60
 White hake, 157
 White mullet, 97
 White perch, 122
 Whiting, 153, 172
 Window-pane, 165
 Winter flounder, 163
 Winter skate, 62
 Wolf fish, 152
 Wolf fishes, 152
 Wrasse-fishes, 135
 Wry-mouth, 151
- X.
- Xiphas gladius, 106
 Xiphidæ, 106
- Y.
- Yellow crevallé, 111
 Yellow perch, 120
 Yellow-tail, 133
- Z.
- Zoarces anguillarlis, 152
 Zoarcidæ, 152

Notes on the Spring and Summer Fishing in Deep Water off Newport During the Years 1905-1909.

BY SUPERINTENDENT E. W. BARNES.

The following data, which have been collected during a period of five years (1905-1909) are published as a bare record of facts which are interesting and valuable in themselves, but with no pretense at drawing general conclusions. As far as it has been possible to obtain accurate information, a statement is made for each year of the arrival, abundance, and the close of the abundant season, of several marketable fishes which are caught in the traps off Newport and the Sakonnet River.

Following this there are calendars giving in tabular form the "run" of scup, mackerel, and squiteague for these years. A table is also given of the first appearance of various fishes.

SEASON OF 1905.

Scup. A single scup caught off Seal Rock on May first was the herald of the scup season in Rhode Island. Then for over a fortnight a few scup were caught daily until May sixteenth, when the catch was large enough to be spoken of in terms of barrels. There was a gradual increase in numbers from this time until the first of June, when the "run" actually began, and for a little over two weeks hundreds of barrels of scup were caught daily. A large proportion of these fish were put into pounds to avoid "glutting" the market. Commencing with the eighteenth of June the catches were light, and the fishing season ended about the twenty-fifth of June; although for a few days after that fish were shipped from the pounds. The scup season in 1905 was rather poor, owing partly, perhaps, to the large run of pollock during the middle of May. As will be seen by the appended calendar, the scup were late in arriving.

Mackerel (*Scomber scombrus*). The first appearance was near the mouth of the Sakonnet River, where one specimen was caught on April twenty-eighth. On May second a few were caught in offshore traps. The first large catch of mackerel was landed at Newport on May fourteenth, and amounted to 335 barrels. June

fifth was the commencement of the big run at Newport which reached its height on June nineteenth. The period of abundance ended June twenty-eighth.

The "Tinker" mackerel began to arrive on the twenty-fifth of June, and on the sixth and seventh of September the harbor at Newport was full of them.

Weakfish or Squeteague (*Cynoscion regalis*). The first appearance of the squeteague off Newport was on June fourteenth, and at the waning of the scup season there were some good catches in the traps. The culmination period was about June twenty-first.

SEASON OF 1906.

Scup. The first scup was caught off Coggeshall's Ledge on April twentieth. From this time until May first about a half-barrel was caught. On May first the familiar announcement, "Scups come," was made by the trappers, and ten barrels were brought in. The catches increased rapidly, and the most abundant period was from May fifth to June fourth. The season closed about June fifteenth.

A large run of pollock in the middle of May (as in 1905) greatly interfered with the catch, but these fish left about May twenty-first and the scup-fishing was accordingly improved.

Mackerel. Four mackerel were caught on the fourth of May, but the first shipment out of Newport was May fourteenth—of 25 barrels. By May twenty-fifth the shipments had increased to 300 barrels, and the big "run" commenced on June fourth, when 1,200 barrels were landed at Newport. The season drew to a close near the end of July.

"Tinkers" arrived in this year on the fourth of June, somewhat ahead of the usual time.

Butter-fish. This year the butter-fish arrived April sixteenth, a very early date, and fishermen who had been trapping for twenty years or more had seen nothing like it. The usual appearance is in May, and ordinarily they come after the scup arrive, but this year the order was reversed. Several good catches were made in the last part of April and first half of May, and beginning with May twenty-first they were very plentiful.

Squeteague. The first appearance of weakfish was one straggler on May fourth. Two days later one-half barrel was caught. The big run was about June tenth.

Striped Bass. Two striped bass were caught April twenty-first, two weeks ahead of the usual date. May ninth, 430 pounds were caught.

Sea robins made their first appearance April thirtieth.

Squid came in May fourth, when five barrels were caught in one trap. On this date squid were worth more than scup.

SEASON OF 1907.

Scup. Scup did not appear until May second. On this date three were caught. Single catches were then made until May tenth, when one and a half barrels were caught. There was a rapid improvement in number, and on the fourteenth the big run began. The culmination date was May twenty-first, and on June tenth the catches began to diminish. The season closed June twenty-fourth.

The first week in June the fishermen were greatly troubled by the jelly-fish, which were present in sufficient numbers to clog the nets.

Mackerel. The first mackerel made its appearance on May second, but it was not until May seventeenth that the first catch was made. On this date 294 barrels were brought in. These fish were quite large and many weighed four pounds or more and only fifty-five to sixty were required to fill a barrel. The catches of mackerel then increased steadily, June fourteenth marking the commencement of some very heavy catches. On July first the mackerel-fishing at Newport was extraordinary; 270 barrels were caught in four single hauls, and yet many fish were lost because the nets broke with the weight of the fish. The mackerel-fishing continued good for number of weeks.

The first "tinkers" arrived on June tenth.

Squiteague. Two squiteague were caught the twenty-first of May, and from this date no more were caught until June eighteenth. On this date quite a number were caught, and on June twenty-fourth the "run" began with a catch of 250 barrels. The largest catch of the season was on June twenty-seventh, when the Fisheries Company caught 300 barrels in one haul. The run of squiteague continued good for sometime.

Butter-fish. The first catch of these fish was on May tenth, when two were caught. No more were seen until May twenty-fourth. On this date 50 barrels were caught in one haul.

Other Fish. Three striped bass were caught May second, and on May thirteenth they were more plentiful than scup, and twelve were caught in one trap.

The first sea bass was caught May eight.

Sea robins appeared May ninth.

Squid appeared May tenth.

May eighth a salmon weighing 22 pounds was caught by Capt. Petty at Sakonnet Point. Nearly every summer one or two small salmon are caught which weigh from two to three pounds, but it is said that none as large as this one has been caught in forty years.

SEASON OF 1908.

Scup. The first scup was reported by Guy Avalone from Coddington Cove on April twenty-third. Later in the day two more were caught off Coggeshall's Ledge. April twenty-seventh the catch was reported by the barrel, and on the twenty-ninth the "run" began. June third the catches commenced to decrease, and by June ninth the shipping was mostly from the pounds. Scup were very abundant this year, especially in the Bay, where more scup were caught than for many years.

Two heavy storms (one on May eighth and the other on May thirtieth) were very disastrous to the fishermen. It has been estimated that, besides a great deal of damage to the gear, 5,000 barrels of fish were lost in the latter storm.

Mackerel. The first mackerel of the season was caught April twenty-seventh. The customary occasional catches were made until May fourteenth, when 216 were brought in. There was a steady increase until May twenty-fifth, when 400 mackerel were brought in in one day. From this time on there was good average fishing until July first. The record day was June twentieth, when 86,000 mackerel were brought in. The first "tinker" was caught May twenty-seventh.

Other Fish. Striped bass were first caught on April twenty-fourth, sea robins on April twenty-fifth, and squid on April twenty-fifth.

Squiteague. Two squiteague were landed on May seventh, and about a month later, on June sixth, the first barrel was caught. The squiteague season opened June eleventh.

The first horse mackerel were caught the twenty-fifth of June.

SEASON OF 1909.

Scup. Several scup were caught off Watch Hill April 19-20. April twenty-first one was taken off Seal Rock. The scup season really began on May first and closed about June fourteenth. May tenth the scup were very abundant.

Mackerel. April second two mackerel were caught, the first of the season. May fourth, 42 barrels were shipped from Newport. The first big catch of mackerel was on May sixteenth, when 500 barrels were caught. May twenty-fourth nearly 2,000 barrels were landed at Newport, and from this time on until the end of June there was good fishing.

June seventeenth, "tinkers" first appeared.

Other Fish. Butter-fish appeared April twenty-first and were about as abundant as usual.

Striped bass also appeared on April twenty-first.

A few very large squiteague were caught May nineteenth. The run began June seventeenth, when 15 barrels were taken.

Bluefish were first caught June seventeenth.

Menhaden came into the Bay on June fifth.

On the twenty-eighth of May a 16½ pound salmon was caught off Newport.

June 28, 1909, the crew of the *Shenandoah*, Capt. James Gannon, sighted a monstrous sea turtle swimming leasurly at the surface. It was captured, brought to Newport, and placed on exhibition at J. W. Hammond & Co.'s Fish Market.

This specimen was of the "leather back" or "Luth" species (*Sphargis coriacea*), a sub-tropical form that has been found to occur as far north as Massachusetts Bay. It was the only one that has been reported off Newport for a number of years.

The weight and measurements were as follows: weight, 930 pounds; length of carapace, 6 feet, 9 inches; greatest width, 2 feet, 10½ inches; depth, 1 foot, 8 inches.

Calendar of Scup Season off Newport, 1905-1909.

	1905.	1906.	1907.	1908.	1909.
First appearance.....	May 1.	April 20.	May 2.	April 23.	April 19.
Run commences.....	May 16.	May 1.	May 10.	April 29.	May 1.
Run ends.....	June 25.	June 15.	June 24.	June 9.	June 14.
Most abundant.....	June 1 to June 18.	May 5 to June 4.	May 21 to June 10.	April 29 to June 1.	May 10 to June 7.

Calendar of Mackerel Season off Newport, 1905-1909.

	1905.	1906.	1907.	1908.	1909.
First caught in traps.....	April 28.	May 4.	May 2.	April 27.	April 17.
First large shipment from Newport	May 14.	May 14.	May 17.	May 14.	May 4.
Most abundant.....	June 5 to June 19.	June 4 to June 30.	June 11 to July 5.	May 25 to July 1.	May 16 to July 1.
Record day.....	.....	June 4.	July 1.	June 20.	May 24.
Season ends at Newport.....	June 28.	Near end of July.	Near end of July.	Near end of July.	Near mid- dle of July.

Appearance of Tinker Mackerel.

YEAR.	FIRST APPEARANCE.
1905	June 25.
1906	June 4.
1907	June 10.
1908	May 27.
1909	June 17.

Catch of Squiteague in Scup Traps off Newport, 1905-1909.

	1905.	1906.	1907.	1908.	1909.
"Stragglers" first appeared.....	June 14.	May 4.	May 21.	May 7.	May 19.
Commencement of run.....	June 21.	June 10.	June 24.	June 6.	June 17.

First Appearance of Various Marketable Fish in Traps off Newport.

	1905.	1906.	1907.	1908.	1909.
Butterfish.....	May 22.	April 16.	May 10.	April 28.	April 21.
Striped bass.....		April 21.	May 2.	April 24.	April 21.
Sea bass.....			May 8.	May 5.	May 4.
Sea robins.....		April 30.	May 9.	April 27.	May 1.
Squid.....		May 4.	May 10.	April 27.	May 1.
King fish.....				May 8.	May 4.
Horse mackerel.....				June 25.	June 17.

THE PLAGUE OF SEA CLAMS AT EASTON'S BEACH, NEWPORT.

On September 11, 1909, your Commissioners received the following interesting letter from the secretary of the Easton's Beach Co.:

EASTON'S BEACH, NEWPORT, R. I.,

OFFICE, 10 CATHERINE STREET,

September 10, 1909.

The Commissioners of Inland Fisheries,

State House, Providence, R. I.

GENTLEMEN:—We beg to call your attention to a most extraordinary visitation of small clams on this beach beginning last April, and only gradually decreasing in numbers (the total being probably in the millions), in the hope that something may be done for the benefit of the general public here towards preventing a repetition of the nuisance.

We sent a few samples of these clams (of one-half inch to one inch in length) to Professor Alexander Agassiz, who suggested that we might appeal to you in the matter. He also gave the opinion that probably an examination by dredging and diving might be necessary to determine what is best to be done.

No one remembers ever seeing these small clams here before. After storms some large beach-clams have washed up each year, and sometimes a few clams of about 2 inches to 3 inches in length have been on the beach for a short period of the summer, but never these small ones. Some of these latter appear to have grown to a size of $1\frac{1}{2}$ inch in length, but thousands more of the smaller ones would wash up and die in the sun, making a bad odor. We have been carting them to the east dunes all summer, tons upon tons of them, at large expense and trouble; until now the arrivals being few, we can keep pretty well ahead of new arrivals on every tide.

The patrol men have been diving down to the bottom to examine the raft chains and anchors, in a depth of about six feet at low tide, and report that they find clams, and sea-weed which they *think* is growing there, which is unusual.

No one seems to know what sort of clam it is, or whether the young of big clams. They have already been in banks of over a foot deep on the beach, and should

they ever grow to the size of big beach clams they would completely barricade the surf.

If you would kindly advise us in this matter, we would be greatly obliged both for the public and ourselves, and would be glad to send you samples of these things.

Yours very truly,

EASTON'S BEACH CO.,

Per F. H. PAINE, *Secretary*.

Mr. Barnes was requested to examine into the matter, and makes the following report. It is difficult to see how such an occurrence could be prevented.

Visitors at Newport's popular beaches during the summer of 1909 had ample opportunity to be impressed with the astounding productivity of the sea as revealed in the immense number of young sea clams that were piled high upon the shores.

The easterly storms of early April washed immense numbers of the young sea clams into the bays along the southern shore of Rhode Island. Particularly at Easton's Beach (over a mile in length) the drifts of clam were often 14 inches deep along the shore, and since the beach clams are vigorous burrowers, the sand was also filled with them to a depth of about 4 inches. They extended, as far out from the shore as the life-raft (about 450 feet), at least, and every subsequent storm drove fresh numbers upon the shore. A good idea of the quantity can be obtained if one considers the problem confronting the Easton's Beach Company in their efforts to dispose of them. The deep piles of clams above the low-tide mark rapidly dried in the hot summer sun and became a nuisance. The clams could not be thrown into the water because the surf would only drive them back. They could not be carted away and buried because a hole large enough to contain them all would be a tremendous undertaking. They could not be used to fill up uneven ground because the health officers would not permit such a great mass of decaying matter to lie exposed.

Still it was impossible, of course, to have them left upon the beach. The plan finally adopted was to cart them to a comparatively little frequented part of the beach, heap them up in mounds, and cover them with seaweed and lime. All through June a cart was kept busily hauling away the shells and live clams; and from July first to September eighteenth they were continually carted away in teams. Often as many as 42 loads were hauled away in one day, yet in the last of September the beach was still slightly covered with them.

These clams first came on the shore in April and were most abundant the last of June and July. At this time the entire beach was covered with them, and in large drifts they were fourteen to sixteen inches deep. At first the west end of the beach was covered deepest, but gradually the great bulk worked along to the east end. After the fifteenth of August the continued carting had begun to affect the numbers, though even in September they were abundant.

The question was often raised by the visitors to the beach as to what these creatures were and where they came from. This species is the true beach clam (*Mactra solidissima*). Many persons familiar with beach clams have been deceived into thinking that it was a different species because the specimens were so small and uniform in size and did not seem to grow during the summer.

This extraordinary influx of small clams was due not entirely to the particularly abundant set, but also to the fact that the storms occurred opportunely. There has always been a bed of large clams of this species in the sand off Easton's Beach and even there in the heavy winter storms in windrows upon the shore.

CHANGES IN THE LOBSTER REARING APPARATUS AT WICKFORD IN 1909.

A number of changes in the lobster-rearing apparatus were tried out this summer in the effort to make the rapidly growing plant easier to operate and capable of greater extension with the least amount of lost energy in the way of friction as a result of the motion of the waves on the comparatively slender framework of the apparatus.

Raising Shaft Beams.

The shaft beams on two of the rafts were elevated high enough to permit the raising of the hatching-cars entirely out of water without touching the beams. This got rid of the doors on the side of the cars and consequently the cars were stronger.

Hoisting Device.

To make the raising of the cars easier a hoisting-gear consisting of a drum and ratchet gear operated by a handle was put on each of the uprights at the corners of the cars. This device has proved very satisfactory and saves considerable time and strength.

Changes in Paddle Connections.

The paddles were adjusted to fit over and rest upon a bearing-stud placed in the bottom of the car and were connected with the gear shaft by means of a small square shaft one end of which was united to the paddle shaft by means of an ordinary pipe-coupling and the upper end fitted into a sleeve-coupling which was cast with a square hole one end of which received the small square shaft just mentioned and the other end received the square gear shaft. The sleeve-coupling was slotted on one side about three-quarters of its length, through which it was pinned to the shaft. By means of this slot the coupling was allowed to slide upon the gear shaft to disengage the paddle shaft and when engaging the paddle shaft by sending down the pin preventing it from slipping off the end.

Rafts in Two Pool Units.

The rafts which have previously been built in six-pool sections were tried out this summer in units of two pools and were found much stronger and easier to handle. It is intended that the whole plant shall be remodelled to conform to these plans.

Electric Motor.

The idea of furnishing power to these units by placing a small electric motor on each raft was partially tried out this summer. This scheme, if economical, is much better in several particulars. It gets rid of the long line of shafting which is necessary to transmit power to the extreme rafts. This shafting is constantly bending by the motion of the waves, while wires necessary to transmit the electric power can easily have enough slack to allow for all motion. Furthermore, power can be turned on or off by simply turning a switch. A unit thus established could be installed wherever there is an electric-lighting system. The apparatus consisted of a $\frac{1}{4}$ -H. P. alternating current motor running at 1800 R. M. P., and imparts through a worm and gear a speed of 20 R. P. M. to a shaft which in turn, by means of a beveled gear, gives a speed of 10 R. P. M. to the two paddles of the unit. On account of delays the scheme was installed too late to be used in the lobster season, but was tried out sufficiently well to warrant a more thorough test next year.

ADDITIONAL NOTES UPON THE DEVELOPMENT OF THE LOBSTER.

BY DR. PHILIP B. HADLEY.

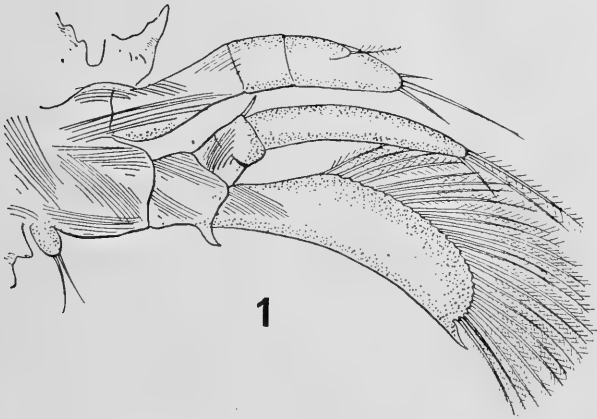
PREFACE.

The present work is the culmination of a study of the development of the American lobster (*Homarus americanus*). Its aim is to present, in a series of drawings the most important points in the development of the appendages and body-form of the lobster as it passes on from the larval stages into maturity. Drawings of all the appendages in all the stages are not presented, only those being figured which show the more important changes in shape or size. In all cases, the aspect which shows best the most important parts of the appendages has been represented. All drawings of the appendages were made with camera lucida, and the magnification is stated in each figure. The work was done while the writer was investigating problems of the lobster at the Wickford Experiment Station of the Rhode Island Commission of Inland Fisheries, and at the biological laboratory of Brown University. Thanks are especially due to Prof. A. D. Mead, of Brown University, for the opportunity of carrying on this work, and for much material assistance.

