PUBLIC DOCUMENTS

OF THE

STATE OF MAINE

BEING THE

REPORTS

OF THE VARIOUS

PUBLIC OFFICERS
DEPARTMENTS AND
INSTITUTIONS

FOR THE TWO YEARS

JULY 1, 1924-JUNE 30, 1926

FOURTH BIENNIAL REPORT

OF THE

Commission of Sea

AND

Shore Fisheries

OF THE

STATE OF MAINE

1926

STATE OF MAINE

BIENNIAL REPORT

DEPARTMENT OF SEA AND SHORE FISHERIES

Rockland, Me.,

To the Honorable Governor and the Executive Council:

Sirs:

We have the honor to transmit herewith, in compliance with the law, the report of H. D. Crie, Director of Sea and Shore Fisheries, for the year ending June 30, 1926, together with such additional statements as the Commission has made.

Fred B. Spear, Eastport,
Charles H. Cahill, Bath,
William H. Thurston, McKinley,
COMMISSION.

By H. D. Crie,
Director.

Approximate Amount Expended by the Department of Sea and Shore Fisheries

July 1st, 1924 to July 1st 1925

"Salaries and Clerk Hire"		$4,338.33
"General Office Expenses"		
Rent of Office	$393.75	
Electricity	13.20	
Printing	234.05	
Janitor Service	45.00	
Equipment	110.23	
Director's Traveling Expenses	927.85	
Commissioners' Traveling Expenses	671.75	
Miscellaneous, (Telephone Bills, Office Supplies, Stamps, etc.)	625.80	
		$3,021.63
"Pay & Expenses of Wardens"		
Wardens' Salaries	$28,400.60	
Wardens' Expenses	9,567.05	
Repairing and operating boats, including machine shop bills, rent of wharves, boats, etc.	6,828.52	
		$44,796.17
"Purchase of Seed Lobsters"		$8,816.39
"Propagation of Shell Fish"		
Fuel for Boat	$11.25	
Groceries for Boat	115.03	
Gasoline for Boat	10.92	
Salaries of Men	1,999.20	
Expenses of Men	15.15	
		$2,151.55

July 1st, 1925 to July 1st, 1926.

"Salaries and Clerk Hire"		$4,141.17
"General Office Expenses"		
Rent	$450.00	
Electricity	12.16	
Printing	557.92	
Stamps and Envelopes	410.20	
Equipment	62.35	
Director's Traveling Expenses	1,063.07	
Commissioners' Traveling Expenses	462.87	
Miscellaneous, (Telephone Bills, Office Supplies, etc.)	461.36	
		$3,479.93
"Pay and Expenses of Wardens"		
Wardens' Salaries	$25,038.60	
Wardens' Expenses	8,741.49	
Repairing and operating boats, including machine shop bills, rent of boats, wharves, etc.	7,118.56	
		$40,898.65

"Purchase of Seed Lobsters"		$13,999.57
"Propagation of Shell Fish"		
Groceries for Boats	$28.02	
Gasoline for Boats	59.48	
Salaries of Men	2,324.80	
Expenses of Men	83.75	
Repairs	3.12	
		$2,499.17

APPROPRIATIONS ASKED FOR NEXT TWO YEARS

	July 1, 1926. to July 1, 1927.	July 1, 1927. to July 1, 1928.
"Salaries and Clerk Hire"	$5,000.00	$5,000.00
"General Office Expenses"	3,600.00	3,600.00
"Pay and Expenses of Wardens"	50,000.00	50,000.00
"Purchase of Seed Lobsters"	20,000.00	20,000.00
"Propagation of Shell Fish"	2,500.00	2,500.00

PREVIOUS APPROPRIATIONS

	July 1, 1924. to July 1, 1925.	July 1, 1925. to July 1, 1926.
"Salaries and Clerk Hire"	$5,000.00	$5,000.00
"General Office Expenses"	3,000.00	3,000.00
"Pay and Expenses of Wardens"	40,000.00	40,000.00
"Purchase of Seed Lobsters"	15,000.00	15,000.00
"Propagation of Shell Fish"	2,500.00	2,500.00

AMOUNT RECEIVED FROM FINES AND LICENSES

	July 1, 1924. to July 1, 1925.	July 1, 1925. to July 1, 1926.
Fines	$1,935.00	$1,980.00
Licenses	478.00	540.00
	$2,413.00	$2,520.00

	July 1, 1924. to July 1, 1925.	July 1, 1925. to July 1, 1926.
Number of Licenses issued	4,392	4,620

Why Every Fisherman Should Be Licensed.

