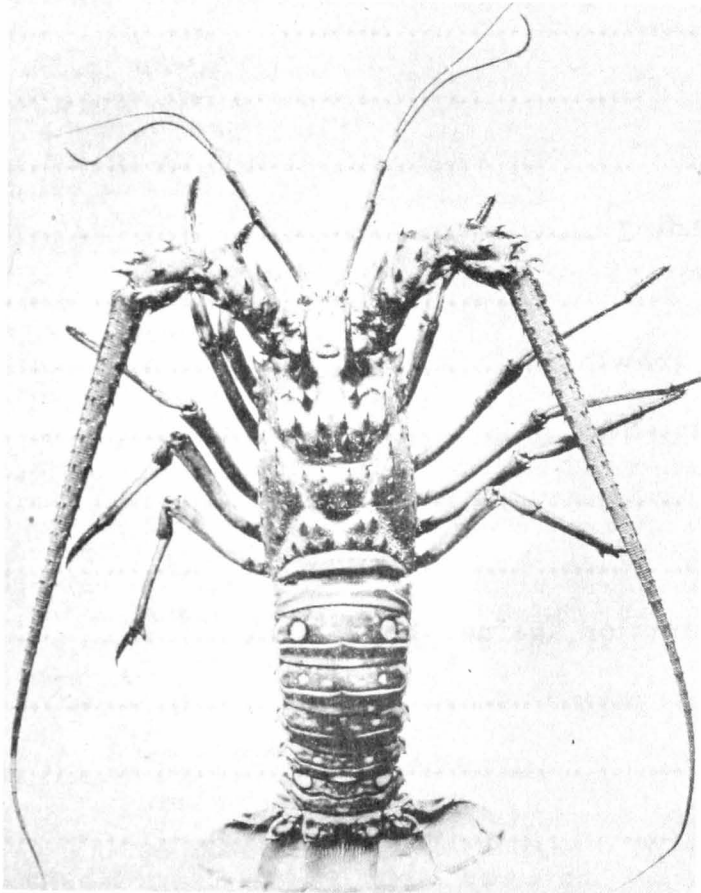


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Spiny Lobsters



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Cover: The spiny lobster of Florida (*Panulirus argus*) is a handsome crustacean mottled with blue, rich yellow, and brown and dotted with numerous spines.

SPINY LOBSTERS

By Lola T. Dees

Branch of Reports
Division of Resource Development

INTRODUCTION

Spiny lobsters are nearly worldwide in their distribution, ranging through the tropical, subtropical, and temperate waters of the Atlantic, Pacific, and Indian Oceans. Since they are distributed so widely, they have many names. They are called *langouste* in French-speaking countries; *langosta* in Latin America; *lagosta* in Portuguese-speaking countries; *kreeft* in Holland; *kreef* or Cape crawfish in South Africa; and rock lobster, spiny lobster, or sea crawfish in the British Isles and North America.

SPECIES

Spiny lobsters belong to the family Palinuridae, which consists of 7 genera and about 30 species. Some species are commercially valuable, the principal ones, with their distribution, being:

<u>Species</u>	<u>Distribution</u>
<i>Jasus lalandei</i>	Australia, Juan Fernandez Islands (off coast of Chile), New Zealand, South Africa, Tasmania, Tristan da Cunha
<i>Jasus verreauxi</i>	Southern Australia, New Zealand, Tasmania
<i>Palinurus elephas</i>	Europe
<i>Panulirus argus</i>	Florida, the Caribbean area, the Atlantic coast of South America, Bermuda
<i>Panulirus inflatus</i>	Gulf of California to Ecuador
<i>Panulirus interruptus</i>	Southern California, Lower California (Mexico)
<i>Panulirus japonicus</i>	Japan

<u>Species</u>	<u>Distribution</u>
<i>Panulirus laevicauda</i>	Bermuda to northeastern South America
<i>Panulirus longipes</i>	Western Australia, Ryukyu Islands, Taiwan, Philippines, New Caledonia
<i>Panulirus marginatus</i>	Hawaiian Islands
<i>Panulirus ornatus</i>	Indian Ocean, Ryukyu Islands, Taiwan, Philippines
<i>Panulirus penicillatus</i>	Indo-Pacific, Korea, Lower California (Mexico), Galapagos, Costa Rico
<i>Panulirus regius</i>	Western Mediterranean, West Africa
<i>Panulirus versicolor</i>	Indo-Pacific

Dr. Fenner A. Chace, Curator, Division of Marine Invertebrates, U.S. National Museum, revised the above list of the species of spiny lobsters and their distribution. Dr. L. B. Holthuis of the Leiden Museum is preparing a revision of the family Palinuridae which may result in some changes in the above list.

