BULLETIN of the BIOLOGICAL BOARD OF CANADA

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BY

A. G. HUNTSMAN,
Biologist to the Biological Board of Canada

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The Lobster

INTRODUCTION

LOBSTERS occur along our Atlantic coast from the Bay of Fundy to Belle Isle strait, and it is natural to conclude that our waters are ideally suited to them. Where else can they be found in such abundance? While this is true as a whole, the conclusion has been forced upon us that ideal conditions for the lobster in all stages of its life are not to be found even generally along our coast.

In the first place our coastal waters are extraordinarily varied. The tides may rise and fall a distance of over 50 feet as in the head of the Bay of Fundy, or the rise and fall may be of quite insignificant dimensions, as in the vicinity of the Magdalen islands. The surface temperature may rise above 70°F. in summer, or may scarcely surpass 40°, while the temperature at a moderate depth may be only 29° at one point, and over 50° at another. It would be a very unusual sea-animal indeed that would be equally well-fitted for life throughout these ranges.

What then, may we ask, are the best or ideal conditions for the lobster? These cannot be stated in very simple fashion, for they are complex, and they seem to change with development and growth.

SALTNESS OF WATER

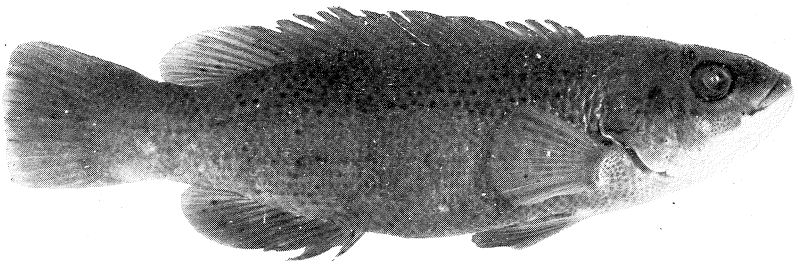
Our waters show all gradations in amount of salt content or salinity from perfectly fresh water to water with nearly $3\frac{1}{2}$ per cent. of salt as in ocean water. The lobster does well in the saltest water we have, providing it is not too deep, but it does not go far into the brackish estuaries. In the Miramichi river, for example, while the shrimp and certain other sea animals pass up considerably above Newcastle almost into fresh water, the lobster tends to keep well outside the mouth proper of the river below Loggieville, where the salinity is at least two-thirds as great as on the open coast of Nova Scotia. We do not know whether or not the eggs of the lobster can develop properly in water of lower salinity than that in

which the adults live. We have, however, experimented with the fry, and have not succeeded in rearing them when the salinity was as low as half that on the open coast, showing that they behave in this respect like the adults.

TEMPERATURE OF WATER

If we consider the adult first, we find that it is quite hardy in regard to temperature. During the winter on some parts of our coast it cannot escape exposure to temperatures as low as 29°F. It does not, however, live in the north where such a temperature occurs throughout the year, but seems to require a summer temperature of 40° or more for its growth. It migrates into the shore waters in summer when these have a temperature approaching 70°, but it does not occur far southward along the coast of the Atlantic states, which indicates that high temperatures are unfavourable for it. The eggs are carried by the female on the lower surface of the abdomen or tail from one summer to the next, and they must therefore be able to withstand the summer's heat and the winter's cold. Experiments are lacking to prove whether they will develop properly if the temperature be kept high, but, to judge from other cases, it is probable that they require a rather low temperature. That they do not require a high temperature is shown by the fact that they develop properly and hatch out in regions where they can never be exposed to temperatures higher than 50° or even less.

It is very different for the fry. We have for some years believed that low temperature or some other factor was causing the fry throughout extensive areas of our coastal waters to perish utterly. We were led to this through observation of the extraordinary differences between the waters of the Bay of Fundy and those of the Magdalen shallows in respect to abundance of fish fry in general. It is a very striking thing to find such a marked contrast as that between these two bodies of water. When the small floating life is collected with a fine plankton net and examined, the water of the Magdalen shallows is found to swarm throughout the summer with a great variety of eggs and fry of fishes and other sea animals. It is quite otherwise in the Bay of Fundy. Floating eggs are only moderately abundant and the fry that should hatch from these are almost wholly lacking.



THE CUNNER

THE CASE OF THE CUNNER

Although the death of eggs and fry is a general phenomenon in the Bay of Fundy, it is demonstrated most easily and most distinctly for the common cunner or blue perch, which abounds on most parts of our coast, and is found on the coast of the New England States to the south, and around Newfoundland to the north. It is a shore fish, congregating about wharves, therefore easily observed and caught. It does not migrate from place to place except very slowly in the course of years. Its eggs float near the surface and the fry also keep quite near the surface, so that they are very easily obtained.