The importance of the great Sea & Shore Fisheries is not fully realized by a majority of the inhabitants of the state of Maine, because we have been unable up to this time to obtain a correct statistical report. In years past the wardens were required to visit the different firms doing a fish business and procure all the data they could from them, also get all the information they could from the fishermen. This was a very unsatisfactory method to pursue because one was liable to get an account of a fisherman's catch from the man who caught the fish and also from the firm that bought the fish. It is almost impossible for a warden to see all the fishermen in the isolated places where they live and in olden days many of the fishermen considered the wardens their worst enemies and would not give them a correct report of their catch. As a result the report that was procured was not worth the paper it was written on. Fishermen do not always like to have their good catches or poor catches advertised so would not give any report and they were not to blame at all, because when a number of men gather statistics some are liable to talk more than they should about some of the good catches, the fishermen would hear of it and next time a warden asked for a report he would not get it. If a report was forwarded to the office that would not be liable to occur because the office force have no special interest in any particular locality or person.

Every fisherman and every person interested in the fisheries should know first hand if the different kinds of fish are increasing at a good healthy growth or are decreasing annually, and the only way we can be sure of this is by an annual statistical report obtained from each individual fisherman. This can be done only by licensing each man that makes a business of fishing, and when a man applies for a license require him to give the amount and value of his equipment and when he renews his license at the expiration of the fiscal year or when he retires from the fishing business render a report of his catch on blanks furnished by the department, said report to be a correct copy of records kept by

him on a pamphlet furnished by the department, having said report sworn to before a Justice of the Peace or Postmaster. If the legislature will pass such a law requiring every fisherman to be licensed and to render reports of equipment, catch in value and pounds we will then know accurately the amount of the annual catch, the number of men employed, the value of equipment, and the annual increase or decrease. Until such a law is enacted we will be drifting regarding the magnitude of our fisheries as we have been in the past.

We also believe that each fisherman should contribute a small amount for the support and maintenance of the Department of Sea & Shore Fisheries, and if a fee of two dollars should be charged for each license it would not work a hardship on any fisherman and he would have the satisfaction of feeling that he was contributing to the support of the department.

Eat More Fish

It is very important that the people of the state of Maine should know more definitely about the value of the fisheries because they furnish an abundance of the most wholesome food on which we live. They not only furnish food for the people of Maine but large quantities are shipped over the United States into practically every state in the Union.

People go to the markets in their immediate vicinity and order fish enough for a meal without any thought really of where the fish come from or who produced them. They should know more about the food values of fish, the medicinal properties of the different kinds, the species that contain fats and those that have practically no fats, so that when the wives order their dinners they will know just what kind to order.

Fish in reality is a healthy diet and more fish should be eaten, especially by elderly people because too much meat is not the proper food for them while fish furnishes food and medicine in just the right proportions to insure health. Mackerel, Herring and Shad are among the species most commonly used containing fats while Cod, Hake and Haddock contain very little fats. Fish of some kind can be procured fresh nearly every day in the year so it is not necessary to be without a fish diet. Cod, Hake and Haddock are caught all the year but in winter they are not

always as easy to obtain because the fishmen have to go out into the bosom of mother ocean to catch them and when severe storms sweep the coast they cannot fish at all.

When fishermen leave their homes in winter and go to the banks to obtain food for the people on land it should be realized that they not only endure severe hardships but are constantly facing the perils of the sea, which may mean that they will never return, so when we are kicking because cod and haddock are expensive please remember what the fishermen have to go through to provide them for us. However, there is another kind that can be obtained during the winter months and those, though smaller in size furnish an abundant supply of food and also furnish employment for thousands of people who would otherwise have little to do at that time of year. The farmer who lives near a river or bay that is frozen over during the winter months has a chance to make some real money catching smelts, and occasionally you will find the good wife with her husband enjoying the sport of catching these fish and helping procure a nest egg, so called, to be put in the bank for the time of need.

Smelts are caught through the ice and each fisherman has a little house with a small stove in it that he fishes in, so that storms have little or no effect on the smelt business. There 5,151 rivers, streams and inlets within the limits of Maine and many of them are dotted with smelt houses. Often you will see twenty-five in a group and in some localities there are a hundred, so it is hard to estimate the value and importance of this branch of our great fisheries.

This specie should be preserved for two important reasons, first it furnishes a fish diet when cod and haddock are expensive and hard to get and second it furnishes employment for thousands of people who would otherwise be out of employment during the winter months.

The clams that we dig from the flats along the coast line of Maine are very important as a food. I am afraid that we do not half appreciate our God-given resources, such as the clams because they are so easy to obtain and oftentimes we do not realize that protection is necessary, until some day when we go to the shores and are unable to dig a pail of clams as we have always done in previous years.

Clams today are a cheap article of food and can be obtained from the markets nearly every day in the year so it is not necessary to be without a fish diet either in winter or summer. It is estimated that there are ten thousand acres of flats capable of producing clams enough to feed every person in Maine two meals per day, if properly cultivated and protected.

