# EDIBLE CRABS OF THE UNITED STATES

by George H. Rees

FISHERY LEAFLET 550

UNITED STATES DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

BUREAU OF COMMERCIAL FISHERIES

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Washington, D.C. December 1963

# EDIBLE CRABS OF THE UNITED STATES

by

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## INTRODUCTION

Crabs are members of the Crustacea (from Latin *crusta,* a hard shall), a class of the great invertebrate phylum Arthropoda (from Greek *arthron,* joint + *pous,* foot), animals with jointed legs and a hardened outer covering, or exoskeleton. Most crustaceans are aquatic animals, and one of the distinguishing characteristics of the class is that they breathe by means of gills. The members of the other classes of Arthropoda, such as the insects, spiders, and centipedes, are essentially terrestrial animals. Crustaceans are the arthropods that often swarm in the sea as the insects swarm on land, and there is hardly a way of life in the sea not followed by some member of this diversified class.

There are many orders in the class Crustacea. Crabs belong to the order Decapoda (from Greek *deka,* ten + *pous,* foot), a name which refers to the fact that the members of this order have five pairs of legs. Some other familiar decapods are the shrimps, prawns, crayfishes, and lobsters. The order is further divided into suborders, and all the true crabs are placed in the suborder Brachyura (from Greek *brachys,* short + *oura,* tail). The name is quite appropriate for this group, for the abdomen, or tail, is a shortened flap that is folded under the body. The suborder Anomura (from Greek *anomos,* irregular + *oura,* tail) also contains a number of species that are commonly called crabs because of similarities in structure and habits to the true crabs. The members of this order have a somewhat reduced abdomen which is not as permanently flexed under the body as in the Brachyura. Hermit crabs are probably the most familiar anomurans, but one very important commercial species, the king crab of Alaska, is also a member of this order.

All crabs possess five pairs of legs, and the first pair is always chelate, that is, equipped with pincers. In one group of crabs, the swimming crabs, the end segments of the last pair of legs are flattened. These flattened segments are used as sculling organs and enable the crabs to swim rapidly.

The true crabs range in size from some not larger than a grain of wheat to others that are the largest known crustaceans. A record specimen of the giant spider crab of Japan, *Macrocheira kaempferi* (from Greek *makros,* large + *cheir,* hand, and *kaempferi* for Engelbert Kaempfer, German traveler and physician whose book, *History of Japan,* published in 1727 was long the chief source of information on that country), measured $12\frac{1}{2}$ feet between the outstretched claws. This giant crab has very long, slender legs, and the body of the animal measured about 15 inches across.

Certain species of crabs live in a close relationship with other animals. The most familiar example of this type of relationship is that of the oyster crab, *Pinnotheres ostreum* (from Greek *pinna,* a kind of shellfish + *therates,* hunter, and *ostreon,* oyster), which lives within the shell of the oyster and shares the food brought in by its host. Almost anyone along the east coast of North America who has ordered oysters on the half-shell has seen specimens of this little crab. Oyster crabs are considered a great delicacy by many people, some of whom would be quite disappointed if they did not find a few of these little fellows included in their servings of oysters.

Note: This is a revision of Fishery Leaflets 71 (July 1947) and 471 (September 1959).

The oyster crab and its close relatives are members of a group commonly known as pea crabs, so called because their bodies are about the size of peas. The majority of the larger species of clams are subject to invasion by some species of pea crabs. The oyster's mantle cavity, through which a current of water flows, is an ideal habitat. Refuge is provided, and food and oxygen are brought to the crab by the host. Although most pea crabs living in clams and mussels apparently do not harm their hosts, the oyster crab does damage the gill tissues of the oyster; thus there is some justification for calling it a parasite.

## NATURAL HISTORY

### Molting and Growth

One of the distinguishing characteristics of the phylum Arthropoda is the presence of an all-enveloping exoskeleton, composed basically of a material called chitin. In crabs, this chitinous exoskeleton is further strengthened by the deposition of calcium salts.