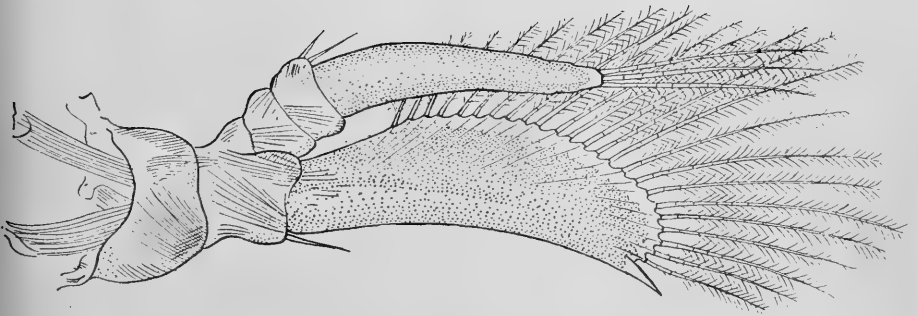
PLATE 1. FIRST-STAGE LOBSTER.

FIGURE 1. **Left, first and second antennæ from below, M=40.** In the first-stage lobster the first antennæ project hardly to the end of the rostrum. The *endopodite* which later form the smaller inner branches, have just commenced to bud off on the inner side of the outer member, or *exopodite*, and is furnished with one seta. The *exopodite* has at its tip several smaller setæ. The second antennæ at this stage are composed of two parts: a broad leaf-like outer branch, the *exopodite*, whose inner margin is curved and furnished with a variable number of feathered setæ, and whose tip has one sharp spine; also a more slender inner part, the *endopodite*, which bears setæ chiefly at the tip, but whose divisions into antennæ segments has not yet occurred.

FIGURE 2. **Right second antennæ from above, M=50.** Description as above.



1

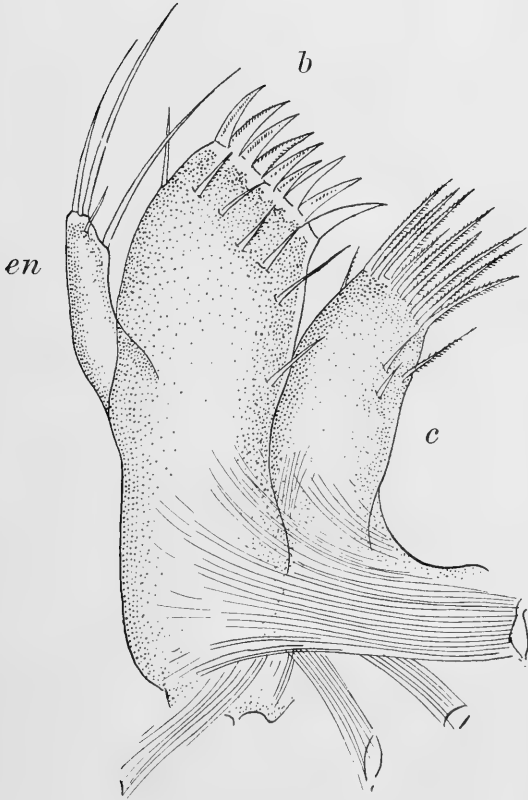


2



PLATE 2. FIRST-STAGE LOBSTER.

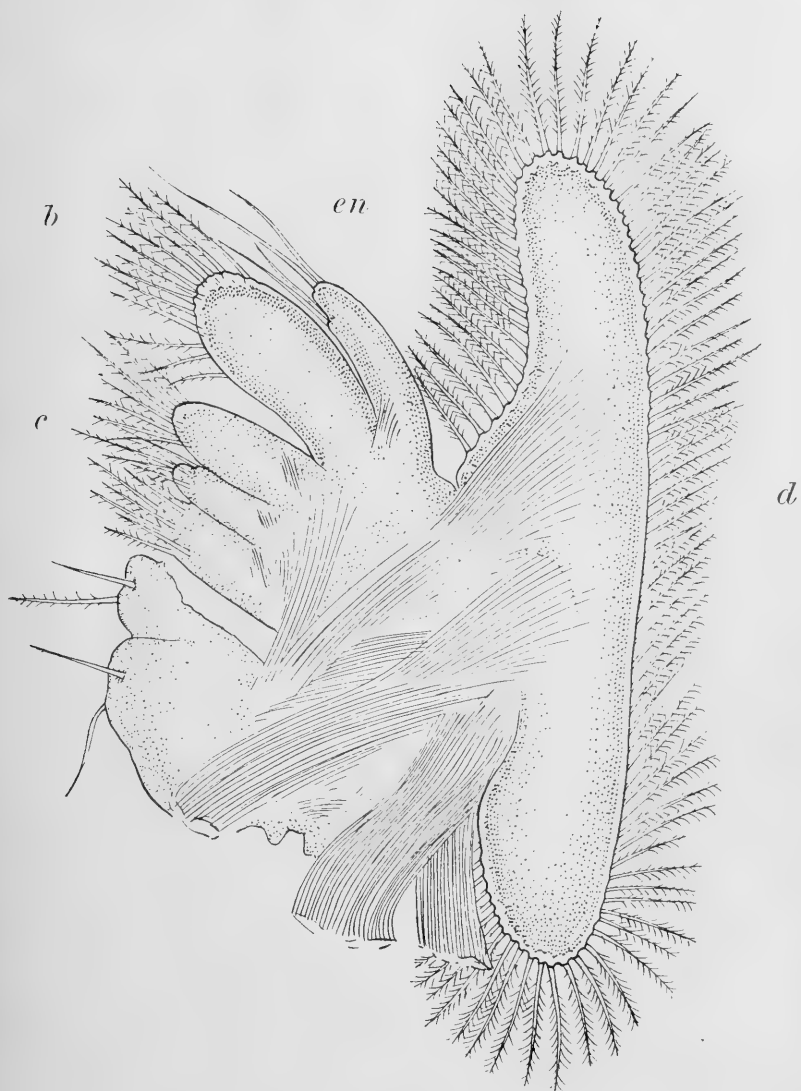
FIGURE 3. **Right first maxilla from above, M=125.** In the first maxilla the *exopodite* is absent, and the *endopodite* (en) is unjointed. The large plates (b and c) represent the *basipodite* and *cozopodite* respectively.



3

PLATE 3. FIRST-STAGE LOBSTER.

Figure 4. **Right second maxilla from above, M=120.** The *endopodite* (en) is small, unjointed, and equipped with several long setæ. The *basipodite* (b) and the *coxopodite* (c) are lamella-like, and divided by deep fissures. The *exopodite* is absent, its place being taken by the plate-like *scaphognathite* (d). There is no gill or *podobranch*.



4

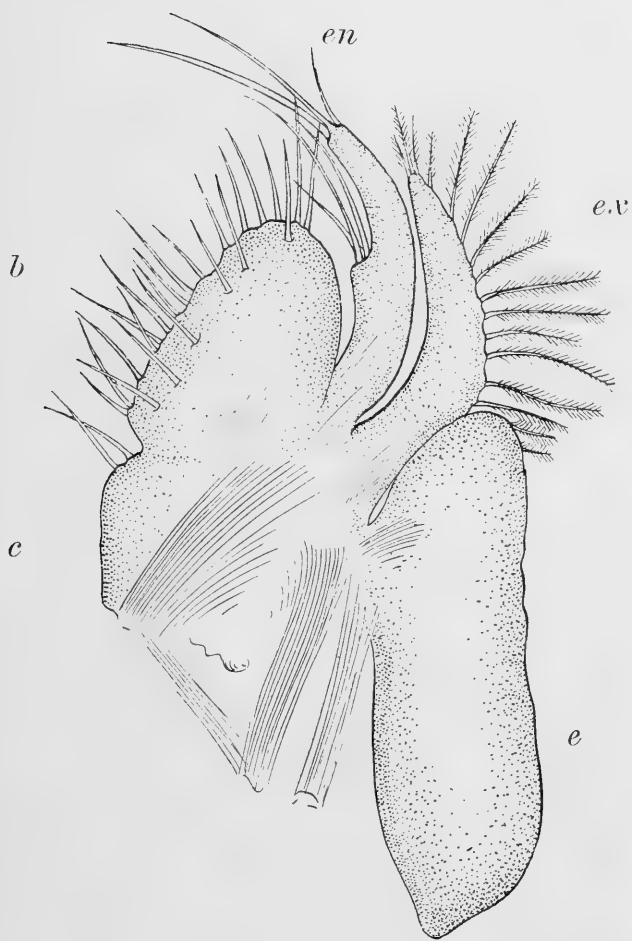
PLATE 3.

PLATE 4. FIRST-STAGE LOBSTER.

FIGURE 5. **Right first maxilliped from above, M=125.** Here the *endopodite* (en) and *exopodite* (ex) are unjointed. The end of the former is tipped with several long setæ, while the latter is bordered on the outer side by feathered setæ. The *basipodite* (b) and the *coxopodite* (c) are not strongly divided, and form a large plate (b. c.). The *podobranch* is absent, but the *epipodite* (e), which is thin and plate-like, is strongly developed.

Section 100.0000 - [illegible]

Figure 2. Slits have been machined from above. $M = 100$. The end position
of the slits is indicated by the arrows. The distance between the slits is
1.5 mm. The distance between the center of the slits and the center of the
large plate is 6 mm. The pedestal is absent for the opposite (c), which is
the same as (a) but with the pedestal removed.



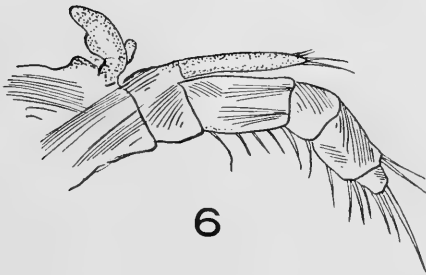
5

PLATE 5. FIRST-STAGE LOBSTER.

FIGURE 6. **Right second maxilliped from below, M=40.** The unjointed *exopodite* (en) is shown attached to the *basipodite*. The basal joint bears the *epipodite* and a rudimentary *podobranch*.

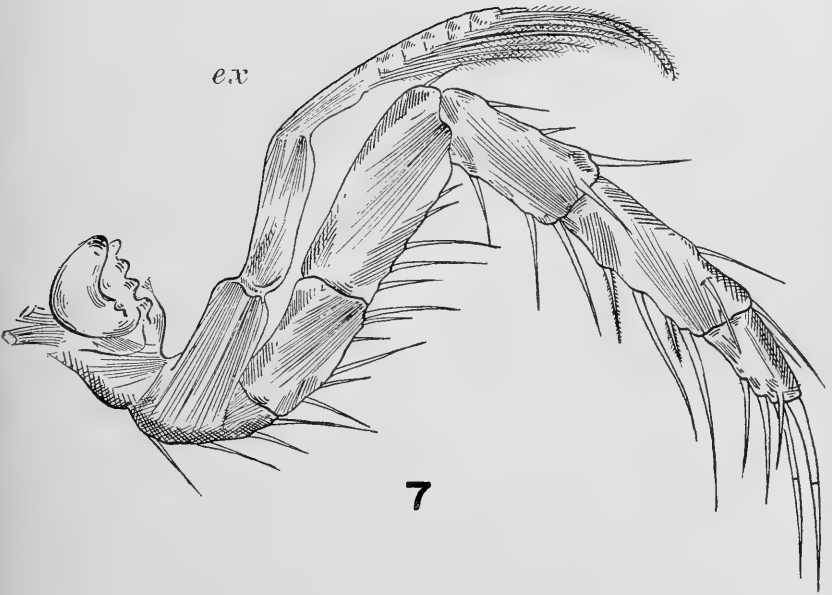
FIGURE 7. **Right third maxilliped from behind, M=54.** The strong and functional *exopodite* (ex) with its long feathered setæ is shown attached to the *basipodite*. The *endopodite* is relatively weak and is divided into five joints: *ischiopodite*, *meropodite*, *carpopodite*, *propodite*, and *dactylopodite*. Both the *epipodite* and the gill (*podobranch*) are attached to the *cozopodite*.

en



6

ex



7



PLATE 6. FIRST-STAGE LOBSTER.

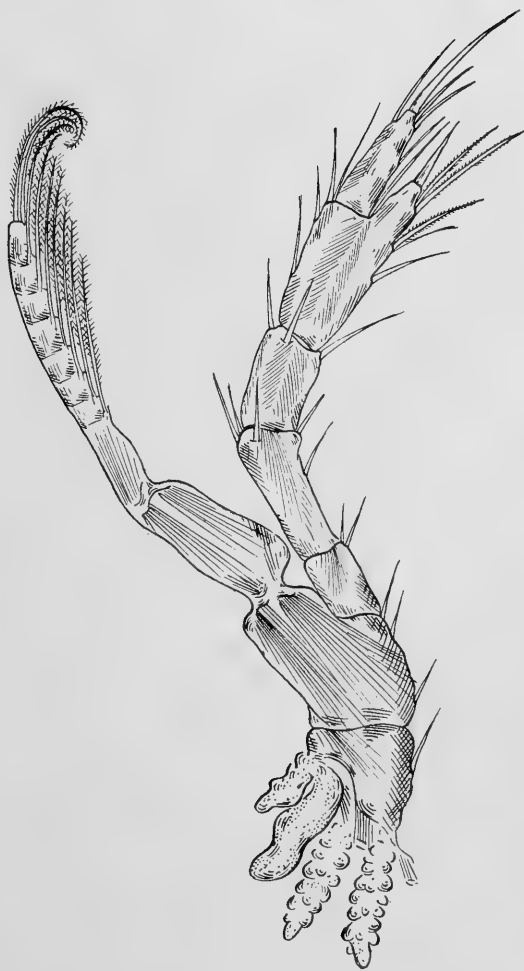
FIGURE 8. **Right cheliped from behind and above, M=37.** The strong functional *exopodite* (ex) is attached to the *basipodite*. The *endopodite*, which is terminated by a non-functional claw, is comparatively weak, and the end of the *propodite* is much shorter than the opposing *dactylopropodite*. The gills (*podobranchs*) are attached to the *coxopodite*. At this stage there is no differentiation in the two chelipeds of the lobster. The characteristic "nipping" and "crushing" claws do not appear until the sixth stage. Until that stage, both claws are alike. The dactyls open upward in a vertical plane and somewhat outward. In the first stage there are no "teeth" on the *dactylopropodite* or *propodite*.



8

PLATE 7. FIRST-STAGE LOBSTER.

FIGURE 9. **Right second walking leg from behind, M=46.** The strong, functional *exopodite* is attached to the *basipodite*. The first two pairs of walking legs are equipped with non-functional claws which are somewhat smaller than the chelæ, and are but slightly functional in this stage. They are tipped with long stout spines. The *epipodite* and *podobranchs* are shown attached to the *coxopodite*. The second pair of walking legs have the same general structure as the first pair.



9

PLATE 8. FIRST-STAGE LOBSTER.

FIGURE 10. **Right third leg from behind, M=50.** The strong functional *exopodite* is shown attached to the *basipodite*. The *endopodite* is comparatively weak. The *propodite* has not grown out to form a claw with the opposing *dactyl*. The latter is tipped with a long spine. The gills and *epipodite* are shown attached to the *coxopodite*.



10

PLATE 8.

PLATE 9. SECOND-STAGE LOBSTER.

FIGURE 11. **Right first antenna from inside and above, M=48.** In the second-stage lobsters the inner rami of the first pair of antennæ have grown out from the buds existing in the previous stage to half the lengths of the *exopodites*. The latter have developed along the inner margin a line of olfactory setæ. Slight trace of segmentation is sometimes visible in both branches in this stage. The position of the auditory sack is suggested in the basal joint.

FIGURE 12. **Right second antenna from above, M=40.** By this second stage the *endopodites* of the second pair of antennæ have grown out to more than equal in length the broad, leaf-like *exopodites* and traces of segmentation are more frequently visible.

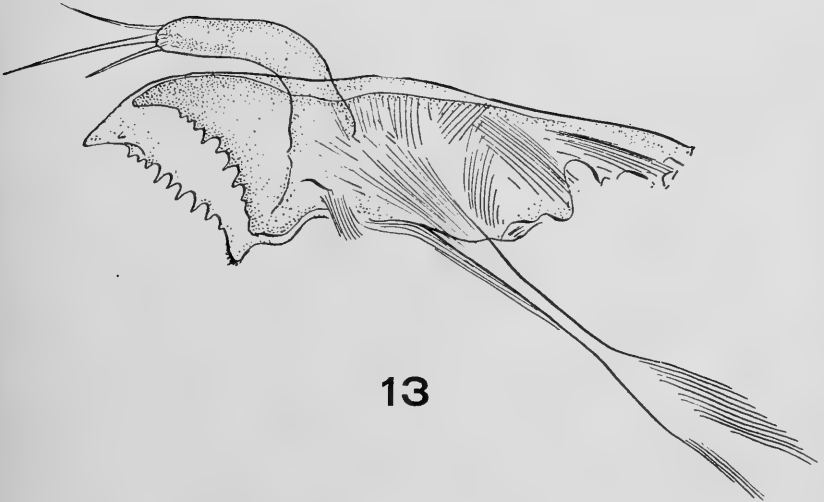
FIGURE 13. **Right mandible from inside, M=80.** The *endopodite* or *palpus* is shown arising from the body of the mandible or *propodite*. The present mandible was taken from a lobster which was about to moult, and the body of the mandible is shown as it begins to draw away from the purely chitinous covering.



11



12



13

1874

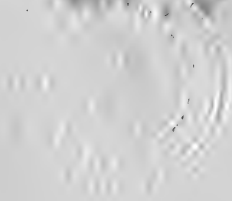
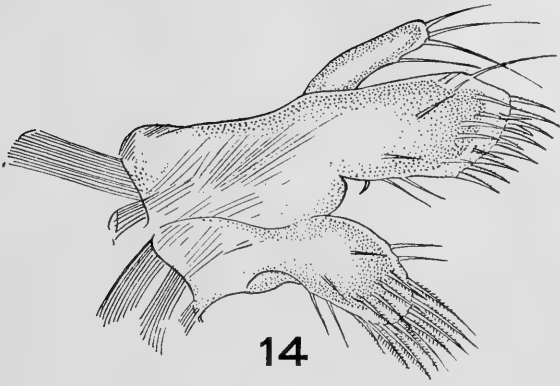


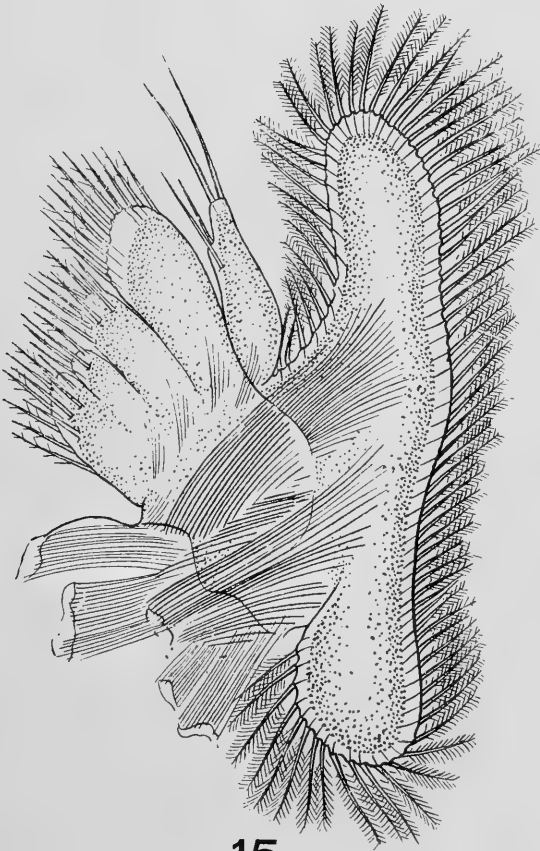
PLATE 10. SECOND-STAGE LOBSTER.