In winter eels are caught by fishing through the ice with a spear, while in summer they are caught in pots so they too help to furnish an all the year round fish diet. There are many other species that can be obtained from the coastal waters of Maine that go to make up a complete list of good wholesome cheap food, and as God gave the different kinds of fish to furnish food and produce health why not avail ourselves of this great privilege and eat more fish.

Tax on Gasoline Used by the Fishermen

We who have lived on the coast of Maine have watched from childhood the gigantic waves of the broad Atlantic dash against the rugged shores and break into spray as they met the rocks and cliffs which have bid defiance to mother ocean. For centuries the sea has met that challenge with fury and untiring force and for ages the great bluffs have come forth with crowns of victory, only to enter another challenge when a southeast gale sweeps the coast. As fall approaches and winter swings into line those challenges are repeated and although the shore withstands the battling fury of the monsters, property suffers a tremendous loss and the fishermen always pay the giant shares of such destruction. Many are the fishermen who go to bed at night, only to be awakened by a howling gale, and realize that the fishing gear that they have entrusted to mother ocean is being swallowed up because the high winds have angered her to such an extent that she now rolls and tosses and runs before the dreaded foe, the wind increasing in velocity until the ocean is rolling and tossing into a boiling mass of waves, mountain high.

For weeks at a time fishermen wait for a chance to go to their property or to the place where they last placed it, only to find that the ocean has swallowed up fifty percent of it and at times, practically all of it. Occasionally after a storm a fisherman finds

himself entirely out of business. Such is the life of the men who furnish the most wholesome food on which we live.

These worthy, weather-beaten citizens should be encouraged in every possible way instead of being discouraged by imposing a gasoline tax on them, to help build and repair the roads of which they seldom have any use. Is it fair to make these men contribute to such an enterprise, and should we take from them, that surplus which they are trying to get together for time of need?

A fisherman's life is filled with disappointments, with hazards and with destruction, but never was disappointment more keenly felt than when he was confronted by a gasoline tax. Nothing could be more unjust, nothing could be more discouraging to a person who braves the sea to furnish food.

Let us all work together with one thought always in mind, and that to relieve the fishermen of the tax on gasoline and in so doing lighten their burdens and give them courage and a feeling that we appreciate the good work they are engaged in.

I am afraid that a majority of the people of Maine do not half appreciate the part the fishermen are playing in the food supply. We go to the markets and purchase vegetables for the table and we all know where and how they are produced because we often see a nice garden or an acre of potatoes or a half acre of cabbages, from our automobiles as we travel the country highway, but it is different with the fishermen because they leave their homes and go out on the ocean far beyond our vision to catch the food that they furnish. If the tax that they pay made the roads they travel any smoother, the tax would be justified but it does not and when a tax is levied on them it makes their roads just that much rougher.

A fisherman's life is not as pleasant as is sometimes pictured. They generally leave home at the dawn of day with the fog often so thick that it is impossible to see more than a few hundred feet away. They go out among the rocks and ledges, taking their lives in their hands to obtain a sufficient amount to furnish their families with the necessities of life and to bridge them over the rough days when they cannot fish. If every day was pleasant, nearly everyone would enjoy fishing but only a few of the three hundred and sixty-five are pleasant ones so the fishermen have to take many chances in order to keep the wolf from the door and give their children an education.

When war was declared the fishermen stepped forward at once, took command of the ships and did their part to hasten the close of the great world war. Courage was necessary to travel a road that was infested with the enemies' submarines but the fishermen did not lack this courage for if they had, they never could have earned their daily bread by fishing.

Now that the war is over, are we to forget in a few short years the prominent part that these fishermen played in that great conflict, or are we going to show our appreciation of that splendid work by repealing the law which imposed a tax on gasoline used by the fishermen in the engines that power their boats?

I believe every legislator in 1927 will feel it his solemn duty to amend the law by striking out the section that imposes a tax on gasoline used in fishing boats. If they will do that they will show the fishermen that the great work done by them in the past is being appreciated.

Assets of the Fishing Industry

From the pen of Hon. L. B. Thompson, retiring Commissioner who was very active during his term of office and was a very valuable man to the Department.

"I wish every citizen of our State could visit along the coast from Kittery to Eastport, almost 2,500 miles, and see for themselves what an asset the fishing industry is to the State. I wish they could visit the villages where so many of these hardy fishermen make their homes and raise their families to succeed them in serving the many millions of people all over our United States that depend on fish for food. I wish they could become acquainted, and mingle with, these faithful men and women, to understand a little better the conditions under which they live, and, for the most part, prosper. It would, undoubtedly, be a revelation to many, if they could but live among them for a short time.

There are approximately 5,000 lobster fishermen, who make a business of fishing for this crustacean. This means about 20,000 people being supported by that branch alone. This is probably the largest branch of our coastal industry. Maine produces more lobsters than any other state on the coast. Isn't it then worth developing and protecting? There are probably 7,000 more engaged in the other branches of the fishing industry, making all together, in round numbers, 12,000 heads of families depending on the products of the sea for their livelihood, or, roughly, 50,000 people along the coast of Maine being supported in this manner.