While the hard shell of the crab forms a fine set of external armor, it also limits the size of the animal inside. For a crab to increase in size, it must periodically shed its rigid outer covering and form a new one. This process is called molting or ecdysis. Prior to molt, a new, soft exoskeleton is formed inside, and the old shell becomes loosened. As the crab begins to molt, the carapace, or back shell, is lifted, revealing a gap between it and the abdomen. The shell splits on either side of the undersurface, and the posterior part of the crab begins to protrude. Over a period of a few minutes, the crab completes the process, gradually backing out of the old shell (fig. 1).

Immediately after molting, the shell is soft and wrinkled; this thin and elastic new cuticle allows the body to expand and grow in size. Growth in size of the animal results from the copious intake of water after molting, with a consequent increase

Figure 1.--Molting. A blue crab is shown "backing out" of its old shell.

in the volume of the body fluid. As a result, the new cuticle becomes stretched, and the animal is considerably larger than before the molt.

In the soft shell state, the crab is practically helpless and is vulnerable to attack by its enemies. Since many crabs are cannibalistic, these enemies often turn out to be members of its own kind. During the molting process the crab seeks some secluded spot where it is safe from attack until the new shell becomes rigid. The new covering soon hardens by chemical change, some of which is brought about by exposure to the water, and the crab is usually able to resume its normal activities within a matter of hours after molting.

The number of times that a crab molts during its lifetime, and the length of time between molts, varies among species and is affected by such factors as temperature and the amount of food available. In general, as the crab increases in size through successive molts, the length of time between molts becomes progressively longer. In some species, an upper limit of size is eventually reached and molting stops. Other species continue to grow throughout life, even though molts occur less and less frequently.

## Reproduction and Development

Mating in crabs generally takes place soon after the female has molted, often while she is still in the soft-shelled state. At this time, the male transfers spermatozoa to the seminal receptacles of the female where they remain until egg laying begins. Some crabs, such as the blue crab of the Atlantic and Gulf coasts, mate only once. The female receives enough spermatozoa at this one mating to fertilize all the eggs which she will lay in her lifetime, some of which may be produced a year after mating. Other crabs, with a longer life span, mate each year after reaching sexual maturity.

When the eggs are mature, they enter the seminal receptacles where they are fertilized and then pass outside the body into a basketlike cavity formed by the curved abdomen and the abdominal appendages (pleopods). The eggs become attached by a sticky substance to long hairs on the pleopods, and a mass of eggs is formed under the abdomen. This egg mass, which may be quite bulky and noticeable, is often referred to as the "sponge". The eggs are carried until they hatch, and during this time the female is called a "sponge crab" or a "berry crab" (fig. 2).

As in most Crustacea, the young of nearly all crabs hatch as larvae that are quite unlike their parents. The first larval form, known as a zoea (fig. 3), is a minute, transparent organism that swims at, or near, the surface of the sea. It has a rounded body, often armed with long spines, and a long, segmented abdomen. The eyes are very large in proportion to the body and are not on stalks as they are in the adult. The legs are not yet developed, and the swimming appendages are actually the future mouthparts of the crab.

After molting several times as it grows in size, the zoea passes into a second larval form called the megalops (fig. 4). In the megalops stage, the body and limbs are more crablike, but the abdomen is still large and not folded under. At this stage, the larva may either swim, or crawl about on the bottom on recently developed true legs.

The megalops molts directly to the "first crab" stage, a form closely resembling the adult. This is the last molt during which any major changes in appearance occur.

There are a few crabs, especially those living in fresh water, which do not have any free-swimming larval forms. In these, the young emerge from the egg as miniature adults.