FIGURE 14. **Right first maxilla from above, M=80.** This appendage has changed little since the first stage.

FIGURE 15 **Right second maxilla from the inside, M=76.** The appearance is much the same as in the first stage.



14



15

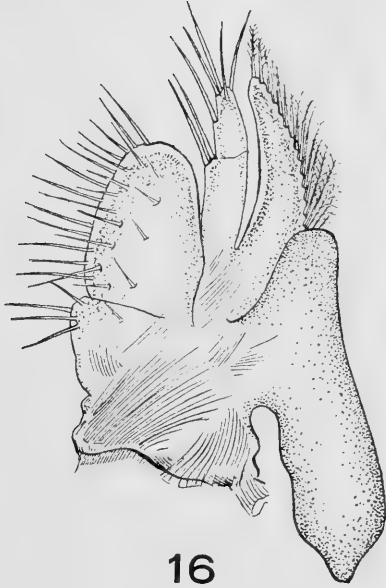
PLATE 10.

PLATE 11. SECOND-STAGE LOBSTER.

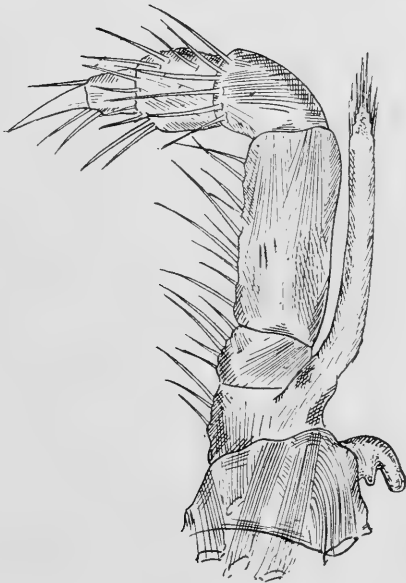
FIGURE 16. **Right first maxilliped from inside, M=58.** Here the *endopodite* (en) has one joint. The *exopodite* is unjointed. The general appearance is as in the first stage.

FIGURE 17. **Right second maxilliped from inside, M=60.** The general appearance is as in the first stage. A trace of segmentation is sometimes visible at the end of the *exopodite*.

en



16



17

PLATE 11.

PLATE 12. SECOND-STAGE LOBSTER.

FIGURE 18. **Right third maxilliped from behind and above, M=44.** The *exopodite* is still functional, but the *endopodite* is relatively larger and stronger than in the first-stage larvæ.



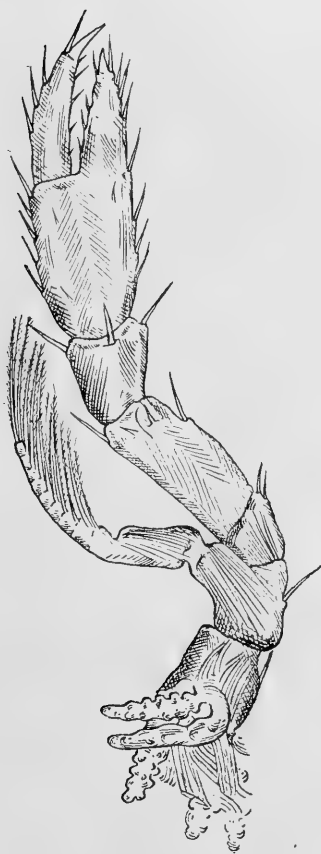
18

PLATE 13. SECOND-STAGE LOBSTER.

FIGURE 19. **Right cheliped from behind, M=22.** The functional *exopodite* is still attached to the *basipodite*, but the *endopodite* is relatively larger and stronger than in the first stage. The end of the *propodite* nearly equals in length the opposing *dactylopodite*. The claw itself is better formed than in the first stage, although in the second it is hardly more functional. The *podobranch* and *epipodite* are attached to the *coxopodite*. In this stage is shown the beginning of the torsion of the claw, of which the *dactyl* in the first stage opened vertically upward and somewhat outward. For further references see Herrick,* and Emmel.†

* F. H. Herrick, Biol. Bull., 1905, IX, 130-137.

† V. E. Emmel, Journal of Exper. Zool., 1906, IV, 603-618. In this paper Emmel shows the interesting parallel between the torsion in the development of the chela through the stages, and the torsion in the development of the claw during regeneration.



19

PLATE 13.

PLATE 14. SECOND STAGE LOBSTER.

FIGURE 20. **Right first walking leg from behind, M=41.** The *exopodite* is still strong and functional, while the *endopodite* is but slightly more developed than in the first stage. The claw is somewhat better formed, and the opposing end of the *propodite* is relatively longer. There are as yet no "teeth" on the inner edges of either. While a torsion has affected the chelæ, causing the dactyls to open upward in a vertical plane and somewhat inward, the dactyls of the claws of the walking legs still open upward and slightly outward.

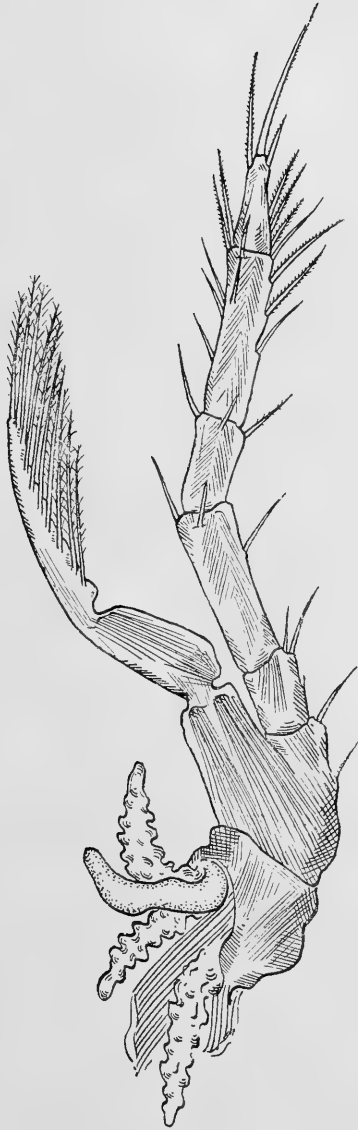


20

PLATE 14.

PLATE 15. SECOND-STAGE LOBSTER.

FIGURE 21. **Right third walking leg from behind, M=40.** This appendage is, in most respects, similar to that of the first-stage lobster. Here is shown a further stage in the progressive development of the gills, which takes place through the early stages.



21

PLATE 15.

PLATE 16. THIRD-STAGE LOBSTER.

FIGURE 22. (Second Stage.) **Right third abdominal appendage (pleopod) from before, M=87.** The *pleopods* of the second, third, fourth and fifth abdominal segments appear first, but in a non-functional state, in the second stage.

FIGURE 23. **Right first antenna from above, M=48.** In the third stage the segmentation of both *exopodite* and *endopodite* are clearly marked. The basal joint is of peculiar form and, the position of the auditory sac is suggested.

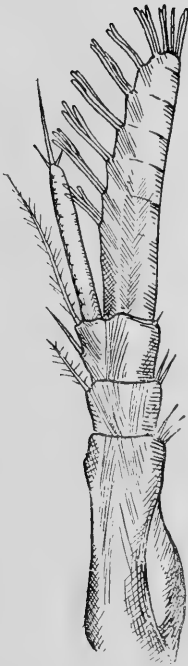
FIGURE 24. **Right second antenna from above, M=40.** By the third stage the *endopodite* has grown out to exceed in length the *exopodite*. The former shows distinct traces of segmentation, and setæ have appeared between the segments. In this specimen the retraction of the body of the antenna due to the beginning of the moulting process is shown.

TABLE III. THE RESULTS OF THE EXPERIMENT.

TABLE III. (continued) The results of the experiment. The values in parentheses are the standard deviations. The values in brackets are the values of the second, third, fourth and fifth orders.

TABLE III. (continued) The results of the experiment. The values in parentheses are the standard deviations. The values in brackets are the values of the second, third, fourth and fifth orders.

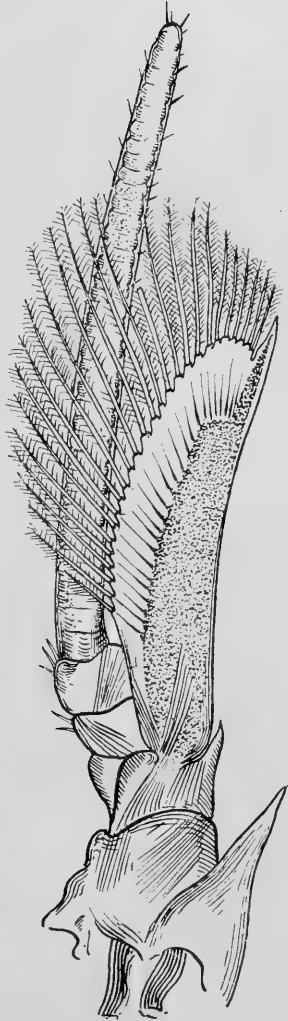
TABLE III. (continued) The results of the experiment. The values in parentheses are the standard deviations. The values in brackets are the values of the second, third, fourth and fifth orders.



23



22

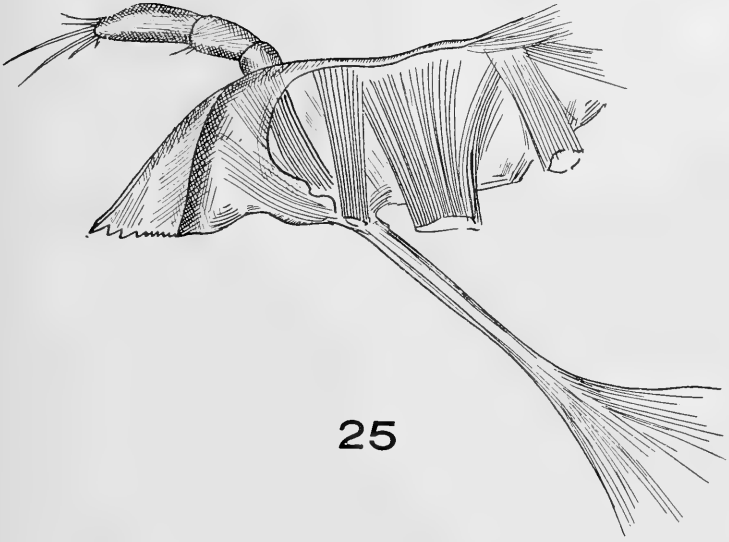


24

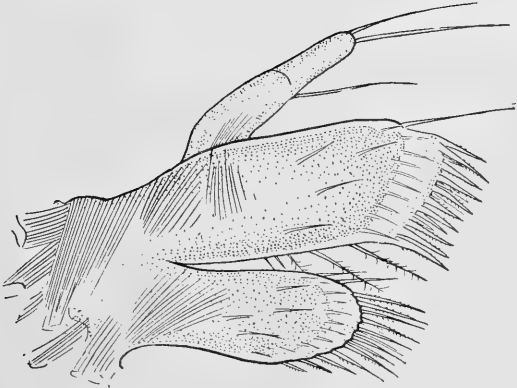
PLATE 17. THIRD-STAGE LOBSTER.

FIGURE 25. **Right mandible from inside**, M=about 60. The palpus or *endopodite* is now two-jointed. The inside edge of the cutting teeth shown; also the strong mandibular muscle.

FIGURE 26. **Right first maxilla from above**, M=75. In the *basipodite* and *coxopodite* is shown the retraction of the body of the maxilla due to moulting. The *endopodite* has now one joint.



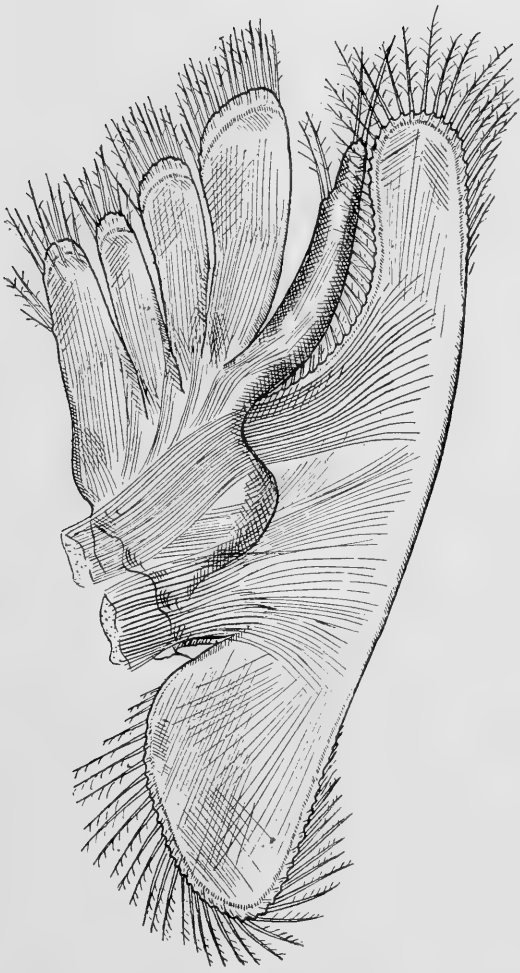
25



26

PLATE 18. THIRD-STAGE LOBSTER.

FIGURE 27. **Right second maxilla from inside, M=80.** The general appearance is the same as that of the second stage.



27

PLATE 18.

PLATE 19. THIRD-STAGE LOBSTER.

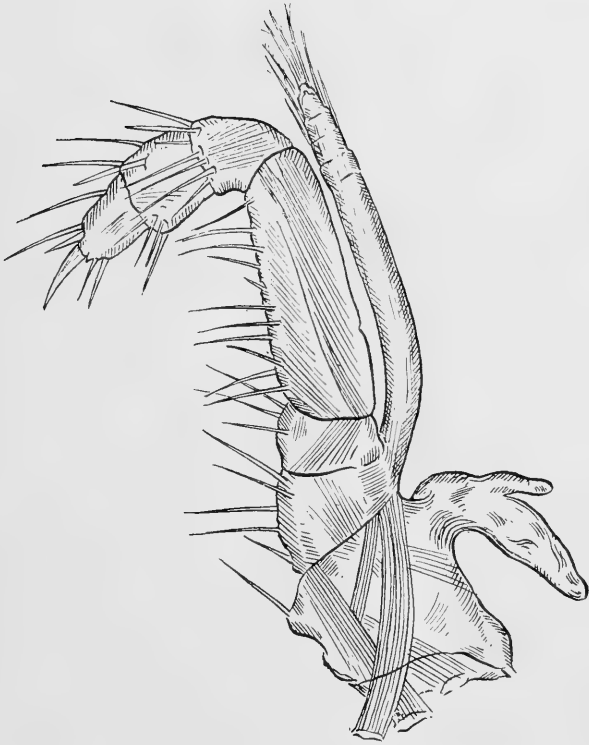
FIGURE 28. **Right first maxilliped from inside, M=86.** The general appearance is as in the second stage. The *tegumental glands* are shown in the broad leaf-like *basipodite*.



28

PLATE 20 THIRD-STAGE LOBSTER.

FIGURE 29. **Right second maxilliped from the inside, M=56.** Segmentation at the end of the *exopodite* is more clearly shown than in the previous stage.

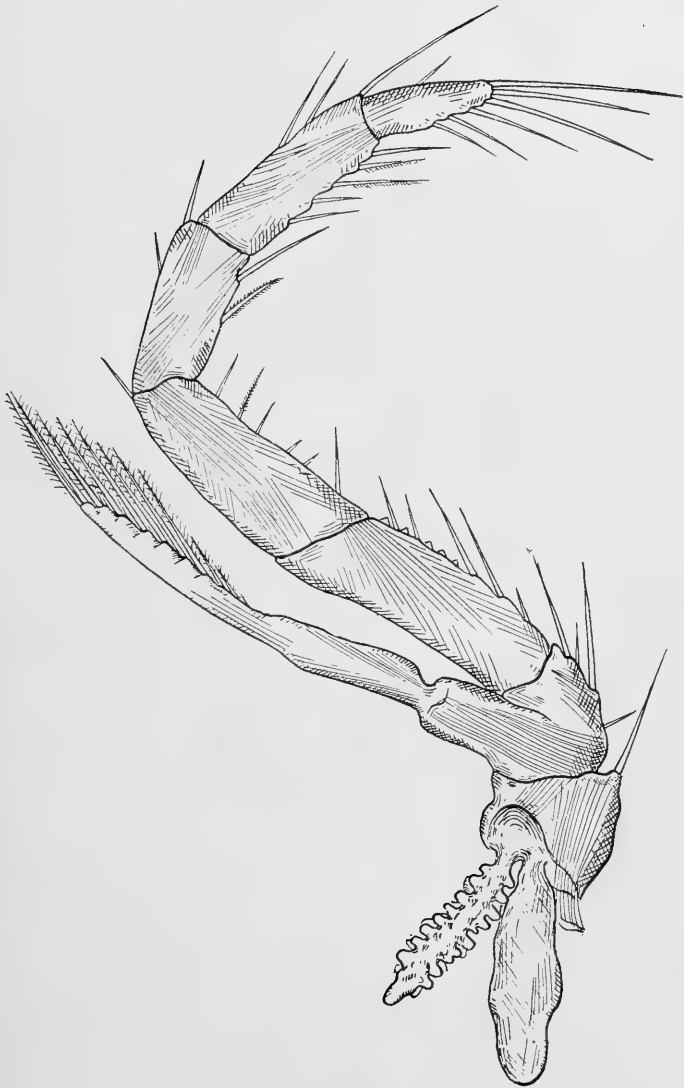


29

PLATE 20.

PLATE 21. THIRD-STAGE LOBSTER.

FIGURE 30. **Right third maxilliped from behind, M=38.** The appearance is similar to that of the second stage. Here the teeth bordering the anterior margin of the *ischiopodite* are suggested. The *podobranch* and the *epipodite* are developing toward the adult structural type.



30

PLATE 21.

PLATE 22. THIRD-STAGE LOBSTER.

FIGURE 31. **Right cheliped from behind, M=27.** The *exopodite* is still strongly functional, but the claw, or chela, has further developed and the whole *endopodite* is stronger. In this stage is noticed especially the beginning of that torsion of the claw which, by the fourth stage, brings the *dactyl* to open toward the inside in a nearly horizontal plane.



31

PLATE 23. THIRD-STAGE LOBSTER.

FIGURE 32. **Right second walking leg from behind, M=27.** The *exopodite* is still functional, and the chelæ are slightly functional in the third stage. The inner edge of the *propodite* and of the *dactyl* have a suggestion of teeth. The projecting *propodite* is relatively longer than in the preceding stage. The *dactyl* opens upward in a vertical plane and slightly outward, a position which is maintained in the adult stage.

THE THEORY OF THE ...

...

... as a function of the ...
... and the ...
... of the ...
... in the ...
... and ...
... in the ...