One branch of the industry that is given very little thought of, except by the ones who are actively engaged in it, is smelts. There is no doubt in my mind but what Maine is one of the largest producers of smelts, but there has never been any real constructive work done among these smelt fishermen to increase the catch or develop this field commercially. This is only one instance of the many that should be studied by the Sea & Shore Fisheries Commission with a view toward scientific development and protection. I believe that the State, through its Legisla-

ture, should provide ample funds for the Commission to work with.

And just a word relative to this Commission. Years ago, when all kinds of sea foods were plentiful and very little, if any, thought was given to the future possibilities, there was no State control, and probably little need for it; but, it was later realized that, in order to save the fishing industry, the State must take a hand. Therefore, a Commissioner of Fisheries was appointed by act of the Legislature, and, until 1917, this office was known as the Commissioner of Sea & Shore Fisheries. During all these years there had been no one man in office long enough to fully test his theories, as at every change of the administration, a new man was appointed. In 1917, by act of the Legislature, a commission of three men was formed, and, with the exception of about one year, when he was a member of the Commission, himself, the same individual has had charge of directing the management of the department, although the personnel of the Commission has changed several times. Mr. H. D. Crie, as Director of the Commission, has done very efficient work. He has gained the goodwill of everybody concerned. Under the "one-man" commission, no such constructive work was even attempted as has been done in the last eight or nine years. It would be very unwise for the Legislature to go back to the old form.

One of the most important things for any state agency to have is accurate statistics gathered by reliable agents over a period of years. This phase of the work has never been done by the Department of Sea & Shore Fisheries with satisfactory results, principally because they have no way to gather the correct figures in any of the branches of the fishing industry. To my mind, it is indeed important that the 1927 Legislature enact a license law, requiring every fisherman, regardless of what he fishes for, to be licensed, and a small fee to be charged for the license. These fees to be turned over to the Department of Sea & Shore Fisheries for use in that Department, thereby furnishing a larger amount of money to carry on constructive development work. Every licensee should be required to render a true account of all gear used by him, the amount of his catch, and what other figures the department might wish for, at least once in every six months. This would enable the department to get records and statistics that would be of value.

As I said at the beginning, lobsters are a very important branch of our coastal industry. It would seem that any money spent by the State to study the possibility of increasing this sea food, would be well invested. I believe at a small expense, a rearing station could be maintained, such as is now in operation in Rhode Island; and our shores filled with young lobsters that have reached the bottom seeking stage, and whose chances are a thousand times better to become mature. When you stop to think that only about one in 8,000 to 10,000 eggs hatched live to maturity, and this because the fry is of a pelagic variety and remains on the surface of the water where it is a prey for all kinds of fish for the first three weeks of its life, where, if it could be protected until this stage of its early life was past, its chances of surviving would be many times greater.

Scallops are another important sea food that should be given some thought, as our old beds are being depleted, and new ones are not being found, or established. Much constructive work can, and should be done. There are several sections along our coast where great scallop beds have been almost, if not entirely, depleted, because there has never been any restrictions governing the taking of this valuable product of the sea. To my mind the beds have been literally smothered by the shells being dumped directly over the beds, whereas, if the shells were taken far out to sea and dumped, this damaging effect would be eliminated. At a small cost, new scallop beds could be created, new permanent beds could be located, but they should be protected by proper legislation, or the expense would be in vain. What is true of the scallops, is also true of other products of our coast. I only mention a few of the most common ones: clams, smelts, salmon, alewives, and ground fish.

I am afraid that a large percentage of the citizens of our good state lose sight of the fact that the fishing industry is second only to agriculture, and we are spending large sums of money each year studying new methods and improvements for the farm, but for the fishermen, the State appropriates only a few thousands of dollars, and the greater part of that is expended to protect just one branch of the industry, the lobsters. It is easy enough to plant an acre of corn, or beans, and study its growth; trace, develop, or eliminate strains in animal life; but to study the life habits of a cod, or lobster, in its natural environments down at

the bottom of the sea, is quite a different matter, so that funds expended for the benefit of our fishermen, will show results only after careful experiments. Let me call your attention to one experiment which has proven successful. In 1918, when Mr. Crie became associated with the Department, he began to liberate berried, or seed lobsters when, and where they were caught, thus allowing the eggs to hatch under natural conditions. In 1925, seven years after, or when the lobsters would reach a length of about eight or nine inches, it was found that many more lobsters were being caught, and in 1926 our lobster catch was the largest on record, which is pretty sure proof that it pays to give the lobsters a fair chance.