LIFE HISTORY

Description

Spiny lobsters resemble the northern lobsters (family Homaridae), but lack the giant claws and the stiff tail fan that are characteristic of those animals. Numerous spines dotting the body and pointing forward further distinguish spiny lobsters. The most prominent of these spines are two large ones which project forward and curve over the eye stalks. The legs and the heavy, spiny antennae are longer than those of the northern lobster. The chief portion of the spiny lobster that is usually eaten is the muscular tail.

The two principal parts of the spiny lobster body are the cephalothorax and the tail. The cephalothorax has two eyes and two pairs of antennae in front and five pairs of long, jointed walking legs on the underside. The antennae act as special sensory organs; organs at the base of the antennae maintain the sense of equilibrium.

The back part of the body is the tail, which is narrower than the cephalothorax and is divided into ringlike segments. Four pairs of swimmerets (leaflike structures) are beneath the tail. At the end of the tail there is a flexible and somewhat leathery fan, consisting of a middle piece with two flaps on each side.

The color of the body varies with individuals, time since molting, and the type of ocean bottom. The shells of recently molted lobsters are brighter and have more olive-green pigmentation than the old shells. Lobsters on sandy bottoms or in deeper water generally have more blue and brown than those which live in shallow water. When the lobster is boiled, the shell changes to bright red.

The maximum length of the Florida spiny lobster is about 17 inches, and its weight is frequently over 10 pounds. The largest California spiny lobsters, which are generally similar to the Florida species, are believed to reach a weight of over 30 pounds, but individuals over 18 inches in length and 6 pounds in weight are rare. Males of both species are usually larger than females. The average market size of the Florida spiny lobster is 10 inches long, exclusive of the long antennae; a 9-inch one weighs about a pound. California has a minimum of $10\frac{1}{2}$ inches and a maximum of 16 inches. There is little reliable information on the age of the various species at marketable size; however, it is not improbable that marketable specimens are upwards of 5 years old. Sex ratios vary year to year and seasonally. An investigation begun in Florida in 1944 found 53.3 percent of the spiny lobsters were males and 46.7 percent females (Dawson and Idyll, 1951). The percentage of females in 482 California spiny lobsters collected at eight different times and places ranged from 33.3 to 69.6, with an overall average of 53.3 (Wilson, 1948).

Sexes

Several characters easily distinguish adult female and male spiny lobsters. The fifth pair of legs of the female has small

pincers (picture on cover) which does not appear on the fifth pair of legs of the male. Swollen sexual openings occur at the base of the fifth pair of legs of the male (fig. 1). In the female the egg ducts open at the base of the third pair of legs (fig. 2) and are much smaller than the sexual openings of the male. The swimmerets of the female (fig. 3) are much larger than those of the male, and each of a pair has two lobes while those of the male are single. Eggs and the sperm sac also distinguish the mature females. The egg masses attach to her swimmerets; during the breeding season the male attaches a sperm sac to the bases of the female's legs.

Food and feeding

Spiny lobsters eat a wide variety of food. They feed on marine worms, mollusks, smaller crustaceans, and fish. Although they sometimes feed as scavengers, they generally prefer fresh to putrid food; traps baited with decaying meat or fish sometimes catch fewer lobsters than unbaited traps. Their stomachs often contain seaweed and, occasionally, young spiny lobsters. If animals containing calcium carbonate (shell material) are not available as food, spiny

