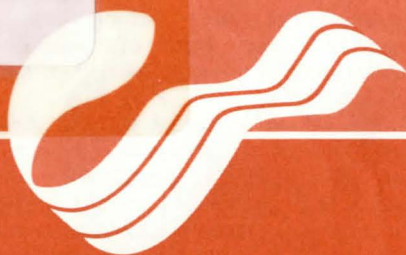


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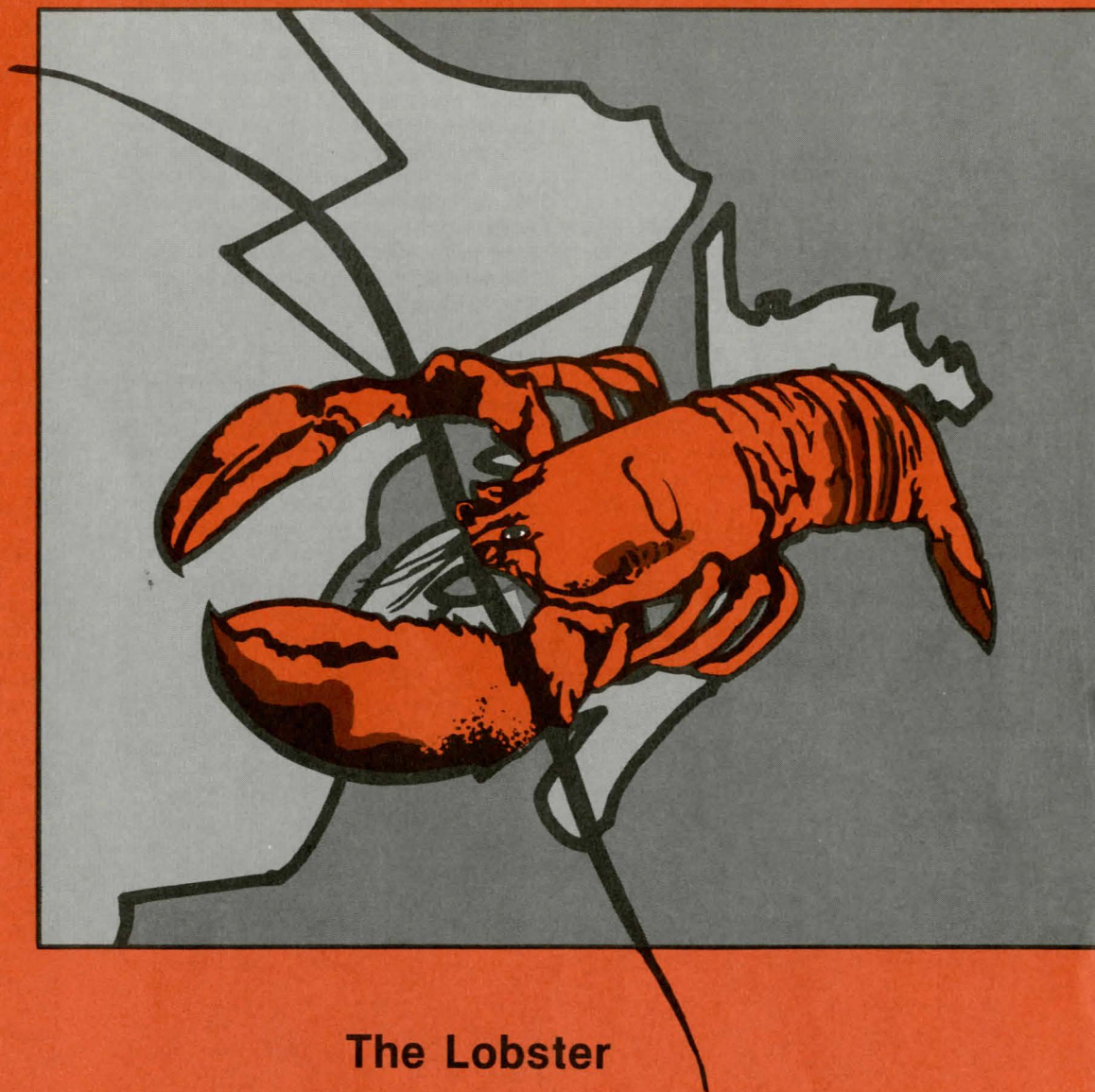
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The Lobster



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The Lobster

Who hasn't looked at a lobster in a fish store and wondered how such an ugly creature could be the epicurean's delight?