There has been in the past several attempts to bring about a better understanding between the Northern Atlantic States and Canada relative to the fishing industry. The progress has been slow, and the results small, but by persistent endeavors great things can be accomplished. As Maine is the leader in many of the sea products, its Sea & Shore Fisheries Commission should take a very prominent part in fostering a union of interests which undoubtedly would in time achieve untold advantages.

Just one more point I want to call to your attention. At the present time all migratory fish are under the joint supervision of two state departments, the Sea & Shore Fisheries Commission, and the Inland Fish & Game Department. This is wrong, as the one department has full authority in tide waters, and the other in fresh water, so that neither can carry on constructive programs within itself. Furthermore, the interests are divided, and no particular stress is laid on these migratory fish by either department. It makes little difference which state department, the Sea & Shore Fisheries Commission, or the Inland Fish & Game Commission, has control, but surely it should be vested in one or the other, and I sincerely hope the proper legislation will be enacted in the 1927 Legislature to bring about this change.

Long may our coastal fisheries prosper.

Only Asking for an Appropriation Necessary to do Efficient Work.

In making an estimate for the different appropriations for the department of Sea & Shore Fisheries we are asking only for an amount sufficient to enable us to do efficient work.

This department is too valuable an asset to the State of Maine to be run on the poor house scale, as it has had to be run for the past six years. Approximately 60,000 people depend entirely on the fisheries for their livelihood. There are about 12,000 fishermen engaged in the production of this wholesome food on which we live.

It has been said that the Inland Fish and Game Department is self-supporting but when this department is used in comparison with the Sea & Shore Fisheries, the fact that it has a large income from fines and licenses should not have any bearing whatever on the appropriations for the commercial fisheries, because one is entirely a sport and derives its income from the sporting world who have money to spend above the actual necessities of life, while the other is composed of poor working men who depend solely on the income derived from their fishing for their existence.

The fisheries furnish food and the only other department of the state capable of comparison is Agriculture which also furnishes food. These two departments are the backbone of our state because we could not exist if it were not for them, for food is necessary to sustain life. We have never heard that the department of Agriculture was self-supporting and we feel that any department that furnishes the necessities of life should have an appropriation large enough to enable it to do good work.

We are only asking for an increase in the "General Office Expenses," "Pay & Expenses of Wardens" and "Purchase of Seed Lobsters." The other appropriations remain the same as they have been for the past few years.

It is necessary to increase the "General Office" appropriation because there is always printing to be done before and after the Legislature and the appropriations allowed for 1925 and 1926 were hardly sufficient to take care of the necessary running expenses, not including the printing.

The appropriation for "Pay & Expenses of Wardens" is the general fund from which the wardens' salaries and their expenses when away from home are paid. The expense of operating and repairing boats used by the department is also included in this appropriation.

Unless this appropriation is increased we will be obliged to lay off a number of wardens during the winter and put others on half time as we have been obliged to do in the past. Whenever this is done the men lose their interest especially if they have large families, as many of them have, because they are not earning an amount sufficient to defray expenses.

The most of our wardens are getting only $3.00 per day and a subsistance allowance of 60c per day when away from home on boats, and unless we can have the amount asked for we shall lose some of our most valuable men and a change spells "inefficiency," because we now have good efficient men, trained to the work.

The "Seed Lobster Appropriation" should be large enough to allow us to purchase every seed lobster taken from the pounds and caught by the fishermen because there is no other way that lobsters can be increased so rapidly as by this method, and unless this practice is continued, what are we going to do with the army of lobster fishermen on our coast who depend entirely on the lobster industry for their livelihood?

The present Director has had nine years experience with the Department of Sea & Shore Fisheries and has been working among the fishermen all his life and now feels that this amount asked for should be allowed because it is actually needed to enable the department to do efficient work.

Habits and Instincts of the Adult Lobster.

The sea bottom is the natural abode of the lobster, as it is of all the large and heavy Crustacea, the source of its food and the scene of all its activities, from the close of free pelagic life to old age. Its external world is the ocean floor, to which it reacts, and it knows no other. While its powers of locomotion are considerable, it never forsakes the water of its own accord or leaves the bottom, to which nature has consigned it by giving it a heavy body and a sedentary disposition. Lobsters wander close to the shore and out to depths of over a hundred fathoms, and the

nature of the bottom, or more directly the supply of food, as well as the physiological condition of the animals, especially in respect to their molting periods, determine their abundance within these limits in any locality.