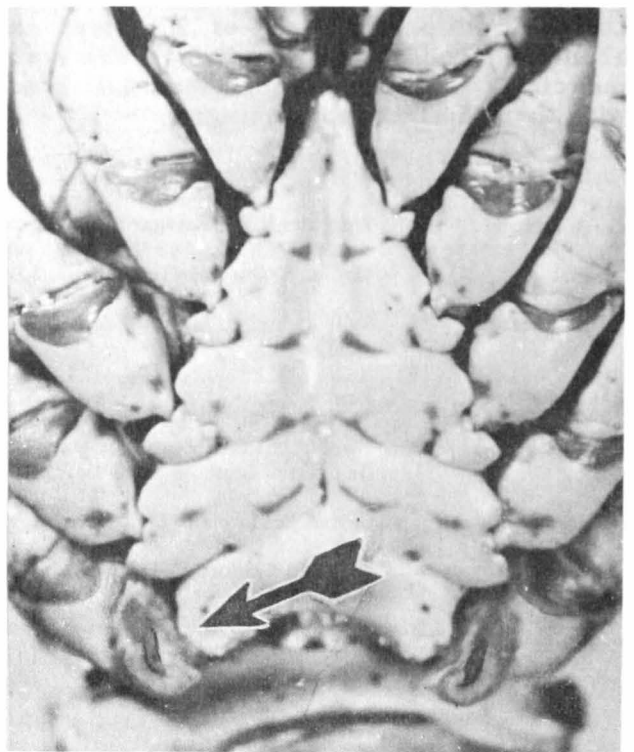


Figure 1.--Under surface of male, showing swollen openings of sperm ducts at base of last pair of legs.

Courtesy of F. G. Walton Smith.

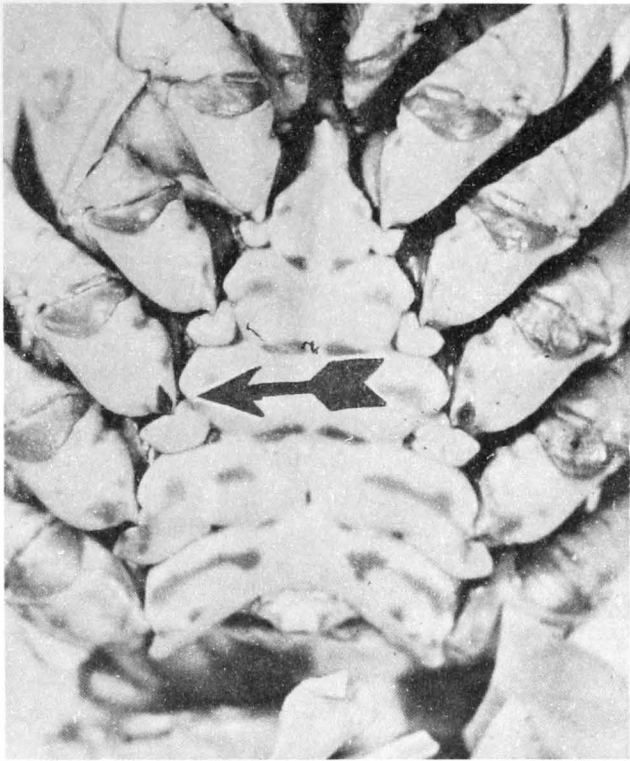


Figure 2.--Under surface of female, showing small openings of ducts at base of third pair of legs.

Courtesy of F. G. Walton Smith.

lobsters will resort to cannibalism when regenerating lost parts of the body or after molting (MacGinitie and MacGinitie, 1949). Just before molting they do not feed actively. A spiny lobster does not have claws; it uses its strong jaws to crack the shells of small animals. Larvae feed on microscopic food. Special sense organs in the antennae enable the lobster to detect food at some distance.

Habits

At night the spiny lobster actively moves about the ocean bottom seeking food. In daytime it usually hides under rocks, sea fans, large sponges, or other marine growth, with only the antennae projecting. It avoids strong currents and muddy bottoms.

The spiny lobster usually walks sideways, backward, or forward on the legs, but, occasionally, when in danger, it moves backward rapidly by quickly bending the tail.

Molting and growth

Growth results when the spiny lobster molts or sheds its shell. Molting occurs following periods of abundant food supply and depends partly upon water temperature.

Mature females molt during early spring before breeding and sometimes after shedding their eggs. Males may molt at any time. Since they are larger than females, they are thought to molt more frequently than females. The young molt more often than adults.