32

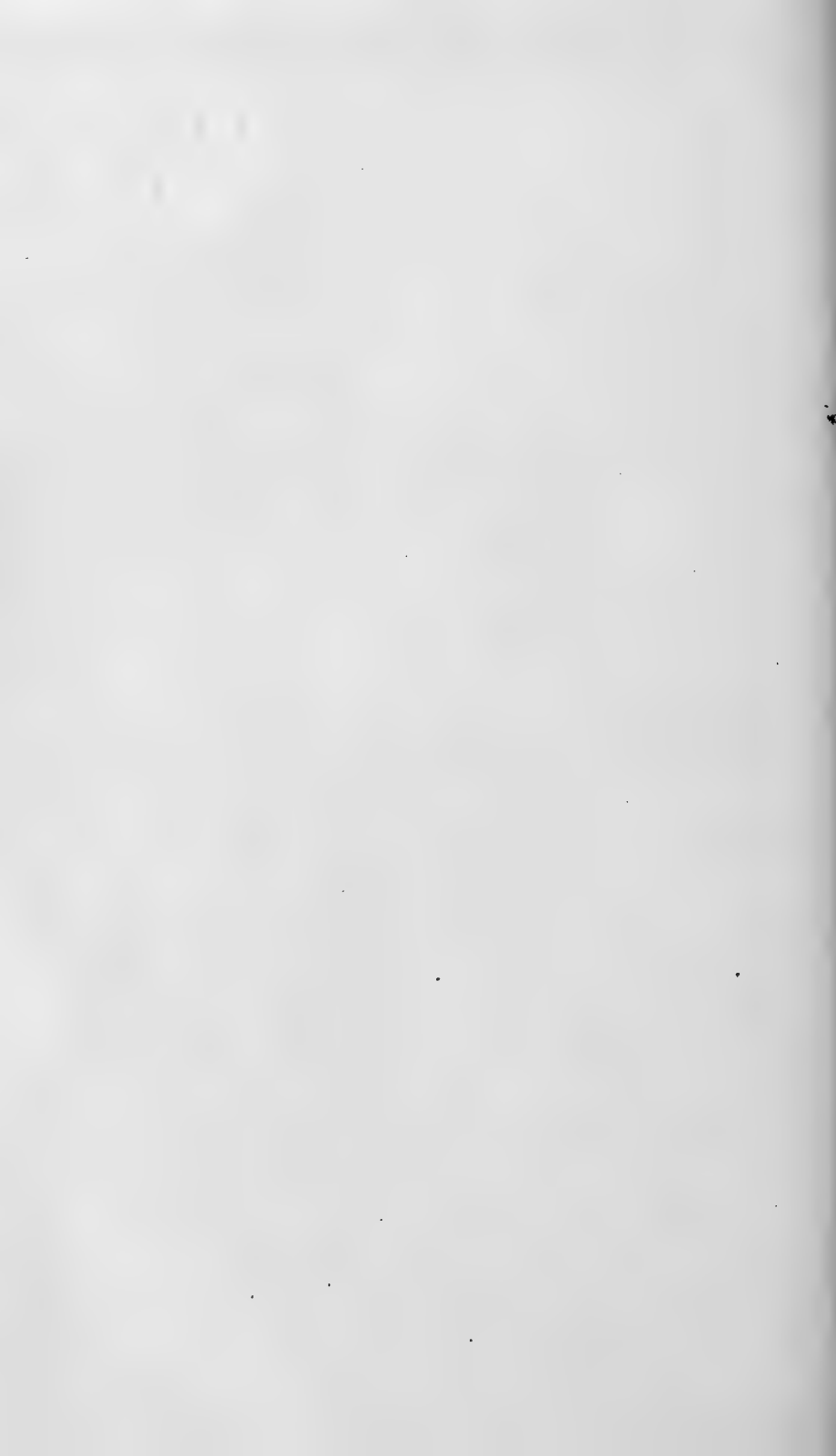


PLATE 24. THIRD-STAGE LOBSTER.

FIGURE 33. **Right fourth walking leg from behind, M=16.** The *endopodite* is relatively stronger than in the preceding stage.

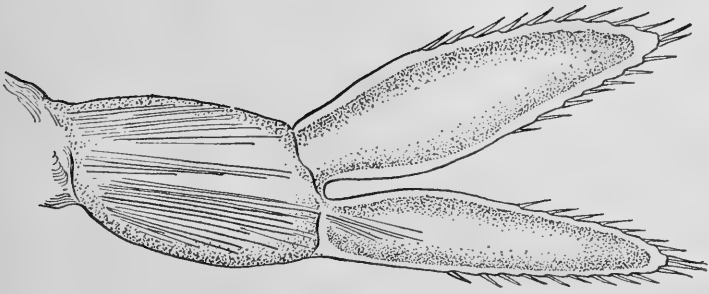


33

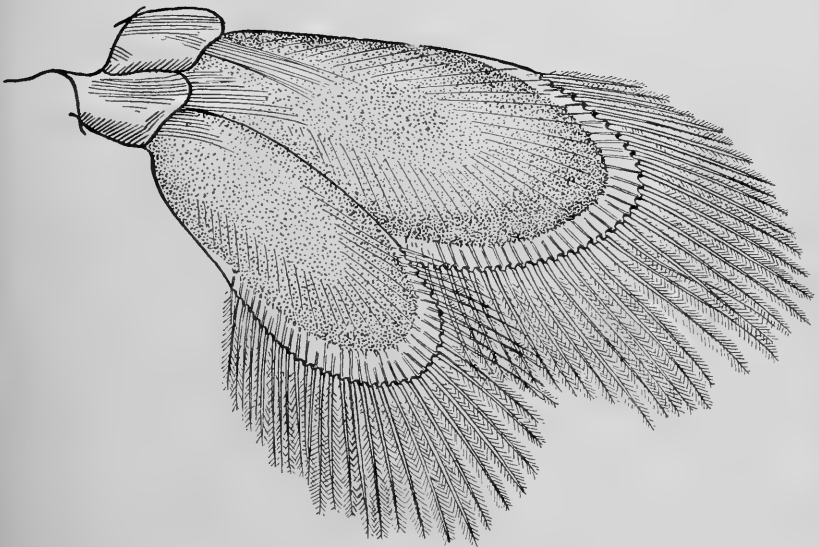
PLATE 25. THIRD-STAGE LOBSTER.

FIGURE 34. **Right fourth abdominal appendage from behind, M=55.** The *pleopods* are larger, stronger and more blade-like than in the second stage. They are not yet functional, but are thinly furnished along the edge with *setæ*.

FIGURE 35. **Right sixth abdominal appendage from above, M=45.**



34

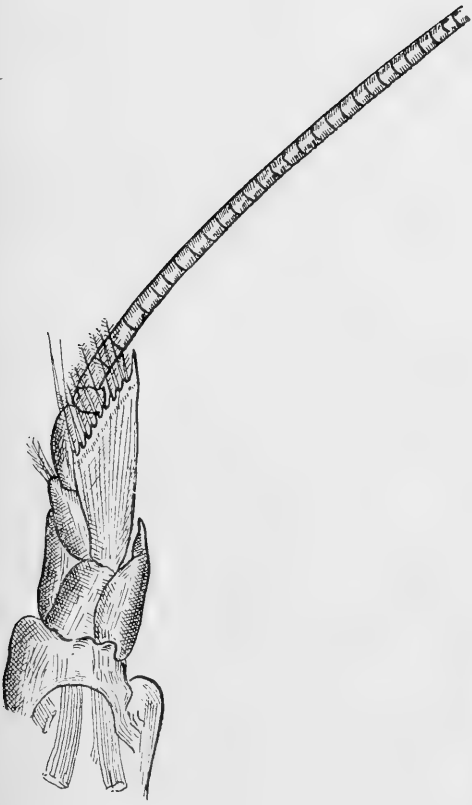


35

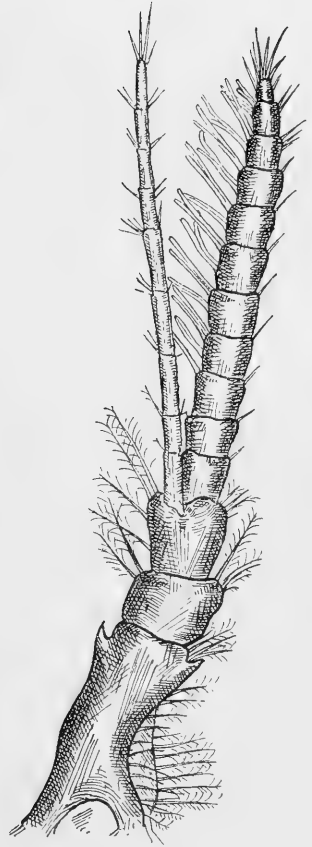
PLATE 26. FOURTH-STAGE LOBSTER.

FIGURE 36. **Right first antenna from above, M=30.** In the fourth stage the inner branch, or *endopodite*, is distinctly segmented and is slightly longer than the *exopodite*, which is also distinctly segmented and bears along the inner edge the olfactory setæ. Throughout the life of the lobster the outer branch remains larger and stouter than the inner.

FIGURE 37. **Right second antenna from above, M=15.** The cramped segments of the *endopodite* which were shown in Fig. 24, Pl. 16, have expanded to form a long lash, while the *exopodite* has degenerated to an equal extent.



37



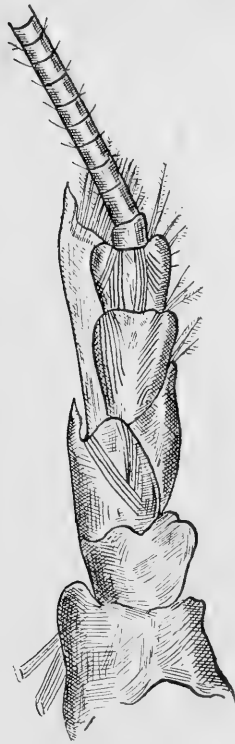
36



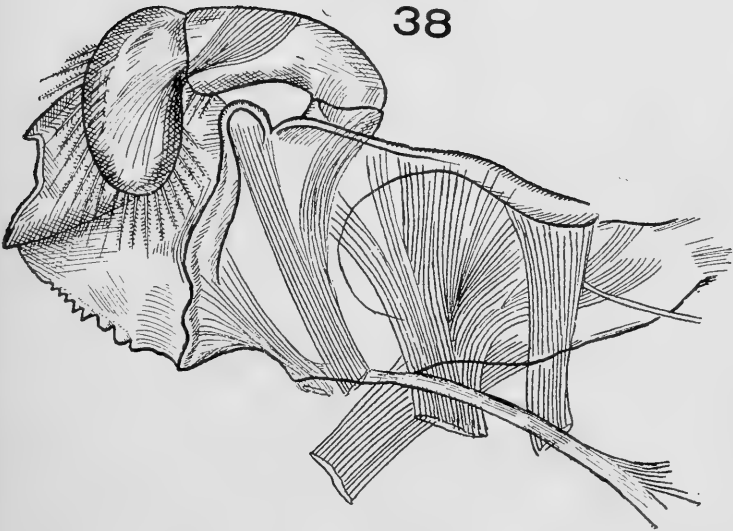
PLATE 27. FOURTH-STAGE LOBSTER.

FIGURE 38. **Right second antenna from below, M=18.** See description of figure 37. The *endopodite* is represented cut off.

FIGURE 39. **Right mandible seen from the inside and above, M=65.** The palpus has further developed since the third stage, and the toothed part of the mandible has become hard through the absorption of lime salts from the water. The same is true of other parts of the exoskeleton.



38



39

PLATE 27.

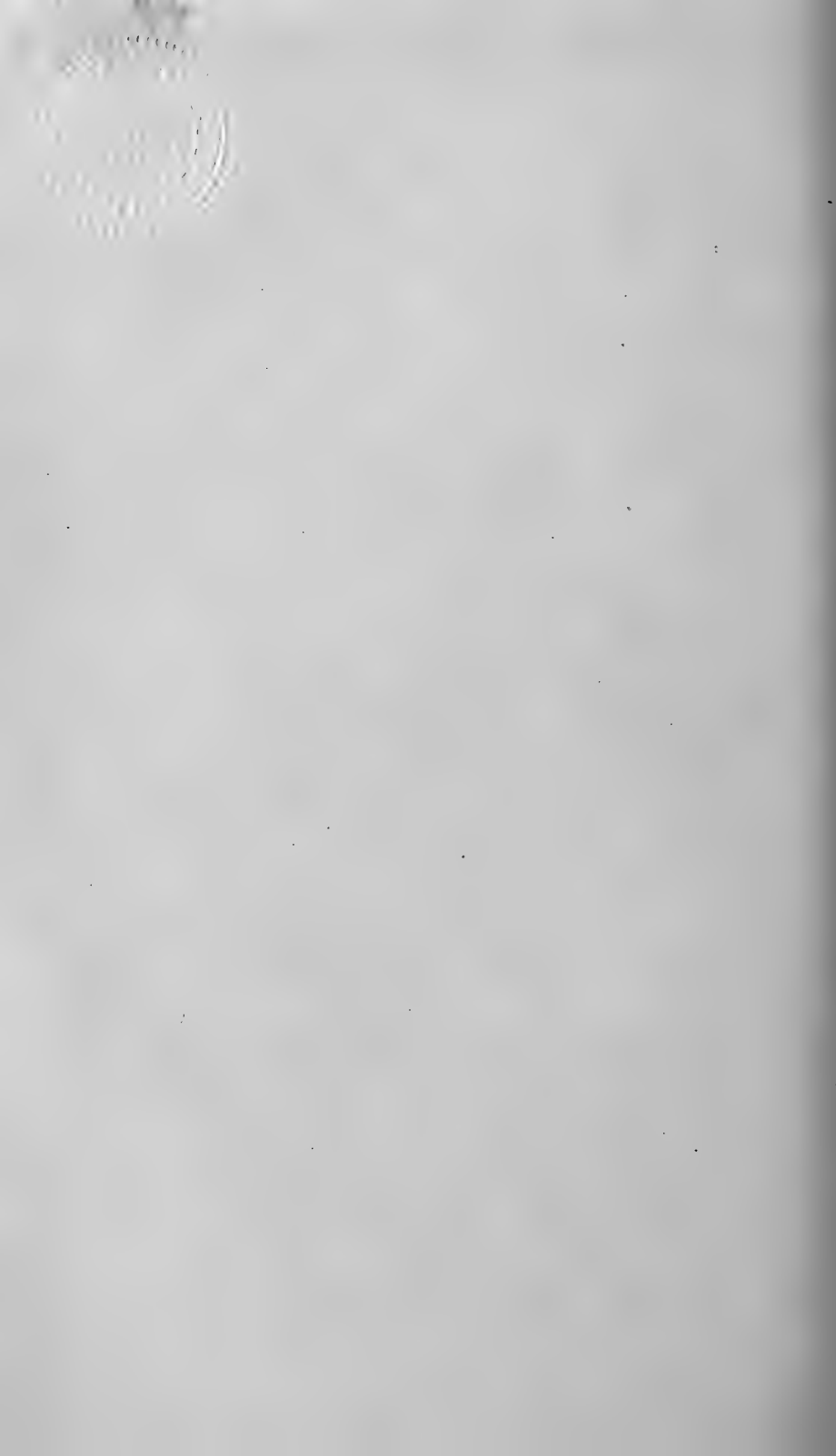
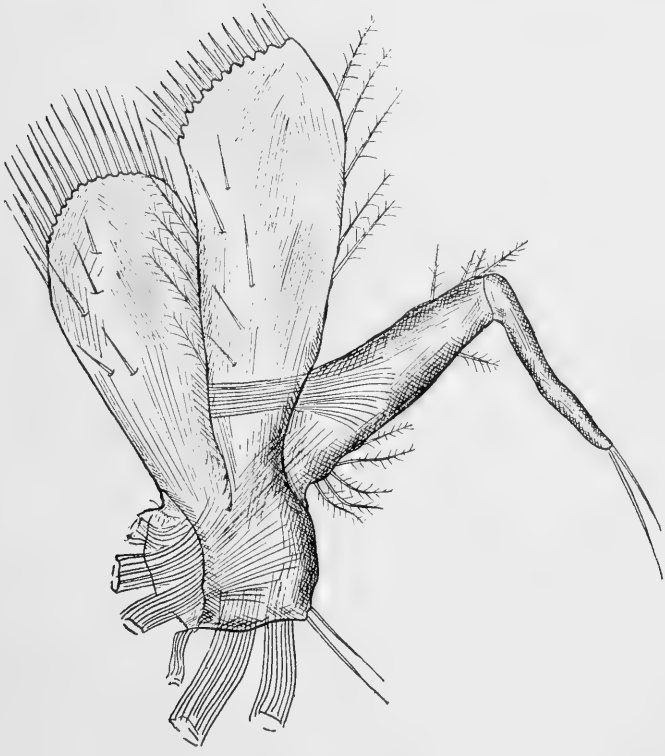


PLATE 28. FOURTH-STAGE LOBSTER.

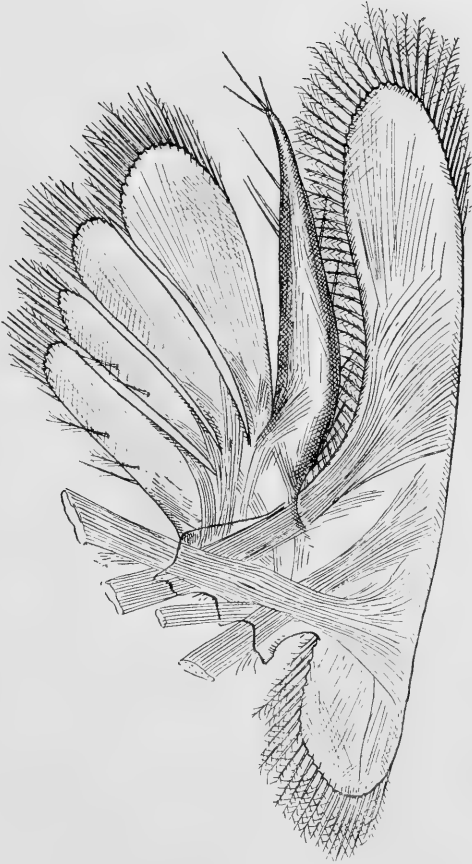
FIGURE 40. **Right first maxilla from outer side, M=75.** The condition is much the same as in the third stage, save for the bend in the *endopodite*.



40

PLATE 29. FOURTH-STAGE LOBSTER.

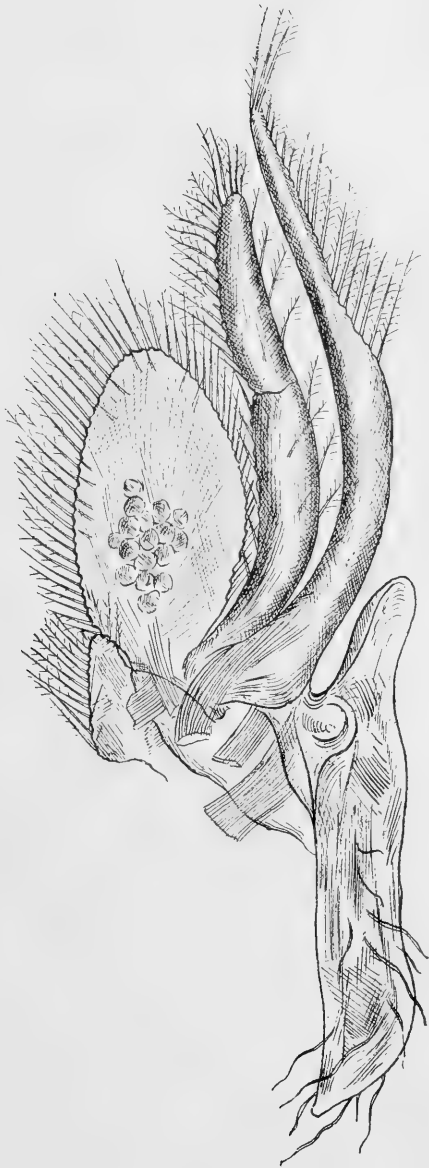
FIGURE 41. **Right second maxilla from inside, M=60.** Except for the change in the shape of the *scaphognathite*, and the slight elongation of the *endopodite*, the condition is much as in the third stage.