The supply of food, the temperature of the water, and in general the physical conditions of the environment vary greatly throughout the range of this animal, as one might infer from a study of the coast line. From Labrador to Maine the coast is very rugged, deeply indented with bays, and studded with islands, some of which present perpendicular walls to the sea. The coast of Maine, particularly in its eastern and middle sections is essentially bold, rocky, and diversified to an extraordinary degree by deep channels, extensive bays, and inlets of all kinds, and these are studded with rock-ribbed, spruce-clad islands. The geological formation is pre-Cambrian, the rocks being mainly granites. From 10 to 30 miles from the shore we find large and important islands standing alone or closely related, as Monhegan Island and the Vinalhaven and Matinicus groups. All are essentially masses of granite, which in some cases have been cut by glacial forces into archipelagoes; they abound in basins and channels of various kinds, into which fresh sea water is driven with every tide, and thus form admirable breeding grounds for food fishes, the lobster, and a host of invertebrates. The Cape Cod region is distinguished for its extensive sand shoals, which resemble those of North Carolina. The northern part of the Massachusetts shore is rocky, while the southerly portions are very diversified, abounding in submerged ledges, sandy and weedy bottoms, a great variety of bays and channels, as in Vineyard Sound and neighboring waters. Here lobsters were once exceedingly abundant, until they were nearly exterminated by the fishermen.

Under the variety of conditions indicated we should expect not only to find lobsters larger and more abundant in some localities than elsewhere, a condition greatly influenced by the number and persistence of the fishermen, but also to meet with variations in the time of egg laying and hatching, of molting, and in the rate of growth.

This animal spends most of its time in the search for food and in reproducing its kind. Its instincts are constantly leading it to secure protection through concealment, and we find it burrowing in the mud or sand, or hiding under stones, whether to await

its prey or to pass in greater security the crisis of its successive molts.

In traveling over the bottom in search of prey the lobster walks nimbly upon the tips of its slender legs, which are provided with brushes of sensitive hairs. The large claws are directed forward, a position which offers the least resistance to the water, or when at rest are held somewhat obliquely, their tips touching the bottom, while the long sensitive "feelers" or antennae, sweep back and forth continually to give warning of a foe or of objects which its other sense organs fail to detect. In exploring its feeding grounds the movement of the body is chiefly maintained by the swimmerets, or pleopods, which spring from beneath the tail in the form of a double bank of paddles on either side. The swimmeret consists of a short stalk and two flexible blades, which beat rythmically with a backward stroke, and thus impel the animal forward even without the aid of the ambulatory legs. Each blade is further garnished with a fringe of long and strong hairs or setae, which add to its efficiency as a rowing organ, and certain of which in the female catch and hold the egg glue by which her progeny, in the form of thousands of eggs, are tethered to her body.

The most primitive sense of animals being that of touch, it is not surprising to find tactile organs widely distributed over the body of this crustacean. As will be seen later, they occur by thousands in the form of tufts and fringes of hair-like setae on the legs and free margins of the shell, and in any part subject to frequent contact either with the body itself, with its food, or the ocean floor. It will also appear that instead of being incased in a solid, impenetrable armor, the crustacean can receive stimuli and impressions from without as readily as if it possessed a soft and delicate skin.

When an enemy appears, or the lobster is suddenly surprised and cornered it will immediately strike an attitude of defense, raising itself on the tips of its walking legs, it lifts its powerful claws over its head, after the manner of a boxer, and, striking the offending object, endeavors to crush and tear it to pieces.

When transferred from sea to land the lobster can only crawl in its vain attempts to walk, owing to the great weight of its body, which the slender legs are unable to sustain. If turned on its back its discomfort is immediately shown by attempts to

right itself, which are usually successful. When taken directly from the water and left to its own devices on the beach, I have seen it strike out by the nearest path to the sea with as keen a sense of direction as a turtle shows on land. It should be stated, however, that this experiment was tried only within short distances from the water.

By far the most powerful organ of locomotion in the lobster is its "Tail," called also the "abdomen" (terms borrowed from vertebrate anatomy,)and the "Pleon." By the rapid flexion of this muscular tail, aided by its terminal fan, the lobster shoots backward through the water with astonishing rapidity, going, according to one observer, 25 feet in less than a second. If tossed into the water, the animal quickly rights itself, and with one or two vigorous flexions of the tail makes quickly for the bottom as if sliding down an inclined plane.

On calm summer evenings toward sundown lobsters are often seen close to shore, lying on little patches of sand or in eel grass, awaiting their chance to seize a passing fish or crab. When alarmed, they assume the defensive attitude; but press them close, or try to pin them down with an oar, and they will dart backward toward deeper water; if still pursued they flee in other directions, zigzagging their way over the bottom until safety is found at still greater depths.

Lobsters kept in aquaria of sufficient size and provided with running water often thrive, and if they receive proper care will live for a long period. If the tank is provided with a pile of stones, the lobster will examine this carefully until the most attractive holes are discovered. When several individuals are placed in the same aquarium, each soon selects a hole or corner, for the possession of which it is always ready to fight. This is true of the "lobsterlings" as well as the adults, showing that the power of association or of the formation of habits, which is the mark of intelligence, is well developed. When the occupants of the same aquarium are of equal size and show no weakness, they usually live in peace; but should one become disabled, as by the loss of a claw, it is quickly attacked by the strong and forthwith destroyed.