At one time surplus catches of lobster were used as fertilizer. Fishermen considered them a nuisance when they became entangled in their nets.

However, for quite a number of years, the lobster has become a highly sought after creature. Gourmets the world over prize this crustacean as the most delectable.

As a result, lobsters are now trapped unrelentingly, and it appears that their populations — at least in certain areas — are threatened. Most females don't get a chance to reproduce even once before being caught by the fishing industry.

Scientists are concerned, and are calling for stiffer controls. Fishermen and producers claim that the industry is already severely over-regulated. In any event, there is a need for reexamination of a management code which has evolved over the past 90 years. Skillful management must weigh potential short-term losses against long-term gains. Ultimately, it is obvious that all concerns are contingent upon the protection of the species.

Description

That most coveted of crustaceans, the American lobster (or *Homarus americanus* as it is known scientifically), is an invertebrate crustacean. It has no immediate relatives in Canada. It does have, however, one European brother — *Homarus vulgaris*. Also related is the Norway lobster

or scampi. The lobster belongs to the decapod or 10-legged family of crustaceans which includes shrimps, prawns, crabs and crayfish.

Lobsters have a jointed external shell, which protects and supports the body parts, while still permitting movement. The lobster's body is formed mainly by the cephalothorax, or head and chest area, and the six-jointed abdomen which is commonly known as the tail. The claws, carried on its first pair of legs and to which it owes much of its distinctiveness, are called the pincer and the crusher according to their respective functions. Four pairs of walking legs occur on its thorax, and a series of swimmerets, used for carrying eggs in the case of the female, are suspended from beneath the abdomen. Lobsters come in various colours — mostly colours which are useful for camouflage purposes, but are usually greenish when in the water, tending to redden when out.

Adult lobsters vary greatly in size among localities, depending upon the age and local growth rate, as well as the intensity of the fishery. In areas where the exploitation rate is high, the local stock of lobsters is maintained at a young average age. The average size is consequently smaller than it would be if there were less fishing pressure. The intensively-fished Gulf of St. Lawrence stocks have an average size of less than 400 g. Some lobsters can grow to a size of more than 20 kg if they survive the fishery and natural mortality.

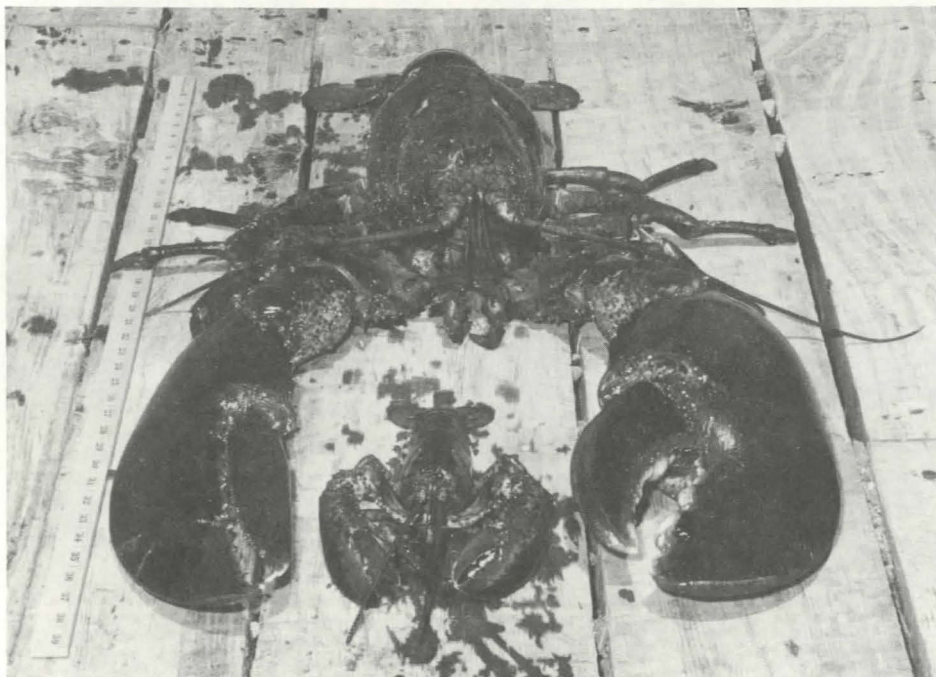
Distribution

Lobsters live along the east coast of North America from North Carolina to Labrador. They are abundant off Maine, southwest Nova Scotia, and the Gulf of St. Lawrence coastline of the Maritimes.