41

PLATE 30. FOURTH-STAGE LOBSTER.

FIGURE 42. **Right first maxilliped from inside, M=68.** There has occurred, since the third stage, a slight change in the shape of the *exopodite* and *endopodite*, together with a modification in the *epipodite*. The *tegumental glands* are seen in the *basipodite*.



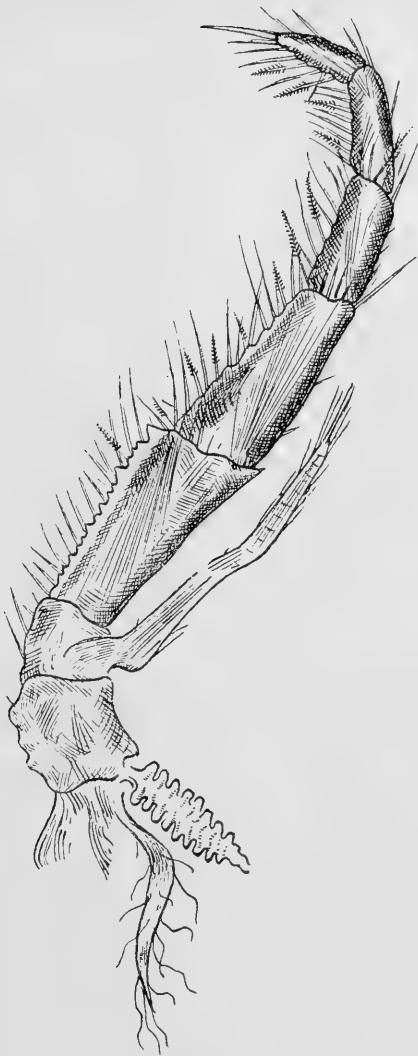
42

PLATE 30.

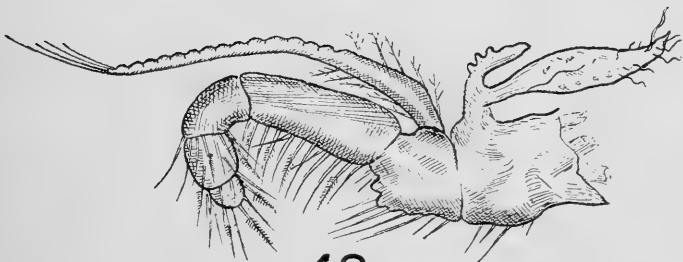
PLATE 31. FOURTH-STAGE LOBSTER.

FIGURE 43. **Right second maxilliped from above and inside, M=38.** This figure shows a continued modification of the *exopodite* which remains functional. The *podobranch* and the *epipodite* have undergone further development from the third stage.

FIGURE 44. **Right third maxilliped from above and in front, M=32.** This figure shows the *exopodite*, which, though slightly degenerated in structure, still remains functional; also the teeth on the inner margin of the *ischiopodite*. The *podobranch* and the *epipodite* have undergone further development.



44



43

PLATE 31.

PLATE 32. FOURTH-STAGE LOBSTER.

FIGURE 45. **Right cheliped seen from above and in front, M=15.** Here is observed the culmination of the process of torsion which began in the second stage. The *dactyl* of the claw now opens inward horizontally, not vertically upward, and slightly outward as in the first-stage larvæ. Tactile hairs are shown on the *propodite* and on the *dactyl*. The non-functional rudiment of the *exopodite* is seen still attached to the *basipodite*. The *coxopoditic setæ* show above the *podobranch*, which together with the *epipodite* is developed beyond the point of the third stage.



45

PLATE 32.

PLATE 33. FOURTH-STAGE LOBSTER.

FIGURE 46. **Right second walking leg from behind, M=23.** The walking legs of the fourth-stage lobster have elongated. The *exopodite* is reduced to a rudiment, still attached to the *basipodite*, but non-functional. The claw has now reached nearly the adult structural type, but the *dactyl*, which in the chelipeds underwent a torsion through about 90 degrees, still opens upward and slightly outward. The *podobranchs* have further developed, and *coxopoditic setae* are present.

FIGURE 47. **Right third walking leg from behind, M=23.** Except for the spike-like *dactyl*, the conditions are the same as in the case described above.



46



47

PLATE 34. FOURTH-STAGE LOBSTER.

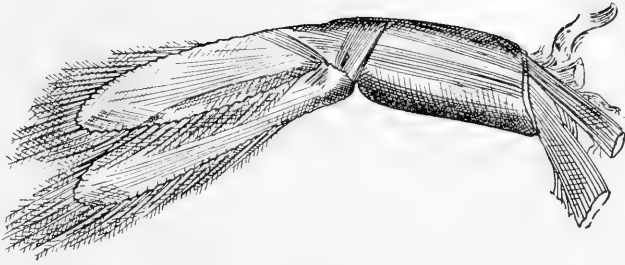
FIGURE 48. **Right second abdominal appendage (pleopod) seen from behind, M=29.** The *endopodite* and *exopodite* have become more blade-like than in the third stage, and are now strongly functional. Their edges are fringed with long feathered setæ.

FIGURE 49. **Right sixth abdominal appendage from above, M=30.** Both the *exopodite* and *endopodite* are larger and stronger than in the third stage. They are fringed about the edge with a thick mat of feathered setæ.

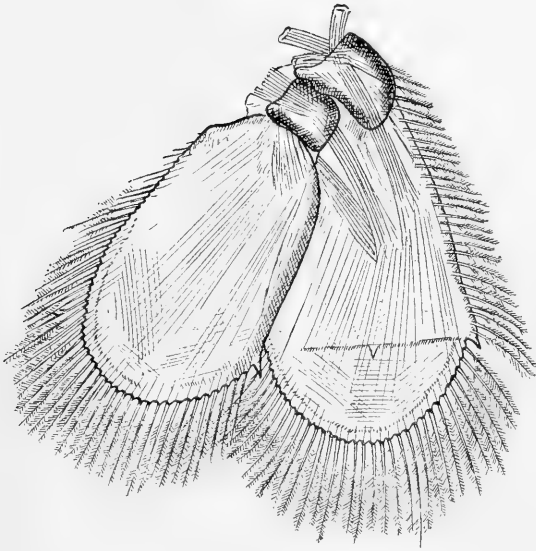
PLATE 31. FOUNTAIN-STONE INSCRIPTION.

PLATE 31. FOUNTAIN-STONE INSCRIPTION. The inscription is on a stone which is now in the possession of the British Museum. It is a fragment of a larger inscription, and is now in the possession of the British Museum. The inscription is in the form of a fountain-stone, and is now in the possession of the British Museum.

The inscription is in the form of a fountain-stone, and is now in the possession of the British Museum. It is a fragment of a larger inscription, and is now in the possession of the British Museum. The inscription is in the form of a fountain-stone, and is now in the possession of the British Museum.



48



49

PLATES XXVI AND XXVII. THE FIRST-STAGE LOBSTER.

The first-stage larva at the age of three days has a length of about 8 mm. The accompanying figure shows the larva in the normal swimming position with the abdomen bent at an angle of about forty-five degrees from the plane of the cephalo-thorax, which is in turn bent about forty-five degrees from the horizontal. The eyes are large and prominent. The thoracic appendages bear the swimming attachments, the exopodites, by whose rapid vibratory strokes the larva is kept up in the water, and by whose motion, backward or forward, the movement of the lobster is accomplished. The abdominal appendages have not yet appeared, though they often may be seen as buds beneath the cuticle on the under side of the abdomen. The tail or telson has the shape of a simple fan, whose posterior margin is bordered by short spine-like setæ.

PLATES XXVIII AND XXIX. SECOND-STAGE LOBSTER.

The appearance of the larva in this stage is similar to that of the first stage. The eyes, however, are relatively smaller, the thoracic appendages are further developed, and the abdominal appendages have appeared on the under side of the abdomen. The tail is still broad and fan-like. At the age of six days the second-stage larva is about 9.5 mm. long.

PLATES XXX AND XXXI. THIRD-STAGE LOBSTER.

The third-stage larva, at the age of nine days, is usually about 11.5 mm. in length. The antennæ and the thoracic appendages have continued to develop. The torsion of the claws of the chelipeds is not well shown in these figures. The appearance of the appendages on the sixth abdominal segment are shown, together with the modification of the tail-fan.

PLATE XXXII. FOURTH-STAGE LOBSTER.

The fourth-stage lobster at the age of fourteen days is about 14.3 mm. in length. The chief modifications in this stage are the great change in the body-form, and in detail, the following: the extension of the *endopodites* of the second antennæ; the relative small size of the eyes; the great development of the *chelipeds*; the loss of the *exopodites*, or swimming attachments of the thoracic appendages; the presence of functioning *pleopods* on the under side of the second, third, fourth and fifth abdominal segments; the relative small size of the telson, compared with the appendages of the sixth abdominal segment. The *reproductive appendages* do not appear on the under side of the first abdominal segment (in male) until about the eighth stage. The atrophied stumps of the *exopodites* of the thoracic appendages do not appear in the drawing.

The fourth stage of development is the stage of the embryo which is about 1.5 mm in length. The chief modifications in this stage are the great change in the body-form, and in detail, the following: the extension of the endophytes of the second rudiment; the relative small size of the great; the great development of the webbed; the loss of the scapular, or swimming attachment of the thoracic appendages; the presence of functioning gills on the under side of the second, third, fourth and fifth abdominal segments; the relative small size of the second, compared with the appendage of the sixth abdominal segment. The respiratory appendages do not appear on the under side of the first abdominal segment (in this) until about the eighth stage. The atrophied stumps of the scapular of the thoracic appendages do not appear in the drawing.

PLATE XXXIII. YOUNG MALE LOBSTER

The length of this young adult lobster was 65 mm., and the age approximately fourteen months. The lashes, or *endopodites*, of the second antennæ are longer than in the fourth stage—usually longer than the body. The *chelipeds* are differentiated, after the fifth stage, into the “nipping” and “crushing” claws, respectively. The atrophied stumps of the *exopodites* disappear from the thoracic appendages (except in the second and third maxillipeds) after the fifth stage.

THE HISTORY OF THE UNITED STATES

The history of the United States is a story of growth and change. It begins with the first settlers in the North and the Spanish explorers in the South. The American Revolution was a turning point in the nation's history. The Constitution was written to provide a framework for the new government. The Civil War was a struggle for freedom and equality. The Reconstruction period was a time of rebuilding and reform. The Gilded Age was a period of rapid industrialization and economic growth. The Progressive Era was a time of social reform and government intervention. The New Deal was a response to the Great Depression. The Cold War was a period of tension and conflict between the United States and the Soviet Union. The Vietnam War was a controversial conflict. The 1960s were a time of social and cultural change. The 1970s were a period of economic stagnation and social unrest. The 1980s were a time of economic recovery and conservatism. The 1990s were a period of economic growth and technological advancement. The 2000s were a time of political and social change. The 2010s were a period of economic recovery and technological advancement. The 2020s are a time of global challenges and uncertainty.

PLATE XXXIV. OLD MALE LOBSTER.

This specimen, whose age can not be accurately estimated, but can not be less than sixteen or eighteen years, was taken from a fish trap in the southern part of Narragansett Bay, where it had become entangled in the meshes. The massive crushing claw was larger than the whole cephalo-thorax, and shows well the development of the two great tubercles which, in the case of aged lobsters, alone remain. The cephalo-thorax was broad, but the head portion narrow. The eyes were small, scarcely larger than shoe buttons. The appendages were all intact, but much worn and stubby. The exoskeleton was extremely thick and heavy, deeply scarred, and beset with barnacles and molluscs, several of which had grown into the articular membranes between the joints of the chelipeds.

DISTRIBUTION OF THE CLAM SET.

The clam set and clam planting in the late summer of 1909 revealed an almost entire absence of sets on both shores from Field's Point southward to the Bonnet. Only a very few small areas even had what might be called a fairly good set, and only one place had a very abundant set and that was on the southerly shore of Field's Point. Here on September 29th a parcel of shore about the area of an acre contained in an average bit of soil (one foot square and 4 inches deep) 289 clams measuring about one-half inch in length, and the entire mess of clams measuring a pint and a half. From this parcel of shore the following places were planted: Kickemuit River, 16 bushels, on about one acre; Dyer's Island, 8 bushels on about one-quarter acre; Cornelius Island, 24 bushels on one and one-half acres; Point Judith Pond, one-half bushel, scattered.

E. W. BARNES.

State of Rhode Island and Providence Plantations.

JANUARY SESSION, 1909.

CHAPTER 437.

AN ACT IN SUBSTITUTION OF CHAPTER 969 OF THE PUBLIC LAWS, PASSED AT THE JANUARY SESSION, A. D. 1902, ENTITLED, "AN ACT IN SUBSTITUTION OF CHAPTER 857 OF THE PUBLIC LAWS, PASSED AT THE JANUARY SESSION, A. D. 1901, ENTITLED 'AN ACT FOR THE BETTER PROTECTION OF THE LOBSTER FISHERIES.' "

Passed May 7,
1909.

It is enacted by the General Assembly as follows:

SECTION 1. No person, either as principal, agent, or servant, shall, at any time, catch or take any lobster from any of the waters in the jurisdiction of this state, or place, set, keep, maintain, supervise, lift, raise, or draw in or from any of said waters, or cause to be placed, set, kept, maintained, supervised, lifted, raised, or drawn in or from any of said waters, any pot or other contrivance designed or adapted for the catching or taking of lobsters, unless licensed so to do as hereinafter provided. Every person who shall violate any of the provisions of this section shall be fined twenty dollars or be imprisoned not more than thirty days, or both, for each such offence.

Penalty for catching, possessing, etc., any lobsters, unless licensed so to do.

SEC. 2. The commissioners of inland fisheries may grant or refuse to grant licenses to catch and take lobsters from the waters within the jurisdiction of this state (in the manner, at the times, and subject to the regulations provided in this act), to such citizens of this state as have resided in this state for at

To whom licenses may be granted.

least one year next preceding the granting of such license, as they may think proper. Whenever any such license shall be granted, the same shall be granted to expire on the 15th day of November next succeeding the granting of the same, unless sooner revoked as hereinafter provided, and each person to whom such license shall be granted shall, for each license, pay to said commissioners the sum of five dollars for the use of the state. Said commissioners, in their annual report to the general assembly, shall state the number of licenses granted, with the names of the persons licensed and the amount of money received therefor. Said commissioners shall issue to each person licensed as aforesaid a certificate stating the name of the person to whom such license has been granted and the date of expiration of such license, and shall also issue to each person so licensed a metal badge in such form and bearing such inscription as said commissioners shall determine. If any person licensed as aforesaid shall, at any time, be adjudged guilty of any violation of any of the provisions of this act, after full hearing by said commissioners or a majority of them, the said commissioners or a majority of them shall revoke the license issued to such person, and such person shall thereupon cease to have any authority thereunder.

Each person licensed under the provisions of this act shall at all times while engaged in pursuit so licensed wear upon his person the badge issued him.

SEC. 3. Each person, licensed under the provisions of this act, shall, at all times, while engaged in the pursuit so licensed, wear upon his person the badge issued to him as provided in the preceding section, and shall, upon demand of any of said commissioners or any of their deputies, exhibit said badge and the certificate issued to him as provided in the preceding section. Every person violating any of the provisions of this section shall, for each offence, be fined five dollars.

SEC. 4. No negative allegations of any kind need be averred or proved in any prosecution brought under this act, but the respondent in any such action may show his license by way of defence.

SEC. 5. No person shall catch or take from any of the waters within the jurisdiction of this state, or have in his possession within this state, any lobster, cooked or uncooked, which is less than four and one-eighth inches in length, measured from the forward end of the bone projecting from the head to the rear end of the body shell. No person shall have in his possession within this state any female lobster bearing eggs, or from which the eggs have been brushed or removed. Every person violating any of the provisions of this section shall be fined five dollars for each such lobster; except that any person licensed under this act catching and taking any such lobster and immediately returning the same alive to the water from which it was taken shall not be subject to such fine. The possession of any such lobster, cooked or uncooked, shall be *prima facie* evidence that the same was caught and taken in violation of this section.

No lobster shall be taken from the waters of this state which is less than four and one-eighth inches.

SEC. 6. Each and every "lobster pot," so-called, set, kept, or maintained, or caused to be set, kept, or maintained, in any of the waters in the jurisdiction of this state, by any person licensed under this act, shall be plainly buoyed. Every person violating any of the provisions of this section shall be fined twenty dollars or be imprisoned not more than thirty days for each such offence, or both.

Each and every lobster pot set, kept, or maintained in the waters of this state by any person shall be plainly buoyed.

SEC. 7. No person licensed under this act shall use any pots for catching, or cars or other contrivance for keeping, lobsters unless the same and the buoys attached thereto are plainly marked with the name or names of the owners thereof, or the person or persons using the same, and the license number or numbers of such person or persons. Every person violating the provisions of this section shall be fined twenty dollars or be imprisoned not more than thirty days, or both, for each such offence, and all pots, cars, and other contrivance used contrary to the provisions of this and other sections of this act shall be

Penalty for using any pots for catching or cars or contrivance for keeping lobsters unless the same and the buoys attached thereto are plainly marked with the name or names of the owners thereof, or the persons using the same, and the license number or numbers of such persons.

seized by any officer engaged in the enforcement of this act, and said property shall be forfeited.

Close time on lobsters between November 15th in each year and the 15th day of April next succeeding.

SEC. 8. Between the fifteenth day of November in each year and the fifteenth day of April next succeeding, no person shall catch or take any lobster from any of the waters in the jurisdiction of this state, or place, set, keep, maintain, supervise, lift, raise, or draw, or cause to be placed, set, kept, maintained, supervised, lifted, raised, or drawn, in or from any of said waters, any pots or other contrivances designed or adapted for the catching or taking of lobsters. Every person violating any of the provisions of this section shall be fined twenty dollars or be imprisoned not more than thirty days for each such offence, or both.

SEC. 9. No person except the commissioners of inland fisheries and their deputies shall lift or raise any pot, belonging to any person licensed under this act, set for the catching or taking of lobsters, except with the permission of the owner or owners thereof and license so to do under this act. Every person violating any of the provisions of this section shall be fined ten dollars for each such offence.

Penalty for mutilating any uncooked lobster.

SEC. 10. No person shall mutilate any uncooked lobster by severing its tail from its body, or have in his possession any part or parts of any uncooked lobster so mutilated. Every person violating any of the provisions of this section shall be fined five dollars for each such offence, and in any and all prosecutions under this section the possession of any part or parts of any uncooked lobster, so mutilated, shall be *prima facie* evidence sufficient to convict.

Deputies to be appointed.

SEC. 11. The commissioners of inland fisheries shall appoint at least two deputies, whose duties shall be the enforcing of the provisions of this act. Each of said deputies appointed as aforesaid shall be, by virtue of his office, a special constable, and as such deputy may, without warrant, arrest any person found violating any of the provisions of this act, and detain such

person for prosecution not exceeding twenty-four hours. Said deputies shall not be required to enter into recognizance or become liable for costs.

SEC. 12. For the purpose of enforcing the provisions relative to the protection of lobsters, the commissioners of inland fisheries and their appointed deputies may search in suspected places, or upon any boat or vessel that they may believe is used in the catching or transporting of lobsters, and may seize and remove lobsters taken, held, or offered for sale in violation of the provisions of this act.