As the lobster lies in its corner of the aquarium, usually with the tail folded, and always so if a female in "berry," it slowly sweeps the water with its long, sensitive antennae, which are now

held erect, now lowered, until they lie horizontal and extend directly forward in front of the body. The smaller antennae are elevated, while the stouter outer branch of each beats with a rhythmical up and down movement; this branch carries the delicate hairs or setae, which are regarded as the organs of smell. One often sees the animal deliberately lower the ship-like branches of the first pair of antennae and clean them by drawing them through the brushes of the large mazillipeds; and the great claws when not extended and ready for immediate use are turned obliquely inward and downward, with their tips touching the bottom.

All animals that play the part of scavengers must have strong powers of scent or keen eyes to guide them to their prey, and lobsters are no exception to this rule. The turkey buzzard sees, but, according to Audubon and Bachman, can not scent its prey, while the lobster, though dull of sight, has a keen chemical or "olfactory" sense. This is illustrated by the way in which it can be enticed into the traps. It is asserted that when traps are set on a trawl placed across the tide, the catch is greater than when the trawl is set in the direction of the current, since in the former case the chemical substances, or fine particles coming from the bait, are more widely diffused. Lobsters are sometimes wary and shy of entering a trap, and have been seen to crawl about it several times and examine it cautiously on all sides before, too weak or too hungry to resist temptation, they finally enter. When the pots are hauled, lobsters sometimes escape by darting backward through the narrow opening of one of the funnels, but this seldom happens and may be set down to accident.

Sluggish as the lobster may appear when out of the water and partially exhausted, it is quite a different animal, as we have just seen, when free to move at will in its natural abode on the bottom of the sea. In the water it is agile, wary, pugnacious, capable of defending itself against enemies often larger and more powerful than itself, and on occasion of exhibiting a high degree of speed. It often captures its prey by stealth and with concealed weapons. Lying hidden in a bunch of seaweeds, in a rock, crevice, or in its burrow in the mud, it waits until the victim is within reach of its claws. Though far less active and keen witted than many of the higher crabs, and sedentary in the sense of being restricted in its range, it is sluggish only at the period of the molt or in very cold weather. The sense of hearing is probably absent and that of

sight far from acute, but this animal possesses a keen sense of touch and smell, possibly a sense of taste, and is quite sensitive to changes of temperature and light.

Food and Preying Habits

The food of the adult lobster consists principally of fish, alive or dead, and of invertebrates which inhabit the bottom and come within its reach. It is not unusual to find bits of algae or common eel grass in its stomach, and at times in such quantities as to suggest that it may not be an accidental occurrance. Vegetable matter, however, forms at most but a small and casual part of its diet. Fragments of dead shells, coarse sand, and gravel stones as large as duck shot are also swallowed. The former yield lime, which is in some measure absorbed; the latter are not needed in grinding the food as in the gizzard of the domestic fowl, since the lobster's stomach has, as is well known, a mill admirably adapted for this purpose, and their occurrence is probably accidental.

I have dissected soft lobsters, with fragile papery shells, from 3½ to 4½ inches long, in which the stomach was literally crammed with water-worn calcareous fragments of the dead shells of crustaceans and mollusks such as one can gather on the beach, besides other shells of mollusks which had undoubtedly been eaten alive. This suggested the possibility that the supply of lime for hardening the new shell might at times be obtained in this way for it seemed hardly probable that they would be swallowed to be immediately regurgitated. The lobster undoubtedly regurgitates the insoluble and indigestible parts of its food, as is the known habit of crayfish. Some such outlet for waste matter is absolutely necessary in an animal where the fluid or finely divided and digestible parts of the food only can pass to the delicate intestine. The hard parts of fish, mollusks, and crustaceans, however, appear to be retained until they have given up a good deal of their lime, thus contributing to the calcareous supply of the exoskeleton.

An analysis of the stomach contents of lobsters captured at Woods Hole from December to June revealed the following organisms, which are named in the order of their relative abundance: Fish(procured independently of the traps); crustaceans, embracing chiefly isopods and decapods; mollusks, consisting

largely of small univalves; algae, echinoderms, and hydroids. The bones of the fish eaten belonged as a rule to small individuals or species. Among the crustacean remains parts of small mud-crabs, the common species in Vineyard Sound, were almost invariably recognized, and it was not unusual to find parts of the skeletons of small lobsters. The isopod is frequently eaten by the lobster, and often in large numbers. It is a scavenger, and devours the bait used in the traps, a fact which explains its common occurrence in the stomachs of lobsters newly caught. In the case of a female captured in January, the stomach was filled with fresh lobsters eggs in an advanced stage of development. These eggs were not stolen from any lobsters in the trap, but under what circumstanees they were obtained one can easily conjecture. The egg lobster is undoubtedly a shining mark, not only for predaceous fishes but even for members of its own species. The larger mollusks are eaten by crushing the shells and picking out the soft parts, while many of the smaller kinds are swallowed entire and presumably pulverized in the gastric mill. Echinoderms probably enter largely into the diet of the lobster wherever they abound. Parts of the common starfish and rarely a few spines of the sea urchin were detected, but it might be that the latter were swallowed together with other calcareous fragments. Very little change in the food was noticed during the winter and spring months, and there was little evidence that the appetites of these animals sensibly abated during cold weather, yet it is probable that food if not less abundant is less necessary in winter.