Lobsters prefer a habitat where they can find shelter. In deep water canyons off the coast of the U.S., lobsters have been observed lodged individually in small burrows dug into the face of clay cliffs. Inshore lobster populations are found on rocky bottoms, where a large number of individuals can obtain appropriate shelter. On sand or mud, lobsters may be found hiding under rocks of about their own size.

In a number of areas lobsters tend to be larger in deeper water. There are exceptions. For example, large egg-bearing females are found in shallow waters in the Bay of Fundy where they reproduce and moult during the summer months.

Just as the emergence of droves of office workers on a sunny day in spring does not necessarily indicate that the number of office workers themselves is on the rise — so it is with lobsters. They become more active



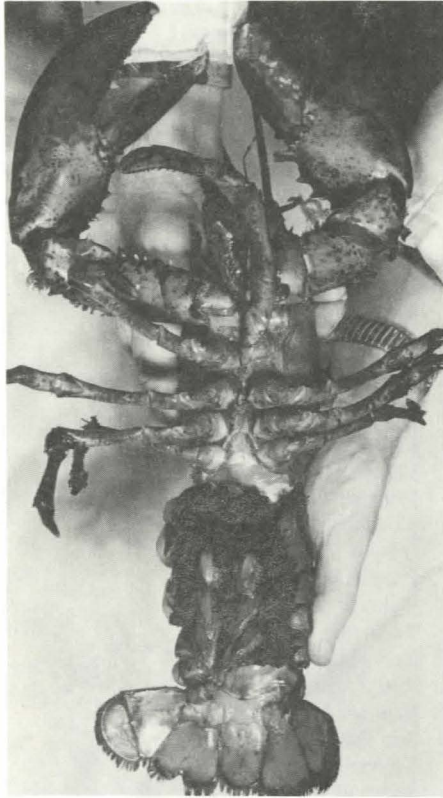


Fig. 1. Egg-bearing or berried lobster.



Fig. 2. Close-up section of berried lobster.

when the water begins to warm up. Thus the catch increases and it *appears* that there are more. In fact, they are only more active. So water temperatures, if not taken into account, can play havoc with demographic surveys.

Life History

The lobster begins its life as an egg, glued to the swimmerets on the underside of the female's abdomen. The speed of maturation at this stage may be accelerated by warmer water temperatures. Usually the eggs hatch in the summer, and the newly-released larvae float to the surface where they feed upon smaller planktonic organisms and undergo three moults, each time growing larger, and more similar to an adult. In three to six weeks, depending on the temperature, the juvenile lobster descends to the sea bottom. At this stage its total length is about 15 mm. The mortality rate of larvae is very high, and only about one per cent of the floating larvae may settle on the ocean floor.

Luckily, each female produces enormous numbers of eggs. For example, a large "canner" with a carapace or shell length of 78 mm releases about 7,500 eggs at one time. Even if only one per cent of these make it to the bottom, this still means that each female has produced at least 75 offspring that have survived. Typical large breeders in the Bay of Fundy release 30,000 eggs at a time, and the jumbos of more than 125 mm in length have been known to produce more than 40,000 eggs.

In order to survive, small lobsters lead a very secretive existence, so most of their time is spent hiding in burrows. Throughout their lives, they prey upon correspondingly small individuals of high food quality, such as crabs, mussels, clams, sea urchins and starfish. There is no evidence of cannibalism in the wild.

As the growing lobster becomes too big for its shell, it sheds it for a larger one. Between moults, the flesh becomes progressively more densely packed inside the shell. Meanwhile, a new soft shell develops inside the old one. Calcium salts are absorbed from the outer shell and stored in the stomach wall. The lobster arches its body into a "V" form, folded at the junction of carapace and abdomen. The large flexible old membrane stretches, then splits, and the animal lies on its side and backs out of the shell. Once free, the lobster flips back into the normal position and proceeds to suck in water and to puff itself up to about 10 to 15 per cent larger than its previous size.