## Autotomy, and Regeneration of Lost Legs

Crabs often lose one or more legs during a lifetime and, unless they have reached a stage where they no longer molt, are able to replace these with new limbs. Most crabs have a highly developed ability to drop an injured leg. This process is referred to as autotomy. Autotomy is the severance of an appendage at a preformed breakage point as the result of a reflex action by the animal. When a leg is severed at this breakage point, which is close to the body of the crab, the resulting opening is closed by a valve, and there is very little loss of blood from the stump. It has also been shown that regeneration, or growth of a new limb, takes place more rapidly at this point than anywhere else

Figure 2.--"Sponge crab". The female blue crab shown here may have 2 million eggs in the sponge.

within the limb. The process of autotomy is an adaptation that permits the animal to rid itself quickly of an injured limb at a point where the possibilities for healing and regeneration are maximum. Autotomy may also be of value as a means of escape when an appendage is grasped by an enemy.

A limb bud, within a protective sac, grows at the point of the break. The protective sac is thrown off at the next molt, and the crab then has a new and usable leg, although it may be smaller than the lost one. Usually two or three molts are necessary to produce a claw or leg of normal size.

## COMMERCIALLY IMPORTANT CRABS

Many species of crabs are sought as food by man. Only certain species, however, possess the qualifications of an important food resource. One of these qualifications is that the crabs must attain a reasonably large size; others are abundance, good flavor, and a ready market. Crabs which meet all of these requirements are found in the marine waters of the Atlantic, Gulf, and Pacific coasts of the United States, and the crab industry is one of the important segments of American fisheries.

### Atlantic Gulf Coast Crabs

The crab fisheries of the Atlantic and Gulf coasts produced, in 1961, 155,458,000 pounds of crabs, worth $8,427,000 to the fishermen. The blue crab, which supports the oldest and largest crab fishery of the United States, accounted for 98 percent of the total landings. Although this crab is fished intensively in the Chesapeake Bay, it is abundant in many parts of the South Atlantic and Gulf coasts where it is scarcely exploited. The rock crab and Jonah crab of New England and the stone crab of the South Atlantic and Gulf support small fisheries, but they could support much

larger ones. The green crab of New England is mainly of interest as a pest to the soft clam industry. The deep sea red crab, which lives in the deep water off the Atlantic coast, has a potential commercial value. A recent import, the Samoan crab, has been transplanted from the western Pacific to Florida, where it may thrive and become a commercially important species.

**Blue crab.**--The blue crab, *Callinectes sapidus* (from Latin *calli,* beautiful + *nectes,* swimmer, and *sapidus,* savory), next to the shrimp and lobster, is the most valuable crustacean of our waters (fig. 5). Its range is from Nova Scotia to Mexico, but it is not sufficiently abundant north of New Jersey to support a fishery. The Chesapeake Bay region is especially famous for its great numbers of blue crabs.

The blue crab is a member of the family Portunidae (from Latin *Portunus,* the Roman god of the port or harbor), the swimming crabs, and although it spends most of its time walking around on the bottom, it can swim with great speed when the occasion demands. Fully grown, it is between 5 and 7 inches across the back shell, although larger ones are sometimes caught. The back shell of the live crab is a dark green or brownish-green and is drawn out on each side into a long spine. The undersurfaces of the body and legs are white. The tops of the claws of both sexes show varying amounts of blue; in females, the

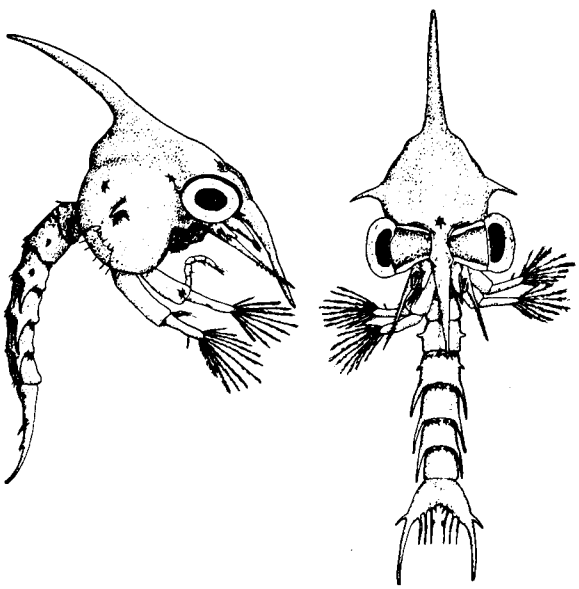

Figure 3.--Zoea larva of the blue crab. (After Costlow and Bookhout.)