Deputies may search in suspected places or upon boat that they may believe is used in catching lobsters in violation of this act.

SEC. 13. Fines incurred under any of the provisions of this act shall enure one-half thereof to the use of the complainant and one-half thereof to the use of the state.

Fines, how to enure.

SEC. 14. The several district courts shall have concurrent jurisdiction with the superior court over all offences under this act, and to the full extent of the penalties therein specified; parties defendant, however, having the same right to appeal from the sentences of said district courts as is now provided by law in other criminal cases.

District courts, jurisdiction of.

SEC. 15. Chapter 969 of the Public Laws, passed at the January session, A. D. 1902, entitled "An act in substitution of Chapter 857 of the Public Laws, passed at the January session, A. D. 1901, entitled 'An act for the better protection of the lobster fisheries,'" and all acts and parts of acts inconsistent herewith are hereby repealed.

SEC. 16. This act shall take effect upon and after the first day of January, A. D. 1910.



LIST OF FEDERAL AND STATE FISHERIES AUTHORITIES.

DEPARTMENT OF COMMERCE AND LABOR.

BUREAU OF FISHERIES, WASHINGTON, D. C.

<i>Commissioner of Fisheries</i>	GEORGE M. BOWERS.
<i>Deputy Commissioner</i>	DR. HUGH M. SMITH.
<i>Chief Clerk</i>	IRVING H. DUNLAP.
<i>Chief, Division of Scientific Inquiry</i>	DR. BARTON W. EVERMANN.
<i>Chief, Division of Statistics and Methods</i>	ALVIN B. ALEXANDER.
<i>Chief, Division of Fish Culture</i>	R. S. JOHNSON.
<i>Architect and Engineer</i>	HECTOR VON BAYER.

ALABAMA.

DEPARTMENT OF GAME AND FISH.

John H. Wallace, Jr., *Commissioner*.....Montgomery.

ARIZONA.

FISH AND GAME COMMISSIONERS.

Phœnix, Arizona.

T. S. Bunch.....	Stafford.
E. A. Sliker.....	Flagstaff.
W. L. Pinney.....	Phœnix.

CALIFORNIA.

CALIFORNIA FISH COMMISSION.

San Francisco, California.

George Stone, <i>President</i>	San Francisco.
F. W. Van Sicklen.....	San Francisco.
M. J. Connell.....	Los Angeles.
Charles A. Vogelsang, <i>Chief Deputy</i>	San Francisco.

COLORADO.

DEPARTMENT OF GAME AND FISH.

Capitol Building, Denver, Colo.

David E. Farr, <i>Commissioner</i>	Denver.
C. W. Lake, <i>Deputy Commissioner</i>	Denver.
R. L. Spargur, <i>Chief Clerk</i>	Denver.
W. S. Kincaid, <i>Gen. Supt., State Hatcheries</i>	Denver.

CONNECTICUT.

COMMISSION OF FISHERIES AND GAME.

Room 66, State Capitol, Hartford.

George T. Mathewson, <i>President</i>	Thompsonville.
John M. Crampton.....	New Haven.
E. Hart Geer, <i>Secretary</i>	Hadlyme.

CONNECTICUT SHELL-FISH COMMISSION.

Rooms 301-303 Exchange Bldg., New Haven.

George C. Waldo.....	Bridgeport.
Christian Swartz.....	South Norwalk.
John H. Clarke.....	New Haven.

FLORIDA.

FLORIDA FISH COMMISSION.

John Y. Detwiler, <i>Honorary Commissioner</i>	New Smyrna.
--	-------------

GEORGIA.

SUPERINTENDENT OF FISHERIES.

A. T. Dallis.....	La Grange.
-------------------	------------

IDAHO.

FISH AND GAME DEPARTMENT.

Boise, Idaho.

W. N. Stephens, <i>Warden</i>	Boise.
Harry G. Dietrich, <i>Clerk</i>	Boise.
B. T. Livingston, <i>Chief Deputy</i>	Boise.

R. C. West, <i>Deputy</i>	Moscow.
James L. Dunford.....	Bloomington.

ILLINOIS.

BOARD OF FISH COMMISSIONERS.

Nat. H. Cohen, <i>President</i>	Urbana.
Henry Kliene.....	Chicago.
S. P. Bartlett, <i>Secretary and Superintendent</i>	Quincy.

INDIANA.

COMMISSIONER OF FISHERIES AND GAME.

Z. T. Sweeney.....	Columbus.
--------------------	-----------

IOWA.

George A. Lincoln.....	Cedar Rapids.
------------------------	---------------

KANSAS.

STATE FISH AND GAME WARDEN.

Prof. L. L. Dyche.....	Pratt.
------------------------	--------

LOUISIANA.

OYSTER COMMISSION OF LOUISIANA.

Rooms 609-611 Maison Blanche, New Orleans.

L. J. Dossman, <i>President</i>	New Orleans.
Clement Story.....	Violet, P. O.
Horace H. Harvey.....	Harvey, P. O.
F. E. Guidry.....	Houma.
A. E. Hoffman.....	Thibodaux.

BOARD OF BIRD, GAME, AND FISH COMMISSIONERS.

605 Maison Blanche Bldg., New Orleans.

Oscar Dowling, M. D.....	Shreveport.
Frank Miller, <i>Pres., Ex-officio Chief Warden</i>	New Orleans.
John D. Fisher.....	Baton Rouge.

MAINE.

COMMISSIONERS OF INLAND FISHERIES AND GAME.

Augusta, Maine.

Leroy T. Carleton, <i>Chairman</i>	Augusta.
J. W. Brackett.....	Phillips.
Edgar E. King, <i>Secretary</i>	Orono.

COMMISSIONER OF SEA AND SHORE FISHERIES.

James Donohue.....	Rockland.
--------------------	-----------

MARYLAND.

STATE FISH COMMISSION.

John H. Wade, <i>Commissioner for Western Shore</i>	Boomsboro.
Samuel Twilley, <i>Commissioner for Eastern Shore</i>	Pocomoke City.

SHELLFISH COMMISSION.

Annapolis, Md.

Walter J. Mitchell, <i>Chairman</i>	La Plata.
Benj. K. Green, <i>Treasurer</i>	Westover.
Dr. Caswell Grave, <i>Secretary</i>	Baltimore.

MASSACHUSETTS.

COMMISSION ON FISHERIES AND GAME.

State House, Boston, Mass.

Dr. G. W. Field, <i>Chairman</i>	Boston.
J. W. Delano, <i>Supt. of Hatcheries</i>	Boston.
George H. Garfield.....	Boston.

MICHIGAN.

STATE BOARD OF FISH COMMISSIONERS.

C. D. Josslyn, <i>President</i>	Detroit.
D. H. Power.....	Suttons Bay.
Fred. Postal.....	Detroit.
Seymour Bower, <i>Supt. of Hatcheries</i>	Detroit.

STATE GAME, FISH, AND FORESTRY WARDEN DEPARTMENT.

Charles S. Pierce, <i>Warden</i>	Lansing.
Charles N. Smith, <i>Chief Deputy Warden</i>	Lansing.

MINNESOTA.

BOARD OF GAME AND FISH COMMISSIONERS.

O. J. Johnson, <i>President</i>	St. Paul.
George J. Bradley, <i>Vice-President</i>	Norwood.
Jos. A. Wessel, <i>Second Vice-President</i>	St. Paul.
Robert Hannah, <i>Secretary</i>	St. Paul.
Henry A. Rider, <i>Executive Agent</i>	Little Falls.
S. F. Fullerton, <i>Supt of Fisheries</i>	St. Paul.

MISSISSIPPI.

BOARD OF OYSTER COMMISSIONERS OF MISSISSIPPI.

Gulfport, Miss.

Duncan Minor, <i>President</i>	Ocean Springs.
F. S. Hewes, Jr., <i>Secretary</i>	Gulfport.

MISSOURI.

MISSOURI STATE FISH COMMISSION.

L. A. Geserich, <i>President</i>	St. Louis.
T. N. McHaney, <i>Vice-President</i>	Kennett.
W. S. Willard, <i>Secretary</i>	St. Joseph.
Edward Willoughby.....	Windsor.
Richard Porter.....	Paris.

SUPERINTENDENTS OF HATCHERIES.

Phillip Kopplin.....	St. Louis.
M. E. O'Brien.....	St. Joseph.

MONTANA.

STATE GAME WARDEN.

W. F. Scott.....	Helena.
------------------	---------

MONTANA STATE FISH HATCHERY.

C. F. Healea, <i>Superintendent</i>	Anaconda.
---	-----------

NEBRASKA.

NEBRASKA GAME AND FISH COMMISSION.

Governor, <i>Commissioner ex-officio</i>	Lincoln.
Daniel Geilus, <i>Chief Warden</i>	State Capitol, Lincoln.
W. J. O'Brien, <i>Superintendent of Hatcheries</i>	Gretna.

NEW HAMPSHIRE.

FISH AND GAME COMMISSION.

Nathaniel Wentworth.....	Hudson Center.
Frank P. Brown.....	Whitefield.
Chas. B. Clark, <i>Secretary</i>	Concord.

NEVADA.

STATE FISH COMMISSION OF NEVADA.

Carson, Nevada.

George T. Mills, <i>Chairman</i>	Carson.
E. B. Yerington.....	Carson.
James Clark.....	Reno.

NEW MEXICO.

GAME AND FISH WARDEN.

Thomas P. Gable, <i>Warden</i>	Santa Fe.
--------------------------------------	-----------

NEW JERSEY.

FISH AND GAME COMMISSION.

B. C. Kuser, <i>President</i>	Trenton.
William A. Logue, <i>Treasurer</i>	Bridgeton.
Percival Chrystie.....	High Bridge.
Simeon H. Rollinson.....	West Orange.
Walter H. Fell, <i>Secretary</i>	West Orange.

STATE BUREAU OF SHELL FISHERIES.

Charles R. Bacon, <i>Chief</i>	Camden.
--------------------------------------	---------

STATE OYSTER COMMISSION.

Edmund Stites, Jr.....	Port Morris.
Jeremiah N. Ogden.....	Bridgeport.
William De Groff.....	Keyport.
Ogden Gandy.....	Dennisville.
Alanzo Bacon, <i>Supt. and Sec'y</i>	Mauricetown.

NEW YORK.

FOREST, FISH, AND GAME COMMISSION.

Albany, New York.

James S. Whipple, <i>Commissioner</i>	Albany.
J. Duncan Lawrence, <i>Deputy Commissioner</i>	Albany.
John D. Whish, <i>Secretary</i>	Albany.
Dr. T. H. Bean, <i>State Fish Culturist</i>	New York.
B. Frank Wood, <i>Supt. of Shell Fisheries</i>	Jamaica.
William F. Fox, <i>Supt. of Forests</i>	Albany.

NORTH CAROLINA.

STATE FISH COMMISSIONER.

Theodore S. Meekins.....	Maneto.
--------------------------	---------

SHELLFISH COMMISSIONER.

W. M. Webb.....	Morehead City.
-----------------	----------------

NORTH DAKOTA.

GAME WARDENS.

F. W. Schlechter.....	Fessenden.
William McKean.....	Sanborn.
R. W. Main, <i>State Fish Commissioner</i>	Cando.

OHIO.

FISH AND GAME COMMISSIONERS.

Paul North, <i>President</i>	Cleveland.
T. B. Paxton.....	Cincinnati.
D. W. Green.....	Dayton.
George McCook.....	Steubenville.

J. F. Rankin.....	South Charleston.
John C. Speaks, <i>Chief Warden</i>	Columbus.
G. C. Blanker, <i>Secretary</i>	Columbus.

OKLAHOMA.

TERRITORIAL GAME AND FISH WARDEN.

Eugene Watrous.....	Enid.
---------------------	-------

OREGON.

DEPARTMENT OF FISHERIES.

Oregonean Bldg., Portland, Ore.

Governor.....	Salem.
Secretary of State.....	Salem.
State Treasurer.....	Salem.

MASTER FISH WARDEN.

H. C. McAllister.....	Portland.
-----------------------	-----------

PENNSYLVANIA.

DEPARTMENT OF FISHERIES.

W. E. Meehan, <i>Commissioner</i>	Harrisburg.
John Hamberger.....	Erie.
Henry C. Cox.....	Wellsboro.
Andrew R. Whitaker.....	Phoenixville.
W. A. Leisenring.....	Mauch Chunk.

Rhode Island Commissioners of Inland Fisheries.

HENRY T. ROOT, <i>President, Treasurer and Auditor</i> ,	Providence, R. I.
J. M. K. SOUTHWICK, <i>Vice-President</i> ,	Newport, R. I.
WM. P. MORTON, <i>Secretary</i> ,	P. O. Box 966, Providence, R. I.
CHAS. W. WILLARD,	Westerly, R. I.
ALBERT D. MEAD,	Brown University.
ADELBERT D. ROBERTS,	P. O. Box 264, Woonsocket, R. I.
WM. H. BOARDMAN,	Central Falls, R. I.

James M. Rheth, <i>Chairman</i>	Beaufort.
L. M. Gasque.....	Marion.
George S. Mower.....	Newberry.

TENNESSEE.

STATE GAME AND FISH WARDEN.

Joseph H. Acklen.....Nashville.

TEXAS.

STATE GAME, FISH, AND OYSTER COMMISSION.

R. H. Wood, *Commissioner*.....Austin.

R. W. Lorance, *Deputy Chief*.....Austin.

UTAH.

STATE FISH AND GAME COMMISSIONER.

Fred W. Chambers.....Salt Lake City.

VERMONT.

DEPARTMENT OF FISHERIES AND GAME.

Henry G. Thomas, *Commissioner*.....Stowe.

VIRGINIA.

COMMISSION OF FISHERIES.

W. McDonald Lee, *Commissioner*.....Irvington.

S. Wilkins Matthews, *Secretary*.....Oak Hall.

George B. Keezell.....Keezletown.

J. M. Hooker.....

Bland Massie.....Tyro.

WASHINGTON.

DEPARTMENT OF FISHERIES AND GAME.

Board of Fish Commissioners.

Governor.....Olympia.

State Treasurer.....Olympia.

STATE FISH COMMISSIONER AND GAME WARDEN.

John L. Riseland, office, Daylight Block.....Bellingham.

WEST VIRGINIA.

FOREST, GAME, AND FISH WARDEN.

J. A. Viquesemy..... Bellington.

WISCONSIN.

COMMISSIONERS OF FISHERIES.

The Governor..... Madison.
 Calvert Spensley, *President*..... Mineral Point.
 James J. Hogan, *Vice-President*..... La Crosse.
 E. A. Birge, *Secretary*..... Madison.
 William J. Starr..... Eau Claire.
 Henry D. Smith..... Appleton.
 Jabe Alford..... Madison.
 A. A. Dye..... Madison.

WYOMING.

WYOMING FISH COMMISSION.

Theodore Tregoning, *Commissioner, District No. 1*..... Laramie.
 C. W. Morgareidge, *Commissioner, District No. 2*..... Wolf.

GENERAL SUBJECT INDEX

TO THE

REPORTS OF THE COMMISSIONERS OF INLAND FISHERIES

OF THE

STATE OF RHODE ISLAND.

1897-1909.

N. B.—For additional references to all species of fishes, see Index to List of Fishes of Rhode Island, Report for year 1909, page 173. For all crabs not mentioned in this index, see Notes on the Crabs of Narragansett Bay, Report for 1908, page 56.

	Report for the Year.	Page.
A.		
Abundance of Fishes.....	1904	15
" Affected by cannon firing.....	1908	12
<i>Achirus fasciatus</i>	{ 1907	68
	{ 1907	83
<i>Alectis ciliaris</i>	1906	66
Alewives.....	{ 1898	11
	{ 1900	19
	{ 1901	10
	{ 1902	15
	{ 1903	15
American Sole, The (See Sole).....	1907	83
<i>Ammodytes americanus</i>	1906	66
<i>Anguilla chrysypa</i> (See Fishes of Rhode Island, VII).....	1908	43
Artificial Hatching—Flat-fish.....	1901	16
(See Lobster, and Clam.)		
Artificial Culture and Growth of the Lobster.—Paper by Prof. Ehrenbaum, Heligoland.....	1907	14
Authorities, Fisheries, State and Federal.....	1909	199
B.		
<i>Balistes carolinensis</i>	1906	67
Bass, Striped.....	1909	177
Beach Clam.....	{ 1909	15
	{ 1909	183

	Report for the Year.	Page.
Bibliography of the Eel Literature.....	1908	54
Bibliography of Literature on Crabs.....	1908	78
	1898	15
	1901	18
	1902	24
	1903	23
	1905	29
Biological Survey.....	1907	46
	1908	11
	1908	41
	1909	10
	1909	33
	1897	4
	1898	6
	1899	7
Black Bass.....	1900	8
	1901	10
	1902	14
	1904	10
	1905	13
	1899	9
Blue Fish.....	1900	18
	1901	12
	1905	17
Boats in Lobster Fishery (See Lobster).		
Bonito.....	1906	33
Breeding Periods of Marine Animals.....	1898	9
Butter-fish.....	1909	177
Butterfly Ray.....	1900	57

C.