Previous to molting, the spiny lobster seeks shelter. After a period varying from a few hours to a few days, the old shell cracks along definite lines and becomes dislodged, first from the cephalothorax and then from the tail. The lobster escapes through this break, usually leaving a whole shell behind. The new shell is in place beneath the old one before molting, but does not harden completely for at least a week. Immediately after shedding the old shell the lobster absorbs large amounts of water and swells to a larger size.

The rate of growth depends upon water temperature, the food supply, and frequency of molting. Growth between molts is about 5 percent of the body length in the case of market size Florida lobsters (Smith, 1958). A Florida spiny lobster 9 inches long has been estimated to grow $1\frac{1}{4}$ inches a year.

Spiny lobsters regenerate lost parts of the body. If a spiny lobster loses a leg, it grows a new one which, at the succeeding molt, may attain a size two-thirds as long as the old one.

Reproduction

The majority of Florida and California female lobsters do not begin breeding until about 8 or 9 inches long. The older females breed earlier in the season than the younger ones (Smith, 1958). Females are thought to spawn every year, and some of them may breed twice in a season. Males mature at a slightly smaller size than females.

Mating occurs in inshore waters during spring, summer, and early winter (principally March through July in California and February through July in Florida). A male extrudes sperm (a viscous fluid) from openings at the base of the fifth pair of legs. This fluid attaches to the under surface of the female between the last three pairs of legs. It rapidly hardens on the outside to form the sperm sac.

A short time after the mating act, the bright orange-red eggs, which are about one-thirty-second of an inch in diameter, flow from the openings at the bases of the third pair of legs and pass over the sperm sac. The female releases the spermatozoa (sperm cells) from the still soft inside of