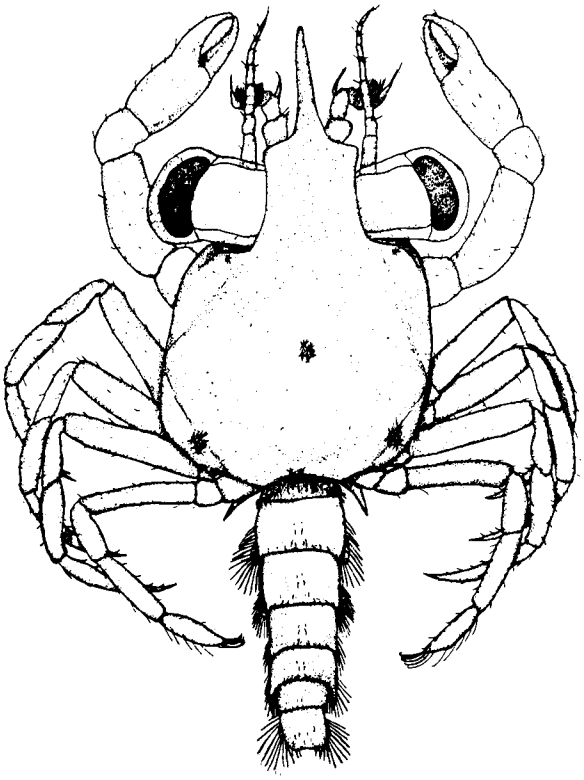

Figure 4.--Megalops larva of the blue crab. (After Costlow and Bookhout.)

tips of the claws are bright red. The blue crab is a very pugnacious animal and quickly attacks when cornered. It is this type of behavior on the part of some crabs that is the basis for the English word "crabby", which means cross or ill-tempered.

The blue crab is essentially a shallow-water crab, and its favorite habitat is in the sounds, bays, and channels near the mouths of coastal rivers. While normally an inhabitant of salt water, it is also found in water that is brackish or even fresh. The life span of this crab is generally about 3 years.

The food habits of the blue crab are quite diverse, for it eats a wide variety of plant and animal material, both living and dead. Because it is capable of quick movements, this crab is often able to use its strong claws to catch small fish. The blue crab is definitely cannibalistic and preys on injured or soft-shelled members of its own kind.