Cannon firing, Effect on Abundance of Fishes.....	1908	12
<i>Caranx hippos</i>	1905	67
	1906	66
Chub Mackerel.....	1906	33
Clam—		
“ Abundance of.....	1906	81
Effect of Abundance on Growth.....	1906	83
“ Abundance of, in 1869.....	1908	5
“ Artificial Fertilization.....	1900	23
	1903	30
	1898	81
“ Attachment of Clam.....	1898	83
	1903	34

	Report for the Year.	Page.
Clam— <i>Continued.</i>		
	1898	93
“ Breeding Season.....	1900	23
	1902	32
	1903	30
	1898	85
“ Burrowing of.....	1898	89
	1900	27
	1903	35
“ Rate of Burrowing	1900	27
	1903	46
“ Byssus Thread.....	1898	89
	1899	36
“ Commercial Value (See Statistics).		
	1898	91
“ Culture.—Collection of Young.....	1900	24
	1901	23
	1899	17
“ “ Experiments in Methods.....	1901	28
	1902	33
	1903	41
“ “ By Mr. Alexander.....	1901	33
	1898	90
“ “ Points Bearing on Clam Culture.....	1899	35
	1906	83
	1901	27
“ “ Transplanting.....	1902	35
	1903	43
	1903	63
“ “ Value.....	1908	13
	1902	42
“ Effect of Digging on Clam Ground.....	1905	105
	1906	83
“ Eggs of.....	1901	21
	1898	56
	1898	93
	1899	28
“ Enemies of.....	1901	22
	1902	31
	1902	43
	1903	38
“ Paddler Crab.....	1902	46
“ Exhaustion of Clam-beds, Causes of.....	1903	37
“ Food.....	1901	23

	Report for the Year.	Page.
Clam— <i>Continued.</i>		
“ Growth and Age of Clams.....	1899	34
	1900	22
	1903	35
	1906	83
“ Growth, Rate of Growth.....	1899	29
	1900	38
	1901	21
	1902	33
	1903	54
	1904	28
“ Habits of the Young Clam.....	1898	78
	1899	23
“ Industry in Rhode Island (See Statistics).....	1909	14
“ Law.....	1909	14
“ Life History of the Common Clam.—Paper by Prof. James L. Kellog.....	1898	78
“ Migration of Young to the Mud.....	1898	84
“ Natural History of the Clam.....	1898	78
	1901	21
	1902	29
	1903	29
“ Observations on the Soft-Shelled Clam.—Papers by A. D. Mead, Ph. D.—		
First Paper.....	1899	20
Second Paper.....	1900	21
Third Paper.....	1901	20
Fourth Paper.....	1902	29
Fifth Paper.....	1903	29
“ Sets of Clams.....	1899	27
	1900	20
	1902	26
	1903	27
	1904	26
	1905	105
	1906	81
	1907	92
	1909	14
“ Sex of Clams.....	1900	24
“ Shore in Narragansett Bay Suitable for Clams.....	1899	21
“ Spawning of Clams.....	1899	23
	1900	23
	1901	21
	1903	30

	Report for the Year.	Page.
Clam— <i>Continued.</i>		
“ Statistics of Yield of Clams in the New England States, (1880–1892).....	1899	20
“ Summary of Natural History of the Clam and of Methods of Culture.....	1903	29
	1899	19
	1899	21
	1902	26
	1903	27
“ Survey of Shores for Clam Sets.....	1904	26
	1905	103
	1905	105
	1906	83
“ Tenacity of Life of Young.....	1898	92
	1897	5
	1898	11
	1898	12
Cod.....	1900	19
	1905	17
	1906	19
“ Enemy of the Lobster.....	1900	19
Commercial Fisheries, Importance of (See Statistics).....	1907	6
Commissioners of Fisheries, State and National.....	1907	117
	1907	118
Commissioners of Rhode Island Fisheries, Establishment of....	1908	4
	1908	14
Committee of Investigation of Fisheries, 1869.....	1908	4
	1908	5
Conger (See Fishes of R. I., VII).....	1908	43
Congress, International Fishery. (See International.)		
Co-operation of State Fish Commissioners.....	1908	14
	1909	16
Copepoda, New Species.....	1906	69
Copepoda of Rhode Island.....	1906	69
Crab.....	1903	69
	1908	66
Commercial Value (See Statistics).		
Enemy of Clam?.....	1902	46
The Natural History of the Crab (Paddler).—Paper by E. W. Barnes.....	1903	69
Distribution.....	1903	69
Breeding Season.....	1903	69
Migrations.....	1903	71
Moulting.....	1903	70
Soft-Shelled Crab Industry in Rhode Island.....	1903	72

	Report for the Year.	Page.
Crabs.—Notes on the Crabs of Narragansett Bay. Paper by Walter E. Sullivan.....	1908	56
Larval Forms.....	1908	57
Economic Value.....	1908	58
Classification.....	1908	59
Bibliography.....	1908	78
Crevallé.....	1906	66
Culture. (See Clams, Fish, Lobster.)		
Cutlas Fish.....	1900	58
<i>Cynoscion regalis</i> , Young of.....	1907	85
(See also Squeteague.)		
D.		
<i>Dasyatis centrura</i>	1906	65
Diatoms, List of, in Rhode Island.—Paper by Lothrop and Ma- son.....	1899	53
Dogfish, Spiny.....	1904	15
Dredging by Fish Hawk, in Narragansett Bay.....	1898	19
E.		
Eel, Common. (See Fishes of R. I., VII).....	1908	43
Eel, Conger. (See Fishes of R. I., VII).....	1908	43
Exhibit at Alaska-Yukon Exhibition, Seattle.....	1909	16
Exhibit at Louisiana Purchase Exposition.....	1903	84
Exhibit at Jamestown Exposition.....	1906	9
Exhibit at the Pan American Exposition.....	1901	53
Exhibit for Washington County Agricultural Association.....	1904	5
(See Sea Farming.)	1905	6
	1906	9
	1907	115
	1908	13
	1909	15
Exhibit at Wickford Experiment Station.....	1909	16
Experiment Station of R. I. Fish Commission (See Laboratory).		
	1897	6
	1898	10
Extermination of Fishes by Over-fishing.....	1899	15
	1900	16
	1905	21
F.		
Fauna of Rhode Island (See Crabs, Fishes, Mollusca, etc.).		
File Fish.....	1906	68
Fish Culture.....	1907	8
	1908	15

	Report for the Year.	Page.
Fish Culture, A Method of.—Paper by A. D. Mead.....	1908	80
Fisheries, Authorities, State and Federal (See Authorities).		
Fisheries, Commission of. (See Commission of Fisheries.)		
Fisheries, Commercial. (See Commercial and Statistics.)		
Fisheries, Scientific Investigation of.....	1909	19
(See Biological, Physical, etc.)		
Fishes, List of, in Narragansett Bay.....	1899	46
“ Addition to List of.....	1900	57
Fishes of Rhode Island, List of.....	1909	35
Fishes of Rhode Island, The.—Papers by Henry C. Tracy—		
I. A List of Fishes of Rhode Island.....	1905	38
II. The Common Fishes of the Herring Family.....	1905	100
III. The Fishes of the Mackerel Family.....	1906	33
IV. Rare Fishes Taken in 1906.....	1906	65
V. The Flat-Fishes.....	1907	47
VI. A Description of Two Young Specimens of Squeteague (<i>Cynoscion regalis</i>), with notes on the rate of their growth.....	1907	85
VII. The Life History of the Common Eel.....	1908	43
VIII. Annotated List of Fishes known to Inhabit the waters of Rhode Island.....	1909	35
Fishes, Transportation of Live Fishes.....	1908	105
(See Fish Culture, A Method of.)		
Fish Fauna of Rhode Island.....	1909	12
	1909	35
Fishing, Traps, off Newport, 1905-1909.....	1909	177
Flat-Fish.....	1900	19
	1905	17
	1907	47
Flat-Fish, The Rusty.....	1907	78
	1907	64
Flounder, The Four-Spotted.....	1907	63
	1907	77
Flounder, The Winter.....	1907	65
	1907	79
Flounder, The Summer.....	1907	63
	1907	76
Food, Sources of Marine.....	1909	11
Foreign Notices of Methods of Rhode Island Fish Commission. (See Lobster, Foreign Notices.)		
Frigate Mackerel.....	1906	59
G.		
Goose Fish.....	1909	167
“ Young of.....	1899	45

	Report for the Year.	Page.
H.		
<i>Gymnodinium peridinium</i>	1908	10
(See Red Water Plague.)		
Halibut.....	{ 1900 1907 1907	59 61 70
Hardtail.....	1906	66
Herring.....	1898	11
Herring Family, Common Fishes of.....	1905	100
<i>Hippoglossoides platessoides</i>	{ 1907 1907	62 74
<i>Hippoglossus hippoglossus</i>	{ 1900 1907 1907	59 61 70
Horse Mackerel.....	{ 1905 1905 1906 1909	17 21 60 177
" Commercial Value. (See Statistics.)		
I.		
Illegal Capture of Lobsters.....	{ 1901 1902 1903 1904 1905 1905 1906 1909	51 83 83 32 110 116 85 8
International Fishery Congress.....	1908	14
" Visit to Experiment Station, Wickford.....	1908	15
Interstate Conferences of Fish Commissioners.....	1908	15
K.		
Kingfish.....	{ 1906 1909	33 177
L.		
Laboratory and Equipment of the R. I. Fish Comm.....	{ 1899 1900 1901 1902 1903 1904 1909 1909	4 4 4 78 4 36 17 186
<i>Lagocephalus lœvigatus</i>	{ 1900 1906	58 68

	Report for the Year.	Page.
	1907	127
Law, Fisheries Laws of Rhode Island.....	1908	14
	1909	5
	1909	9
“ Revised Lobster Law.....	1909	193
	1909	9
<i>Leptocephalus</i> , special paper, Life History of the Eel.....	1908	43
<i>Leptocephalus conger</i> , special paper, Life History of the Eel.....	1908	43
Light, Influence of, Upon Larval and Adolescent Stages of <i>Ho-</i>	1905	237
<i>marus americanus</i>	1906	181
	1907	64
<i>Limanda ferruginea</i>	1907	78
Line Fishing, Influence of Trap Fishing Upon.....	1899	15
List of Crabs of Narragansett Bay.....	1908	56
List of Diatoms in Rhode Island.....	1899	53
List of Fishes of Rhode Island.....	1909	35
“ Index to.....	1909	173
List of Mollusca in Rhode Island.....	1905	30
List of Papers published by R. I. Fish Commission.....	1909	229
List of Rare Fishes Taken in 1906.....	1906	65
	1900	58
<i>Lobotes surinamensis</i>	1906	67
Lobster—		
“ Abnormal Appendages.....	1906	99
	1898	96
	1899	43
	1901	33
“ Abundance.....	1902	55
(See Statistics of Commercial Fisheries.)	1905	130
	1908	7
	1908	17
In Newfoundland.....	1908	9
“ Boats, Number of Engaged in Fishery.....	1908	31
	1909	32
“ Breeding Habits.....	1902	58
	1905	127
“ Culture.....	1905	135
	1902	75
	1905	135
	1906	91
“ “ Artificial Hatching.....	1907	11
	1907	96
	1908	16
	1909	17
	1909	186

		Report for the Year.	Page.
Lobster—Continued.			
	<i>Culture.—Continued.</i>		
"	"	Artificial Culture and Growth of the Lobster. —Paper by Prof. Ehrenbaum, Helgoland.	1907 14
"	"	Early Experiments in Rearing.....	1898 96
"	"	Evidence of Value of.....	{ 1908 7 { 1908 17 { 1908 133
"	"	Experiments in Germany.....	1903 6
"	"	Experiments on Later Stages.....	{ 1904 37 { 1906 88 { 1900 71 { 1901 39 { 1902 76 { 1902 82
"	"	Experiments with Stirring Apparatus.....	{ 1903 7 { 1903 75 { 1904 33 { 1905 136 { 1909 17 { 1909 186
"	"	Foreign notices of methods of R. I. Fish Commission.....	{ 1907 9 { 1907 14 { 1908 15 { 1899 44
"	"	Food.....	{ 1900 68 { 1905 146 { 1909 18
"	"	The Problem of Feeding in Artificial Lobster Culture.—Paper by Victor E. Emmel, Ph. D.....	1907 98
"	"	Fourth Stage, Number of— Per Egg Lobster.....	1906 91 { 1902 75 { 1903 78
"	"	Liberation of Fry.....	{ 1905 148 { 1906 93 { 1907 96
"	"	Method of Lobster Culture.—Paper by A. D. Mead.....	1908 107 { 1898 96 { 1901 38
"	"	Mortality of Fry.....	{ 1901 45 { 1904 34 { 1904 39 { 1909 18

	Report for the Year.	Page.
Lobster— <i>Continued.</i>		
Culture.— <i>Continued.</i>		
“ “ Report on Lobster Culture in 1905.....	1905	111
“ “ Report on Lobster Culture in 1906.....	1906	88
“ “ Report on Lobster Culture in 1907.....	1907	93
“ “ Report on Lobster Culture in 1908.....	1908	16
“ “ Report on Lobster Culture in 1909.....	1909	18
Development—		
Additional Notes upon the Development of the Lobster.—Paper by Philip B. Hadley. (See also Larval Lobsters).	1909	189
Distribution.....	1902 1905	58 123
Enemies.....	1905	103
Feeding, The Problem of, in Artificial Lobster Culture.	1907 1909	98 18
Fifth Stage—		
“ “ Experiments in Rearing of.....	1906	88
“ “ Habits of.....	1906	89
“ “ Number liberated by R. I. Fish Commis- sion since 1900.....	1907	97
Fishermen, number and income of.....	1908	10
“ “ Nationality of.....	1908	11
Fishery in Helgoland.....	1907	25
Fishery, Value of, in Rhode Island.....	1908	10
“ “ Statistics of Men, Boats, and Pots.....	1908 1908	10 31
Food.....	1905	124
Fourth Stage—		
“ “ Number liberated by R. I. Fish Com- mission 1898–1908.....	1908	17
“ “ Number liberated in 1909.....	1909	18
Growth.....	1905 1905	125 153
“ “ Of Sexes.....	1905	186
Larval Lobsters—		
“ “ Feeding Habits.....	1900 1905 1899 1901 1905	68 146 44 38 146
“ “ Food.....	1905 1906 1907 1909	208 175 98 18

Lobster—Continued.		Report for the Year.	Page.
	Larval Lobsters—Continued.		
"	" Form Changes.....	1904	46
"	" Habits.....	{ 1900	65
		{ 1901	36
		{ 1902	62
		{ 1905	136
"	" Influence of Light Upon.....	{ 1905	237
		{ 1906	181
		{ 1909	18
"	" Length of Stages.....	{ 1900	63
		{ 1901	36
		{ 1905	148
"	" Moulting.....	{ 1900	67
		{ 1901	37
		{ 1904	39
		{ 1905	125
		{ 1905	259
"	" Parasites.....	{ 1900	73
		{ 1902	82
		{ 1903	77
		{ 1905	207
"	" Regeneration.....	{ 1904	81
		{ 1905	258
"	" Stomachs of.....	1906	169
"	" Structure.....	{ 1900	62
		{ 1901	36
		{ 1905	127
"	Law, Revised Lobster Law.....	{ 1908	136
		{ 1909	193
"	" Enforcement of.....	{ 1908	9
		{ 1909	8
(See Protection.)			
"	Light, Influences of—Observations on Some Influences of Light Upon the Larval and Adolescent Stages of <i>Ho-</i> <i>marus americanus</i> .—Papers by Philip B. Hadley—		
	First Paper.....	1905	237
	Second Paper.....	1906	181
"	Limits of Size and Age.....	{ 1902	73
		{ 1905	125
"	Migrations.....	{ 1902	71
		{ 1903	79
	(See Tagging of Lobsters.)	{ 1905	124
"	Mortality.....	{ 1901	47
		{ 1904	39

Lobster.— <i>Continued.</i>	Report for the Year.	Page.
	1904	39
	1905	125
“ Moulting.....	1905	156
	1905	181
	1905	258
“ Natural History of the Lobster—		
Habits and Growth of Young Lobsters.		
First Paper by Dr. A. D. Mead.....	1900	61
Habits and Growth of Young Lobsters.		
Second Paper by A. D. Mead.....	1901	35
Habits and Growth of the Lobster.		
Third Paper by Mead and Williams.....	1902	57
Natural History of the Lobster.		
Paper by E. W. Barnes.....	1905	120
“ Number of 4th-and 5th-Stage Fry Liberated Since 1900.	1907	96
	1901	47
“ Observations on Late Stages.....	1902	62
	1905	128
	1905	164
“ Color Changes of Late Stages.....	1904	40
	1904	56
“ Pots, Number of.....	1908	8
“ “ Catch per Pot, 1904–1908.....	1908	8
“ Protection.....	1905	131
	1907	7
	1907	12
“ “ Legal Restrictions (See Lobster, Law).....	1905	131
	1906	85
	1908	9
	1902	73
“ Rate of Growth.....	1905	178
	1906	97
“ Regarding the Rate of Growth of the American Lobster		
—Paper by Phillip B. Hadley.....	1905	153
“ Regeneration.....	1904	41
	1904	81
	1905	126
“ Regeneration of Lost Parts in the Lobster—Paper by		
Victor E. Emmel.....	1904	81
“ Regenerated and Abnormal Appendages in the Lobster		
—Paper by Victor E. Emmel.....	1906	99
“ The Relation of Regeneration to the Moulting Process		
of the Lobster—Paper by Victor E. Emmel.....	1905	258
“ Sexes, Proportion of.....	1902	60
“ Sexual Maturity.....	1905	126

	Report for the Year.	Page.
Lobster— <i>Continued</i>		
“ Size at Maturity..... (See Limits of Size and Age.)	1902	60
“ Spawning Habits.....	1905	127
“ Stomach—The Stomach of the Lobster and the Food of Larval Lobsters.—Paper by Leonard W. Wil- liams, Ph. D.....	1906	153
	1897	7
	1898	7
	1899	10
	1900	10
	1901	11
	1902	16
	1903	14
“ Statistics of Commercial Fisheries.....	1904	13
	1905	15
	1906	22
	1907	35
	1908	7
	1908	28
	1909	6
	1909	23
	1902	71
	1903	79
	1904	41
“ Tagging of Lobsters.....	1905	114
	1905	150
	1906	92
	1906	95
Lookdown.....	1906	67
<i>Lophopsetta maculata</i>	1907	66
	1907	82
M.		
	1897	5
	1899	9
Mackerel.....	1901	12
	1906	19
	1909	177
“ Fishes of Mackerel Family.....	1906	33
<i>Mactra solidissima</i>	1909	15
	1909	183
	1899	9
	1900	18
Menhaden.....	1901	12
	1905	17
	1906	19

	Report for the Year.	Page.
Menhaden Disease.....	{ 1904	16
	{ 1905	17
	{ 1906	19
Mollusca, List of, in Rhode Island.....	{ 1905	30
	{ 1905	79
	{ 1905	95
<i>Monacanthus hispidus</i>	1906	68
<i>Mya arenaria</i> (See Clam).		

N.

Narragansett Bay. (See Biological, Dredging, Physical, Providence River, etc.)		
<i>Neverita</i>	{ 1902	45
	{ 1903	39

O.

Ostracoda of Rhode Island.....	1906	69
Oysters.....	{ 1898	16
	{ 1901	18
" As Food for Starfish.....	{ 1897	21
	{ 1898	55
" At Point Judith Pond.....	{ 1901	18
	{ 1902	24
" Culture.....	1908	13
" Commercial Value. (See Statistics.)		

P.