At this stage the lobster's shell is very tender and the lobster is extremely vulnerable to predation. It begins to eat

soon after moulting, concentrating on high calcium foods to encourage the rapid hardening of its shell. The calcium which had been stored in the stomach walls is also used at this time. Sometimes it may even eat its old shell. For one or two months after a moult the lobster's flesh is watery and does not quite fit the shell. During this period its appetite is enormous and it is readily attracted to the bait in lobster traps.

Growth slows down progressively as the juvenile lobster grows to adulthood. Since lobsters grow faster in more temperate waters they may moult more often. In the Northumberland Strait, for example, where summer water temperatures may reach 20°C, a lobster at the current canner minimum of 63.5 mm carapace length, can moult twice in one year. Once a lobster has replenished the flesh within its new shell, it will be about 50 per cent heavier than before a moult. So in one year a lobster from the Northumberland Strait would grow from 200 g to 450 g, and would moult twice, whereas his counterpart in a cooler habitat would average 300 g, and moult only once.

Temperature is also a factor in the age at which a lobster attains sexual maturity. Female lobsters in the Northumberland Strait may mature at 200 g or three years of age, whereas their counterparts in the Bay of Fundy will not mature sexually until they are 700 g or eight years of age.

The size at which the average female is mature and capable of producing eggs to replenish the population is very important in the regulation of the fisheries harvest, because if females are not given the chance to contribute to the reproduction of the species, the lobster population will obviously suffer a decline. This is the main problem facing the lobster population today.

Reproduction

The female is only sexually receptive for a few days after moulting, while her shell is still soft and flexible. When lobsters mate, the male deposits sperm in the spermatheca between the female's last two pairs of walking legs. The sperm is then stored for as long as a year, until the eggs are ready. At that time the eggs are released from the openings of the oviduct at the bases of the third pair of walking legs. As they pass toward the swimmerets, sperm is released to fertilize them. The eggs are then carried on the swimmerets until the following year. In the past it was assumed that after hatching the eggs, the female would moult and then mate again to recommence a two-year reproductive cycle. However, it seems that very large females are able to conserve enough sperm from a single mating to fer-



Fig. 3. Huge lobster from Bay of Fundy, weighing about nine kg.

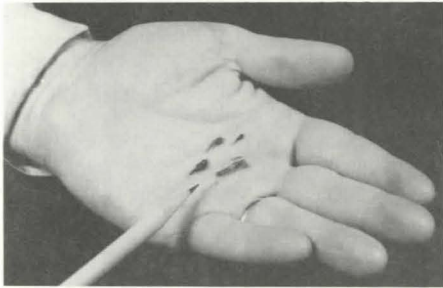


Fig. 4. Young lobsters in early stages of development, during which they moult three times.

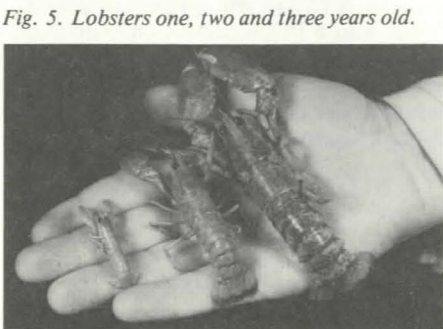


Fig. 5. Lobsters one, two and three years old.

utilize two or even three broods of eggs. They may spawn several times without an intervening moult. So the energy that normally is used in increasing body size, is directed by these prolific females solely to reproducing.

Another deviation from the normal two-year reproductive cycle is the case of females who moult, mate and extrude eggs all in one season. This phenomenon seems to be limited to individuals reproducing for the first time in warmer water habitats.

Natural Mortality

What is the natural mortality rate for lobsters? Firstly, 99 per cent of the larvae do not survive. Once on the sea bottom, the still vulnerable juveniles are so secretive that divers cannot accurately estimate their numbers. It is logical to suppose that mortality diminishes rapidly as lobsters become larger and better able to defend themselves. But once lobsters reach commercial size specifications, the rate at which they are harvested by the fishermen renders natural mortality figures almost insignificant by comparison. In specific isolated cases, epidemics of gaffkemia, a bacterial disease, have decimated local populations of lobsters, but these have almost always been in holding facilities and not in the wild. There are few predators to which a commercial-sized lobster would be vulnerable.