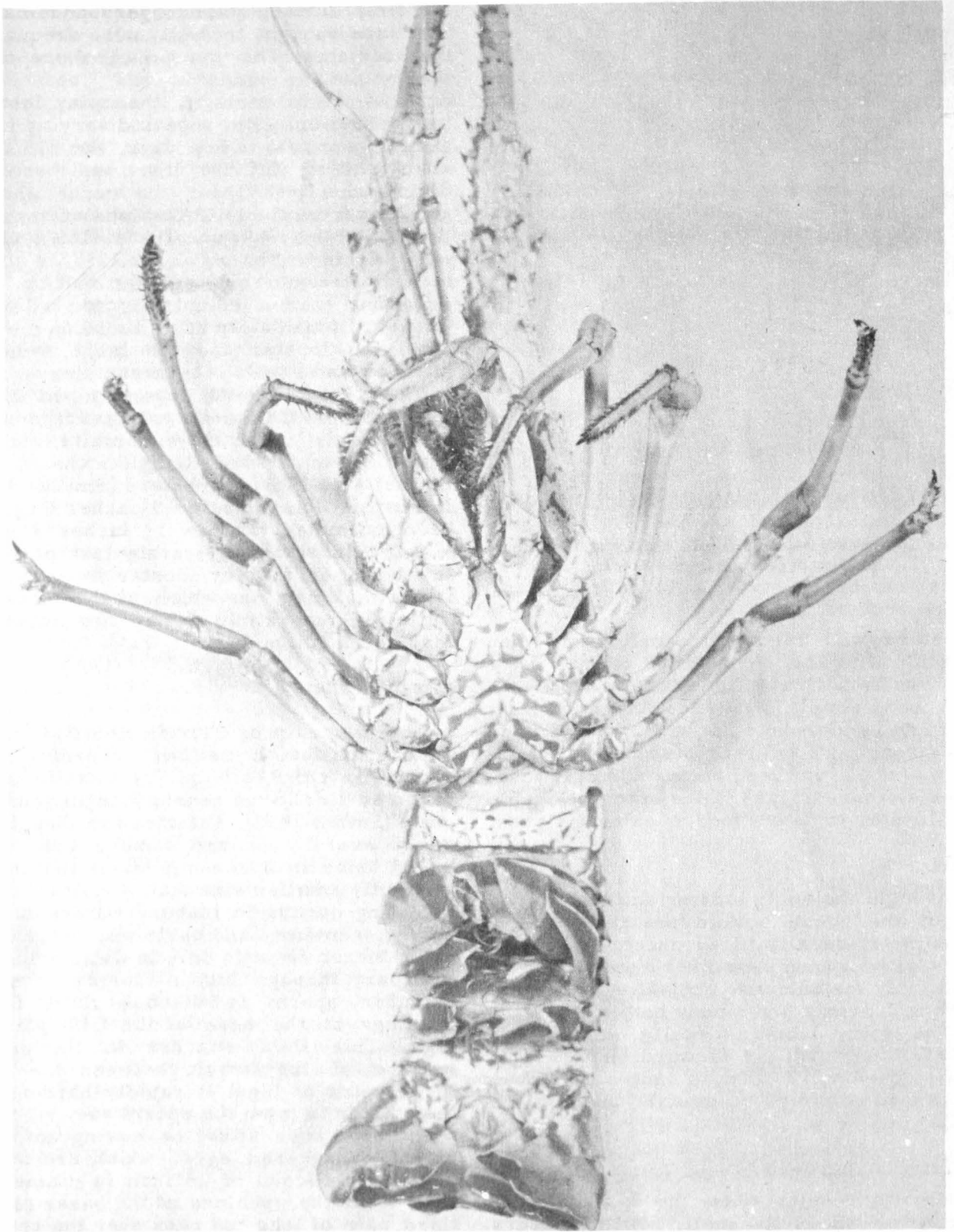


Figure 3.--Under surface of female, showing swimmerets.

Courtesy of F. G. Walton Smith.

the sac by scratching it repeatedly with her legs. The eggs are fertilized by the spermatozoa and then pass to the swimmerets where they attach. As the eggs develop, they become dark brown, then brown, and finally almost colorless just before hatching. The change in color results from the absorption of yolk material.

The number of eggs that a female produces depends on her size. A 14-inch female may produce about 500,000 eggs and an 8-inch one about 50,000 eggs (Allen, 1916).

Most of the females migrate to deeper water while the eggs are incubating on the swimmerets.

The young

Within 3 weeks after being produced, fertilized eggs hatch into small, nearly transparent larvae. The larval existence, in contrast to the comparatively short life in the egg, is long and complicated. The young lobster when it hatches from the egg is a flat, leaflike animal, known as the phyllosoma (fig. 4). About one-tenth of an inch long, it has long legs, a flat body, and large protruberant eyes. There is no lime in the skeleton. Reacting to light, the phyllosoma stage of the Florida lobster rises to the surface during the night, but retires to deeper water during the day (Smith, 1958).

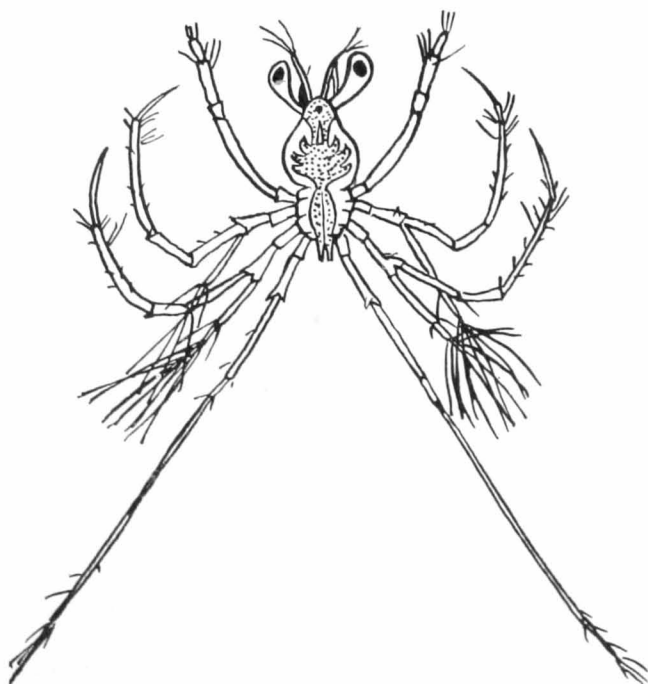


Figure 4.--Young lobster or phyllosoma.

Courtesy of F. G. Walton Smith.