Papers published by R. I. Fish Commission.....	1909	229
<i>Paralichthys dentatus</i>	{ 1907	63
	{ 1907	76
<i>Paralichthys oblongus</i>	{ 1907	63
	{ 1907	77
<i>Pecten</i> (See Scallop).		
Perch, White.....	{ 1900	10
	{ 1905	11
<i>Peridinium</i>	{ 1898	32
	{ 1900	56
	{ 1908	11
	{ 1909	11
(See Red Water Plague.)		
Phyllopora of Rhode Island.....	1906	69

	Report for the Year.	Page.
Physical Examination—	{ 1898	15
“	{ 1901	18
“	{ 1902	24
“ of Narragansett Bay.....	{ 1903	23
“	{ 1905	29
“	{ 1908	11
“	{ 1908	41
“	{ 1909	10
(See Dredging.)		
“ At Point Judith Pond.....	{ 1901	18
“	{ 1902	24
“	{ 1903	26
Plankton.....	1909	11
(See <i>Peridinium</i> .)		
Pollock.....	{ 1905	17
“	{ 1905	21
Pollution of Narragansett Bay.....	1908	12
Porpoise, Commercial Value. (See Statistics.)		
Providence River, Physical and Biological Conditions of.....	{ 1898	17
“	{ 1908	12
<i>Pseudopleuronectes americanus</i>	{ 1907	65
“	{ 1907	79
<i>Pteroplatea maclura</i>	1900	57
Puffer, Smooth.....	{ 1900	58
“	{ 1906	68
Pug-nosed Shiner.....	1906	67
Q.		
Quahaug.....	1900	6
“ Habits and Life History of the Quahaug.—Paper by A. K. Krause.....	1902	49
“ Commercial Value. (See Statistics.)		
R.		
Rare Fishes Taken in 1906.....	1906	65
Red Water Plague.....	{ 1898	31
“	{ 1900	56
“	{ 1901	17
“	{ 1902	23
“	{ 1908	11
“	{ 1909	11

	Report for the Year.	Page.	
Regeneration in the Lobster.....	1904	81	
Relation to the Moulting Process.....	1905	258	
Regenerated Appendages.....	1906	101	
Relief Map.....	1898	96	
Restriction of the Lobster Fisheries.....	} 1907	7	
		1907	12
Rhode Island Commission of Fisheries, Establishment of. (See Commissioners.)			
Rough Dab.....	} 1907	62	
		1907	74
S.			
Salinity of Water.....	} 1898	16	
		1898	93
		1905	29
Salmon, Land-Locked.....	} 1897	4	
		1898	6
		1899	8
	1900	9	
Sand-Dab.....	} 1907	66	
		1907	82
Sand Lance.....	1906	66	
Scabbard Fish.....	1900	58	
Scallop—Habits and Life History of the Scallop.—Paper by Jonathan Risser.....	1900	47	
Scup.....	} 1897	5	
		1898	10
		1899	16
		1900	18
		1904	11
		1905	17
	1905	21	
	1906	19	
	1909	177	
Sea Clam. (See Beach Clam.)			
Sea Farming, Exhibition of Results of.....	} 1908	13	
(See also Exhibit for Washington Co. Agricultural Asso'n.)		1909	15
Sea Robin.....	1909	177	
Sea Snail.....	} 1902	45	
		1903	39
Seaweed Industry of Japan.....	} 1908	13	
		1909	11
<i>Selene vomer</i>	1906	67	

	Report for the Year.	Page.	
Shad.....	}	1900	10
		1901	9
		1902	15
		1903	26
		1904	10
		1905	4
		1906	18
	1907	32	
Shad, Hickory.....	1900	18	
Sharks, Commercial Value (See Statistics).			
Sole, The American.....	}	1907	68
		1907	83
Sounds, Commercial Value (See Statistics).			
Spanish Mackerel.....	1906	33	
Spawn, Commercial Value (See Statistics).			
Spawning Ground of Fishes.....	}	1897	6
		1905	22
Spring and Summer Trap Fishing off Newport, 1905-1909.....	1909	177	
Squeteague.....	}	1897	5
		1898	11
		1899	9
		1899	16
		1900	18
		1904	11
		1904	15
	1905	17	
	1909	177	
" Young of.....	1907	85	
Squid.....	1909	177	
Starfish—			
" Distribution.....	}	1897	14
		1898	34
		1898	38
" Enemies.....	}	1897	25
		1898	68
" Food.....	}	1897	19
		1898	42
		1898	55
" Feeding Habits.....	}	1897	19
		1898	43
" Larval Period.....	}	1897	25
		1898	47
		1898	53

	Report for the Year.	Page.
Starfish— <i>Continued.</i>		
“ Methods of Destruction.....	} 1897 1898	28
		74
“ Mode of Life.....	} 1897 1898	16
		40
“ Rate of Growth.....	} 1897 1898	25
		58
“ Regeneration.....	} 1897 1898	26
		69
“ Size and Age.....	} 1897 1898	25
		66
“ Spawning Season.....	} 1897 1898	24
		44
“ Species.....	} 1897 1898	14
		38
“ Young.....	1898	47
“ “ Habits of.....	} 1897 1898 1898 1898	24
		47
		50
		53
State Fisheries, Authorities (See Authorities).		
	1897	7
	1898	7
	1899	10
	1900	10
	1901	11
	1902	16
Statistics of the Commercial Fisheries.....	1903	14
	1904	12
	1905	15
	1906	20
	1907	33
	1908	28
	1909	5
“ By Years, Since 1887.....	1909	20
Sting Ray.....	1906	65
Sturgeon.....	} 1905 1906	17
		21
“ Commercial Value. (See Statistics.)		
Sword Fish.....	} 1904 1905 1906	15
		17
		21
“ Commercial Value. (See Statistics.)		

T.	Report for the Year.	Page.
Tarpon.....	1900	57
	1906	65
	1897	5
	1898	11
Tautog.....	1900	17
	1901	12
	1904	11
	1905	17
Temperature of Water. (See Physical Examination.)		
Thread Fish.....	1906	66
	1898	99
	1899	42
Tile Fish.....	1900	45
	1905	17
Times of Arrival and Departure of Food Fishes..... (See List of Fishes of Rhode Island.)	1899	9
<i>Trichiurus lepturus</i>	1900	58
Transportation of Live Fishes.....	1908	105
Trap Fishing off Newport, 1905-1909.....	1909	177
	1898	9
Traps.....	1903	16
	1904	14
	1905	21
	1908	7
“ Distribution of.....	1908	32
	1909	30
Traps, Influence of, on Line Fishing.....	1899	15
	1900	16
	1898	12
	1899	11
	1900	11
	1901	13
	1902	18
	1903	16
Traps, Location of.....	1904	18
	1905	22
	1906	24
	1907	38
	1908	32
	1909	7
	1909	24
Traps, Number of, from 1898-1909.....	1908	33
	1909	7

	Report for the Year.	Page.
Trigger Fish.....	1906	67
Triple-Tail.....	1900	58
	1906	67
Trout.....	1897	4
	1899	7
	1900	8
	1901	9
	1902	14
	1903	13
	1904	10
	1905	13
	1906	18
	1907	5
Turtles, Commercial Value (See Statistics).	1907	32
	1908	4
	1909	4

U.

United States Bureau of Fisheries.....	1909	199
--	------	-----

V.

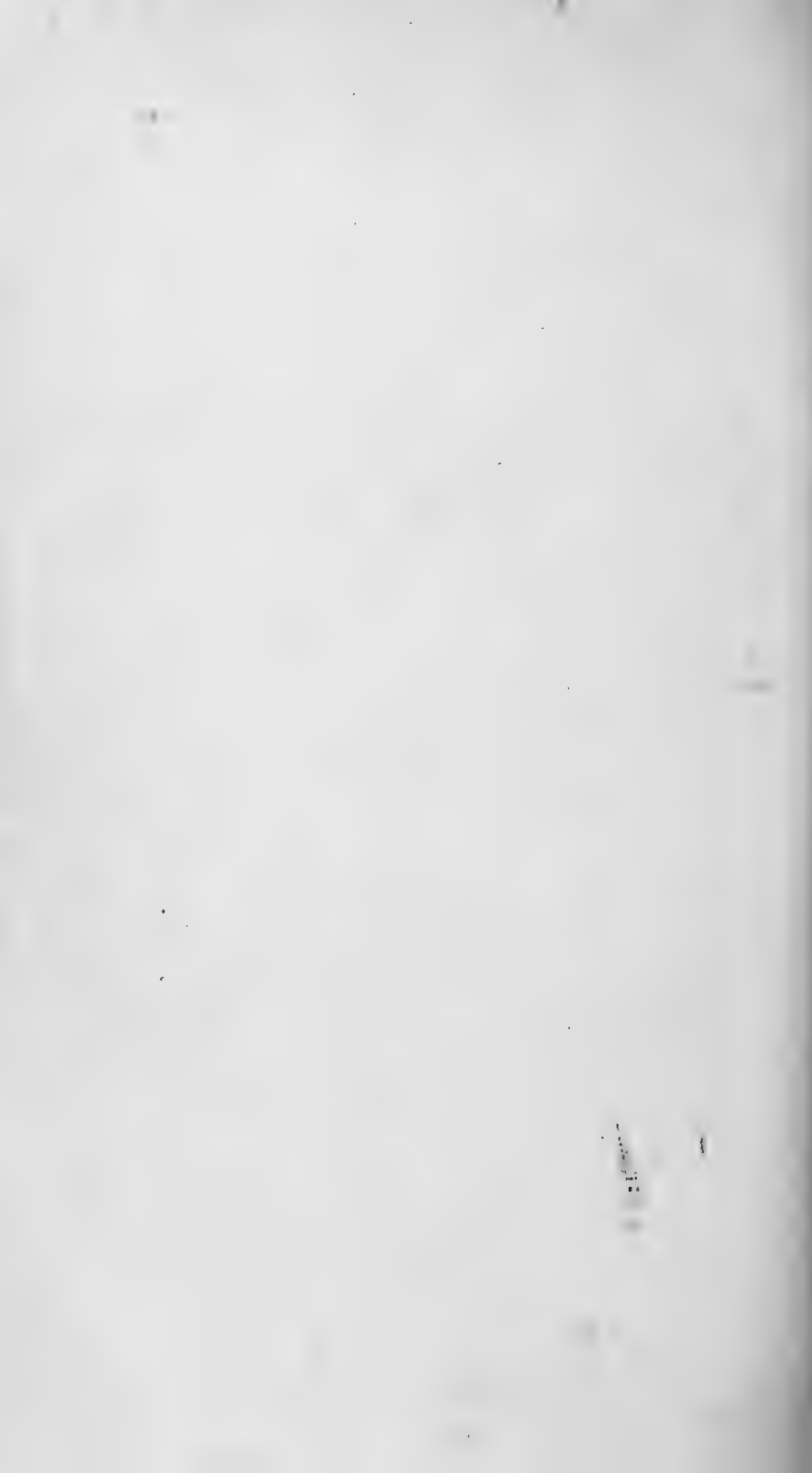
<i>Venus mercenaria.</i> (See Quahaug.)		
<i>Vomer setipinnis</i>	1906	67

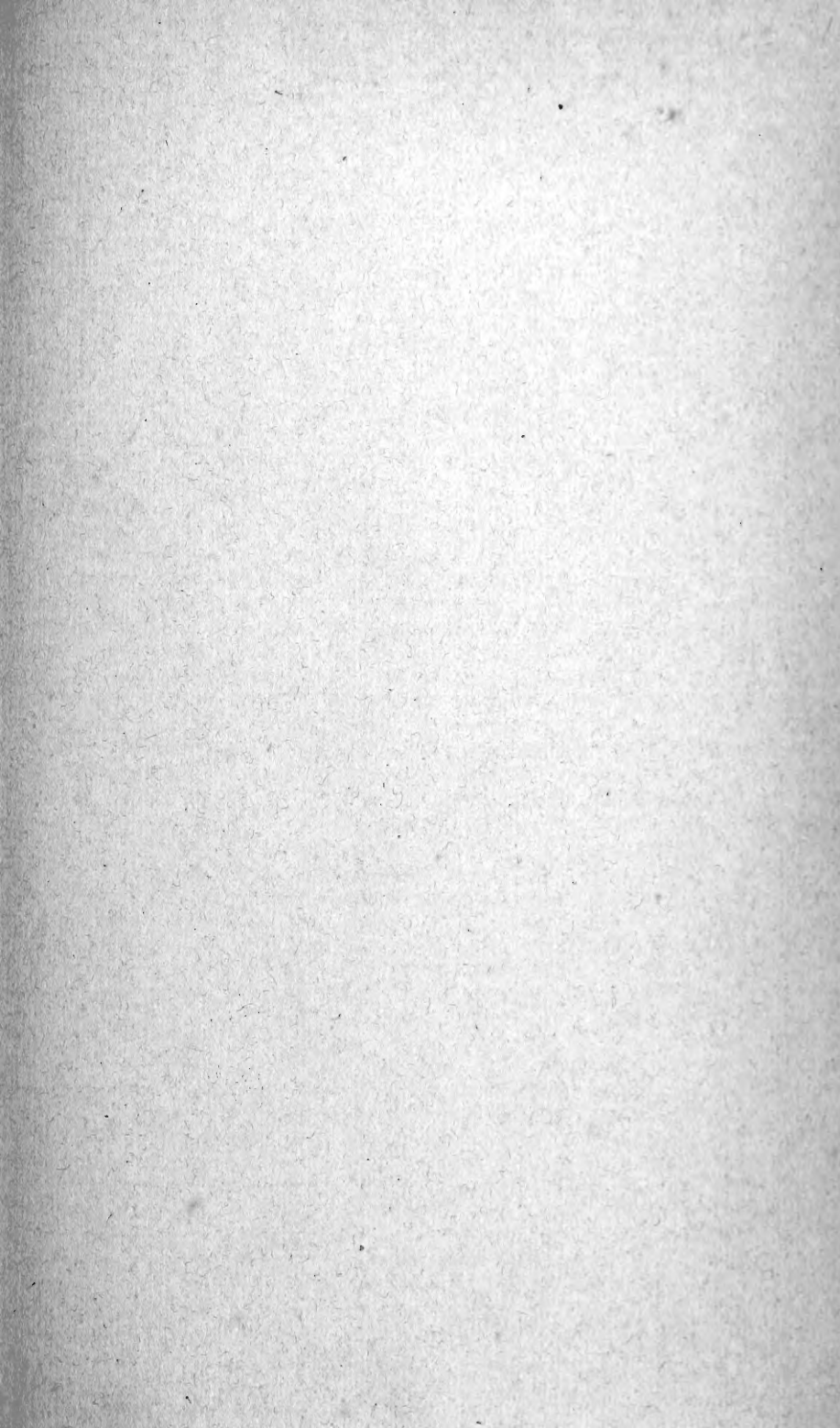


**TITLES OF SPECIAL PAPERS PUBLISHED IN THE ANNUAL
REPORTS OF THE COMMISSIONERS OF INLAND FISHERIES OF THE STATE OF RHODE ISLAND.**

1. MEAD, A. D. The Starfish. (First paper.) Twenty-eighth Annual Report. 1898.
2. MEAD, A. D. The Starfish. (Second paper.) Twenty-ninth Annual Report. 1899.
3. TOWER, R. W. Improvements in the Methods of Preparation of Fish for Shipment. Twenty-ninth Annual Report. 1899.
4. BUMPUS, H. C. The Extension of the Commercial Fisheries of the State. Twenty-ninth Annual Report. 1899.
5. KELLOG, J. L. The Life History of the Common Clam. Twenty-ninth Annual Report. 1899.
6. MASON, N. R. A List of the Diatoms Found in the Water over the Clam, Mussel, and Oyster Beds in Narragansett Bay. Thirtieth Annual Report. 1900.
7. MEAD, A. D. Observations on the Soft-shell Clam. Thirtieth Annual Report. 1900.
8. MEAD, A. D. Observations on the Soft-shell Clam. (Second paper.) Thirty-first Annual Report. 1901.
9. RISSER, J. R. H. Habits and Life History of the Scallop. Thirty-first Annual Report. 1901.
10. MEAD, A. D. Habits and Growth of Young Lobsters and Experiments in Lobster Culture. Thirty-first Annual Report. 1901.
11. MEAD, A. D. Observations on the Soft-shell Clam. (Third paper.) Thirty-second Annual Report. 1902.
12. MEAD, A. D. Habits and Growth of Young Lobsters and Experiments in Lobster Culture. (Second paper.) Thirty-second Annual Report. 1902.
13. MEAD, A. D. and WILLIAMS, L. W. Habits and Growth of the Lobster and Experiments in Lobster Culture. (Third paper.) Thirty-third Annual Report. 1903.
14. MEAD, A. D. and BARNES, E. W. Observations on the Soft-shelled Clam. (Fourth paper.) Thirty-third Annual Report. 1903.
15. MEAD, A. D. and BARNES, E. W. Observations on the Soft-shell Clam. (Fifth paper.) Thirty-fourth Annual Report. 1904.
16. BARNES, E. W. Preliminary Inquiry into the Natural History of the Paddler Crab (*Callinectes hastatus*) with Remarks on the Soft-shell Crab Industry of Rhode Island. Thirty-fourth Annual Report. 1904.
17. MEAD, A. D. Experiments in Lobster Culture. (Fourth paper.) Thirty-fourth Annual Report. 1904.
18. MEAD, A. D. Experiments in Lobster Culture. (Fifth paper.) Thirty-fifth Annual Report. 1905.
19. HADLEY, P. B. Changes in Form and Color in Successive Stages of the American Lobster. Thirty-fifth Annual Report. 1905.
20. EMMEL, V. E. The Regeneration of Lost Parts in the Lobster. Thirty-fifth Annual Report. 1905.
21. TRACY, H. C. A List of the Fishes of Rhode Island. Plates I-XII. Thirty-sixth Annual Report. 1906.
22. TRACY, H. C. The Common Fishes of the Herring Family. Plates VII-XII. Thirty-sixth Annual Report. 1906.

23. BARNES, E. W. Methods of Protecting and Propagating the Lobster, with a Brief Outline of its Natural History. Plates XIII-XXVI and XXVIII, XXXI, XXXII, XXXVI. Thirty-sixth Annual Report. 1906.
24. HADLEY, P. B. Regarding the Rate of Growth of the American Lobster. Plates XXVI-XXXVII, and XL. Thirty-sixth Annual Report. 1906.
25. HADLEY, P. B. Observations on Some Influences of Light upon the Larval and Early Adolescent Stages of *Homarus Americanus*. Plates XXXVIII-XL. Thirty-sixth Annual Report. 1906.
27. EMMEL, V. E. The Relation of Regeneration to the Molting Process in the Lobster. Plates XL-XLI. Thirty-sixth Annual Report. 1906.
28. TRACY, H. C. The Fishes of Rhode Island, III. The Fishes of the Mackerel Family. Thirty-seventh Annual Report.
29. TRACY, H. C. A List of Rare Fishes taken in Rhode Island in the year 1906. Thirty-seventh Annual Report.
30. WILLIAMS, DR. LEONARD W. List of the Rhode Island Copepoda, Phyllopoda, and Ostracoda, with new species of Copepoda. Thirty-seventh Annual Report.
31. EMMEL, V. E. Regenerated and Abnormal Appendages in the Lobster. Thirty-seventh Annual Report.
32. WILLIAMS, L. W. The Stomach of the Lobster and the Food of Larval Lobsters. Thirty-seventh Annual Report.
33. HADLEY, P. B. Regarding the Behavior of the Larval and Early Adolescent Stages of the American Lobster. Thirty-seventh Annual Report.
34. BARNES, E. W. Lobster Culture at Wickford, Rhode Island, in 1906. Thirty-seventh Annual Report.
35. BARNES, E. W. Lobster Culture at Wickford, Rhode Island in 1907. Thirty-eighth Annual Report, 1907.
36. TRACY, H. C. The Fishes of Rhode Island V. The Flatfishes. Thirty-eighth Annual Report, 1907.
37. TRACY, H. C. The Fishes of Rhode Island VI. A Description of two young Specimens of Squeteague (*Cynoscion regalis*) with Notes on the Rate of their Growth. Thirty-eighth Annual Report, 1907.
38. EMMEL, VICTOR E. The Problem of Feeding in Artificial Lobster Culture. Thirty-eighth Annual Report, 1907.
39. TRACY, H. C. The Fishes of Rhode Island VII. The Life History of the Common Eel. Thirty-ninth Annual Report 1908.
40. SULLIVAN, W. E. Notes on the Crabs Found in Narragansett Bay. Thirty-ninth Annual Report, 1908.
41. MEAD, A. D. A Method of Fish Culture and of Transporting Live Fishes. Thirty-ninth Annual Report, 1908. (Paper Presented Before the Fourth International Fishery Congress, Washington, 1908, and Awarded Prize of Two Hundred Dollars in Gold.)
42. MEAD, A. D. A Method of Lobster Culture. Thirty-ninth Annual Report, 1908. (Paper Presented Before the International Fishery Congress Washington, 1908, and Awarded Prize of One Hundred Dollars in Gold.)
43. TRACY, H. C. Annotated List of Fishes Known to Inhabit the Waters of Rhode Island. Fortieth Annual Report, 1909.
44. BARNES, E. W. Notes on the Spring and Summer Fishing in Deep Water off Newport, During the Years 1905-1909. Fortieth Annual Report, 1909.
45. BARNES, E. W. The Plague of Sea Clams at Easton's Beach, Newport. Fortieth Annual Report, 1909.
46. HADLEY, P. B. Additional Notes Upon the Development of the Lobster. Fortieth Annual Report, 1909.







MBL WHOI LIBRARY



WH 1700 X

5074