The Fishery

Canada's commercial lobster fishery began before 1870. In the evolution of the early fishery the abundance of existing large stock was soon exhausted. During the 1870s, lobsters usually averaged from 1-2 kg in most areas, but these larger individuals were fished out by 1887 when average weights were below 500 g. By 1900, average weights were often below 220 g. Overall landings declined from 45,000 metric tons (t) in 1887 to only 12,000 t in 1918. Subsequently the emphasis of the fishing shifted to the smaller canning lobsters.

During the early years of this century, areas like southwestern New Brunswick and western Nova Scotia with easy access to lucrative live lobster markets in the U.S. began to concentrate on larger lobsters to supply these markets. The canneries shut down and the average size of lobsters in these populations increased as a result.

Elsewhere the heavy fishing pressure continued to keep the average sizes small. During the 1920s, the emphasis in eastern Nova Scotia shifted somewhat away from canning, and average sizes increased there.

Since then, the overall average landings have been relatively stable in the long term,

with considerable short-term local fluctuations. The three Maritime provinces are responsible for about 80 per cent of the Canadian total. Quebec and Newfoundland are responsible for most of the rest.

Since the 1920s, the productivity of the lobster fisheries off the coast of the western Maritimes has steadily increased. In 1971 an offshore fishery was developing in the areas of Browns Bank and eastern Georges Bank. Eight large boats fish these waters and take about 600 t of lobster per year. Grand Manan Island and southwest New Brunswick land about 500 t. The southern Gulf of St. Lawrence has produced between 5,000 t and 9,000 t of lobster per year since 1960.

Over the last 80 years the eastern Atlantic coast of Nova Scotia has suffered a severe decline in landings, mainly because most female lobsters are caught before they are able to produce eggs.

The average price paid to fishermen for lobsters has been increasing steadily, although of late that increase has not kept pace with increases in prices paid for most other fish and shellfish. The price varies considerably depending on the season, the location and the use which will be made of the lobsters.

What happens to the lobster after it has been caught?

The large lobster (81 mm or more) is almost always sold live. Jumbos usually are shucked and sold as frozen or canned meat.

Districts in which it is still permissible to land lobsters as small as 63.5 mm exist in very small numbers to supply the plants canning lobster meat, although nowadays freezing supplants canning for the most part.

A recent development is the sale of whole canner or "shack" lobsters frozen in brine for some export markets. This eliminates shucking, permitting greater profit at the processing level.

Interestingly enough, less than 10 per cent of the total lobster catch was consumed in Canada last year.

In 1979 exports had reached 12,800 t. The European Economic Community is an increasingly important importer of Canadian lobster products. The U.S. market declined by about 22 per cent between 1976 and 1979.

Research and Management

For the last 50 years Canadian scientists have been studying the lobster. Recently that research has taken the form of lobster aquaculture. A great deal of information has been obtained about dietary and habitat requirements. Through experimentation with temperature regime or manipulation of hormonal balance, methods have been