That lobsters catch fish alive there is no doubt, but few observers have ever seen the feat performed. Fish that inhabit the bottom, like the flounder, would naturally fall an easy prey to the powerful claws of the lobster, which is said to catch the sculpin; and I have known a lobster when confined in an aquarium to seize and devour a sea robin.

While lobsters are great scavengers, it is probable that they always prefer fresh food to stale. Some fishermen maintain that there is no better bait than fresh herring. Fresh codfish heads, flatfish, sculpins, sea robins, menhaden, and haddock are also used, as well as salted fish. The flesh of sharks was occasionally used by the Gay Head fishermen on account of its firmness and lasting qualities. Nothing could be more offensive to the human

nostril than the netted balls of slack-salted, semi-decomposed herring, which are commonly used as bait on the coast and islands of Maine, but by the wonderful chemical processes which are continually going on in the laboratory of its body, the lobster is able to transmute such products of organic decay into the most delicate and palatable flesh.

Lobsters are very fond of clams, as they are of mollusks of all kinds, and when kept in pounds are constantly scouring and digging up the bottom in search for these shellfish. In a large lobster pound at Vinalhaven Islands I have seen the muddy bottom scored in all directions, the work of lobsters in their search for clams. One was reminded of a pasture in which the soil has been rooted up by pigs. As a fisherman remarked, if you put lobsters in a pound and do not feed them they will soon turn over the bottom as effectively as it could be done with a plow. Some of the holes which the lobsters had made in digging clams were 2 feet in diameter and 6 inches or more in depth. Here they had dug up the eel grass, or loosened it so that it had floated to the surface, and cartloads had been cast ashore. We have already seen that the lobsters sometimes eat parts of this plant, but they had plainly rooted it up in this case with another object in view. The broken and often cominuted shells of the long-necked clam could be seen strewn everywhere about their excavations.

The lobster probably attacks such large and powerful mollusks as the conchs, which live upon hard bottom in deep water, and devours their soft parts. An illustration of this was afforded in an aquarium at Woods Hole in the summer of 1892, when a conch was placed in the same tank with a female lobster which was nearly 10 inches long and which had been in captivity about eight weeks. The conch, which was of the average size, was not molested for several days, but at last, when hard pressed by hunger, the lobster attacked it, broke off its shell, piece by piece, and made quick work of the soft meat.

If a lobster that has fasted for a number of hours is fed with a little fresh meat, such as a piece of clam or fish, the process of feeding will be found to be one of no little interest. The lobster eagerly seizes a piece of food with the chelae of the third and fourth pairs of walking legs, and passes it up to the third pair of maxillipeds, which are held close together, each being bent at the fifth joint and folded on itself. With the third maxillipeds thus

pressing against the mouth, the food is kept in contact with the other mouth parts, all of which are in motion, and their action is thus brought to bear upon it. By means of the cutting spines of the appendages external to the mandibles—chiefly the maxillae and second pairs of maxillipeds—the meat is as finely divided as in a sausage machine, and a stream of fine particles is passed on toward the mouth, to be finally subjected to the cutting and crushing action of the mandibles before entering it.

If one wishes to watch the movements of the complicated mouth parts more closely, one has only to take a lobster out of the water, place the animal upon its back and when its has become sufficiently quiet stimulate the mandibles or the broad plates of the second pair of maxillipeds with the juice of a clam or the vapor of ammonia, which can be squirted with a pipette. Masticatory movements are immediately set up in the appendages, those belonging to the side stimulated usually working independently. The two small chelate legs are also drawn up rapidly to the mouth, as if to hand up pieces of food.

When stimulated in this way, the plates of the first pair of maxillae come together over the lower posterior half of the mandibles. The movements of the masticatory parts of the second maxillae are synchronous with the beating of the scaphognathite. These leaf-like plates project somewhat obliquely over the convex surfaces of the jaws, and are directed inward and slightly upward. The large plates of the first maxillipeds work up and down and at the same time inward toward the middle line, describing an ellipse. The second pair of maxillipeds move alternately or together, inward and outward, with slight up and down movement. The large maxillipeds move together, the toothed margins meeting like the jaws of a nutcracker, while the three terminal joints are bent inward and somewhat downward, as in the case of the second maxillipeds, so as to meet on the middle line below and hold the food up to the mouth.