On the Magdalen shallows the eggs and fry occur in prodigious quantities in summer, the adults populating the bordering coasts of Quebec, New Brunswick, Prince Edward Island, and Nova Scotia. In the Bay of Fundy a few very large fish are to be found along the shores, and the eggs from these may be got from the water in moderate numbers during the summer. No fry have yet been found and the eggs themselves are never found developed sufficiently for hatching. Why this difference? Experiments performed last summer showed that when eggs were kept at a temperature as low as 50°, development was not successful. At higher temperatures development was successful. In the Bay of Fundy the main mass of the water does not in summer rise above 50° in temperature, consequently it is not warm enough for the successful development of the cunner's eggs.

In St. Mary bay rather warm water is to be found at the very head. Investigations have shown that the cunner's eggs do develop successfully in this water at the very height of the summer. As a result of this successful development we find large numbers of cunners all around that bay, and they are of all sizes down to the very smallest.

Why are only very large ones found in the Bay of Fundy? Because none are bred there, and those that are found, can only have come from distant places like St. Mary bay and Casco bay, Maine. As they migrate scarcely at all, only very old ones will have been able to get so far from the successful breeding places.

On the Atlantic coast of Nova Scotia, we find that the cunner breeds successfully but to only a limited extent in Barrington

Passage. In St. Margaret and Mahone bays it is very successful, owing to the higher temperatures of the upper layers of the water. All the suitable breeding places have not been determined, but we know already that outside the Magdalen shallows, they are very limited and local.

LOBSTER FRY NEED WARM WATER

To return to the lobster. At an early stage in our investigations we noticed that where cunners were rare and very large, the lobsters were not so abundant and they were mostly of large size. It can scarcely be denied that an abundance of small lobsters is the best possible proof of successful breeding. Does, however, a scarcity of small lobsters mean relative or complete failure in breeding? We have believed so. Where are small lobsters scarce? In those regions like the Bay of Fundy, where the water does not become very warm in summer. If breeding is a failure in such waters, whence do the big lobsters come? The lobster migrates to a greater extent than does the cunner. Those bred in the favourable places will, therefore, continually scatter along the coast and populate the regions where failure in breeding occurs.

We believed for these reasons that all the lobster eggs hatching out in the Bay of Fundy must perish in the fry stage. This was astonishing. The water is undeniably suitable for the adults, for no finer ones can be found anywhere. The eggs also succeed, for the fry hatch out perfectly from berried females kept in cars. How could it be then that conditions were not suitable for the fry? We proposed to find out by experiment. Fry were taken just after hatching and kept in water of different salinities, at different temperatures, and with different acidities. We found that the water of the Bay of Fundy is perfectly suitable for the lobster fry so far as its salinity and acidity are concerned. The unfavourable condition proved to be the temperature. We succeeded in rearing the lobster fry at 77°, 68°, and 59°. At these temperatures the fry were voracious and lively, and moulted in a few days. At 50° they ate little and were ready to moult only after about a month. They all died either before, during, or immediately after moulting. At 41° the fry were quite sluggish, scarcely ate at all, and all died before approaching the moulting condition.

We have sufficient reason, therefore, for believing that, although waters as cold as the Bay of Fundy are entirely suitable for the adult lobsters and the lobster eggs, they are nevertheless quite unsuitable for the lobster fry.

On this basis we conclude that outside of the Magdalen shallows, the natural breeding of the lobster is successful only in certain limited and local areas, as St. Mary bay, St. Margaret bay, and Mahone bay, and in the colder of these perhaps only in exceptional years. Successful breeding is shown by the presence of large numbers of smallish lobsters. It will be necessary to delimit these successful breeding places rather carefully. This can be done by determining the temperature in summer of the upper 5 fathoms for all promising localities along the coast, and by measuring the lobsters captured in each area, in order to determine the relative numbers of the smaller sizes.

It might be argued that lobsters must go by instinct to suitable places to spawn, and that out of the thousands of eggs laid by a single female surely some lobsters must come. It is obvious, however, that in the first place, the vast majority of the eggs or fry must perish, for, if even one in a thousand survived, the sea would soon be overrun with lobsters; and that, in the second place, adult lobsters go at times not only into places unsuitable for the fry, but even where they cannot themselves survive. On the whole, however, the movements of the spawned lobster are such as to distribute the fry in suitable water, that is the lobster moves inshore into warm water when the eggs are getting ready to hatch. In regions like the Bay of Fundy, the warmest of the shore waters are still too cold for the fry. The berried female lobster does her best for the fry, but that best is not sufficient.

THE EFFECT OF LIGHT

Light cannot penetrate water as readily as it penetrates air. The rays are stopped rapidly and very few of them penetrate far into the water. Animals like the lobster, that live at some depth and hide beneath stones, are really living not in daylight, but in a sort of twilight. We know that direct sunlight injures our skin, causing a sunburn, unless we gradually accustom ourselves to it and develop a coat of tan. Will direct sunlight injure the lobster?