The larvae grow by means of a series of molts until they become adults. At each molt a larva undergoes slight progressive changes, and in about 3 to 6 months it changes into a form similar to that of the adult. This is the puerulus stage and differs from the adult form chiefly in lacking lime in the shell. Finally it molts into a young lobster about seven-eighths of an inch long and settles to the ocean bottom. After two or three molts it loses its transparency and becomes reddish brown.

MIGRATIONS

The water temperature, weather, food supply, and reproduction cause spiny lobsters to migrate. Occasionally spiny lobsters migrate along the Florida coast, usually going north in summer and south in winter. More often they migrate between shallow and deep water. They move out to deep water during still, calm weather and during continued unseasonable or excessively cold weather. At other times the search for food and protection afforded by rocky headlands or marine growth may prompt them to seek deep water. As mating time comes they move from deep water to shallow.

While their migrations generally do not exceed 5 miles, spiny lobsters can travel considerable distances. Some individuals migrate almost 100 miles at a rate of at least 1 mile a day (Smith, 1958).

ENEMIES AND PROTECTION AGAINST THEM

Spiny lobsters have so many enemies that few of the original number of larvae survive. A great variety of fish and other animals eat drifting young lobsters in their early stages of development. Groupers and other bottom fish eat large numbers of small, bottom-dwelling lobsters. Sharks, groupers, and jewfish eat large lobsters.

Spiny lobsters protect themselves against these enemies by hiding during the day and becoming active during the night when their enemies are inactive. The lobster is protected somewhat by the spines on the body and antennae.

CAPTURE

Although spiny lobsters occur in deep water, they are taken mainly in waters less than 50 feet deep. They are usually

caught at night in traps which they enter while seeking food. The traps are usually baited with fish or beef ribs and lowered to the bottom of the ocean. Sometimes bait is not placed in the traps. Lobsters are also speared. Fishermen wade in shallow water or dive in deep water and seek them in their hiding places. The two long antennae, when waving, reveal the presence of a lobster.

UTILIZATION

Spiny lobsters are widely used. Handline fishermen, especially in southern Florida, often use spiny lobsters as bait. They crush and throw them into the water to attract fish.

Because humans also relish their snowy white, red-tinged meat with its delicate flavor, spiny lobsters often support extensive fisheries. In 1960, 3.2 million pounds were caught in the United States, valued at \$1.3 million. Nearly 90 percent of the catch was taken off Florida with California supplying the remainder. Since these quantities do not satisfy the enormous demand in the United States for spiny lobsters, large importations are made. The following table shows the United States imports in 1960:

	Quantity Pounds	Value Dollars
Canned	529,107	851,445
Live	591,818	163,899
Frozen tails	26,801,139	26,644,802
Fresh or frozen whole	3,525,050	2,476,490

Two countries--Australia and the Union of South Africa--furnished 56 percent of the imports. Other important sources of supply are the Bahamas, Brazil, Cuba, Mexico, and New Zealand.

CULTURE

Raising spiny lobsters is not profitable because they demand very exacting care and specialized conditions. Spiny lobsters require clear sea water at an even temperature; a large area, with a suitable bottom; microscopic food for the delicate larvae which have a long and complicated existence; and protection from enemies.

Efforts have been made to raise spiny lobsters. In 1911, eggs from spawn-bearing California females hatched readily in hatching jars, but attempts to raise the young proved futile (Barnhart, 1919). The larvae's extreme delicacy and pelagic habits made

their culture especially difficult. A large egg-bearing California female in a large tank at Scripps Institution of Oceanography produced young in 1918 (Barnhart, 1919). Many of these larvae were put into fresh running sea water where they lived only several days; those in the tank lived only about 8 days. Fish-culturists of the U.S. Bureau of Fisheries, in 1917, found that eggs of Florida spiny lobsters would hatch while attached to females living in floating boxes, but the young died within a day or two after hatching. In the following year, the U.S. Bureau of Fisheries again attempted to hatch the larvae. Eggs stripped from females were placed in MacDonald hatching jars which were supplied with running sea water. Only a small percent of the eggs hatched normally. They could not be prevented from adhering to each other in masses and soon died (Crawford and De Smidt, 1923).

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