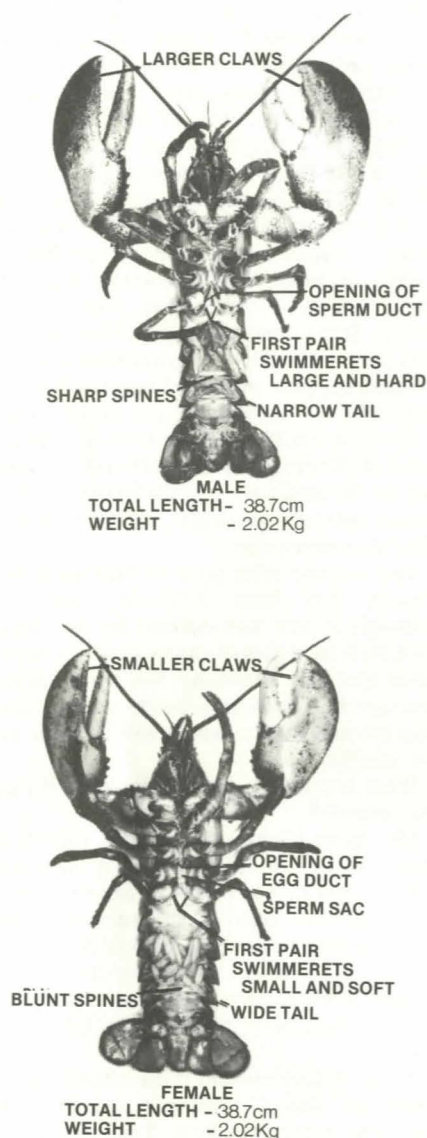


Fig. 6. Underside of mature male and female lobster.

devised to accelerate growth. Lobsters can be raised from larvae to adulthood within two years in captivity. Now it remains to be shown that commercial scale operations can be maintained on a profitable basis while averting the disease problems that threaten any mass-holding facility. It may well be possible that financially viable operations will be exclusively those that do not require supplementary heating of water during the winter. Such operations might be located near thermal power plants in Canada, or almost anywhere in California or Florida. Obviously, the potential impact of such developments on the commercial fishery must be considered. Tens of thousands of people in Atlantic Canada are supported by the lobster industry.

The management of the lobster fishery is founded on the Lobster Fishery Regulations, a complex document which has evolved over the last 90 years of practice. These regulations were instituted for a variety of reasons, the least of which were scientific. In some cases they were responses to the immediate needs or demands of processors and fishermen. In many cases they were based on mistaken ideas about the biology of lobster populations and their reaction to fishing pressure. Modern day research concentrates not only on obtaining biological information, but also on developing the relationship between the biology of lobster stocks and the management measures necessary to ensure a healthy fishery.

The basic tools of fishery management are control of fishing effort and control of the size or age at first capture. In the case of lobster fisheries, effort is controlled through limits on the number of licences, the number of traps, the dimensions of the traps, and the length and dates of the open fishing season. The size at first capture is protected by specifying a minimum legal size of lobsters. In addition females bearing external eggs ("berried females") must be returned live to the sea if captured. Lobster management is complicated by the fact that the Atlantic coast is divided into about 25 management districts. Seasons, trap limits, minimum legal sizes, and numbers of licences vary considerably among these districts.

There is at present much discussion among fishery scientists, managers and fishermen about minimum legal sizes. In both North America and Europe, scientists involved in assessing lobster populations have agreed that in most countries increases in minimum legal sizes would result in improved and more stable lobster catches. At existing size limits, growth rate is much higher than mortality rate (excluding

fishing mortality). Leaving lobsters to grow bigger before catching them should produce higher yields in the long run.

The supply of young lobsters for the fishery should be improved. It is very important to note that in most stocks the present minimum legal sizes at which a lobster may be captured are below the size at which most females are able to produce eggs. Consequently, most females are not able to reproduce even once in their lives. The fishing effort is very intense and only a small minority survive their first season in the fishery.

Since existing laws protect only females bearing external eggs — females that are "pregnant" are not protected. This accounted for a severe lobster harvest failure in Richmond County in 1960.

The desperately low level of catches along the eastern shore of Nova Scotia today has of course led to a considerable decrease in fishing effort. As a result about half the new stock survive their first season. But there are very few recruits. In fact it appears that the only way an increase could be attained is to increase the minimum size limit to the point where most females have already had at least one chance to contribute to the reproduction of their species.

In warmer waters, females who moult into legal size during the summer extrude eggs before the fall of that same year. Consequently, when the fishery starts in the following spring these females are already protected.

It is clear that in *all* areas the number of young lobsters could be improved and stabilized by increasing legal minimum sizes.

There is at present a great need for economic research related to the lobster fishery, especially concerning the possible impact of changes to the fishery regulations based on biological arguments. For example, increased size limits would cause short-term losses in yield. What would be the economic cost of these losses, and would potential long-term gains justify them? Increased size limits also would result in higher average sizes of lobsters. What impact would such changes have on lobster markets, in terms of demand and prices? What would be the impact on employment in the lobster processing industry? Research on these economic questions is necessary to complement the management-oriented biological research currently underway.

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Fig. 7. Fishing lobster traps.

Further Reading:

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Fig. 8. Removing meat from lobster in a small cannery.

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