Blue crabs are caught and marketed both in a soft- and hard-shell condition. The

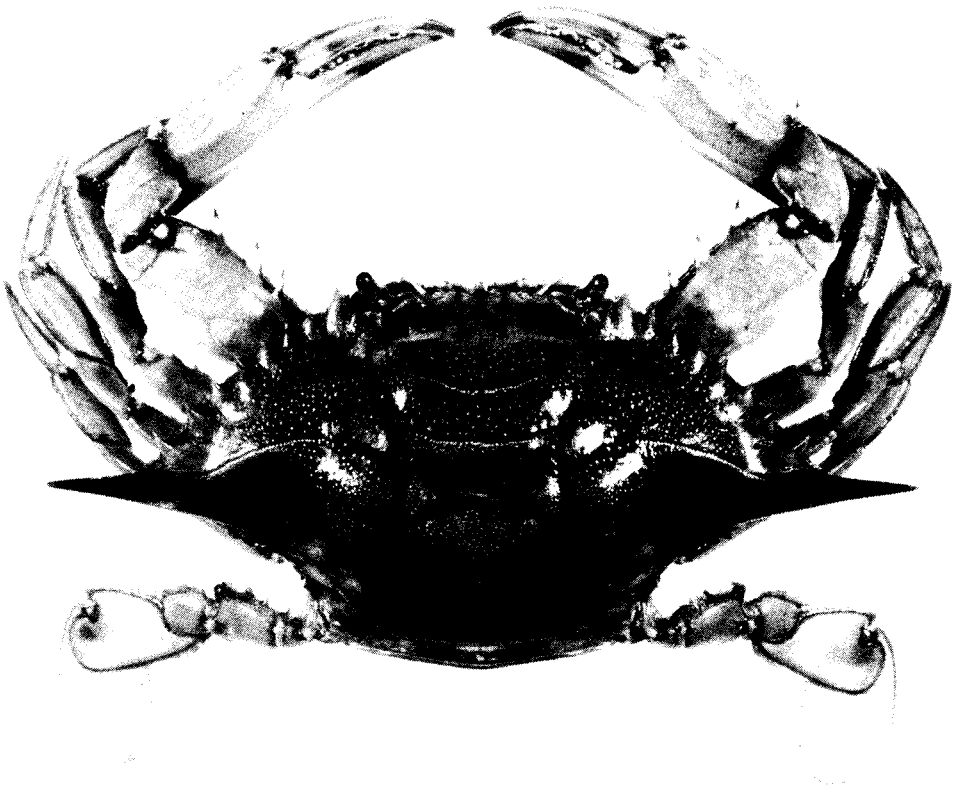

Figure 5.--The blue crab, *Callinectes sapidus.*

entire body of a soft-shell crab may be eaten after cooking. Soft-shell crabs are considered a great delicacy and bring a much higher price than hard-shell crabs. The experienced fisherman can tell when a crab is about to molt, and in some areas these crabs are placed in holding pens and, after molting, are sold as soft crabs. The hard crabs are sold either alive to the consumer or are steamed. In the latter case, the meat is usually picked from the shell, packed in containers that must be kept refrigerated, and sold as fresh crab meat. Very little blue crab meat is frozen or canned. The 1961 catch of blue crabs amounted to 152,758,000 pounds, valued at $8,149,000.

One of the most widely used and efficient methods of capturing blue crabs is the crab pot (fig. 6). This is a traplike device made of chicken wire mounted on a cubical, metal frame about 2 feet in each dimension. The crab pot is designed to allow the crabs to enter easily through funnels, but to make their escape difficult. The pot typically is baited with fresh fish.

Blue crabs are also caught with trawls, dredges, and baited lines, such as the trotline (fig. 7). The trotline is a long length of rope with pieces of bait attached at intervals. It is laid on the bottom, with its ends anchored, and marked by buoys. To collect the crabs, the fisherman runs his boat along the line, forcing the line to pass over a roller attached to the boat. As the boat moves forward, the crabs cling to the bait until they reach the surface, where the fisherman catches them in a dip net and places them in a basket or barrel.

**Stone crab.**-- The stone crab, *Menippe mercenaria (menippe,* probably after *Menippus,* a Greek writer and cynic, and Latin *mercenaria,* hired for wages), is a large, sluggish crab with a smooth, oval body and massive, greatly enlarged claws (fig. 8). It is a colorful crab, the young being a dark purplish-blue, turning to brownish-red, flecked with gray in the adult. The fingers of the large claws are black, and the legs are ornamented with red and yellow bands. Unlike the blue crab, it has no special pair of swimming legs; rather, all its legs are adapted for walking.

The stone crab is found along the coasts of the South Atlantic and Gulf States, but because of its habits, it is seldom seen by the casual visitor to the seashore. The stone crab lives around jetties, lying wedged in the sand at the edge of the rocks. It is also found in shallow areas where it lives in burrows, just below the low tide mark. These burrows extend obliquely downward for a distance of 12 to 20 inches and are about 6 inches in diameter. Young stone crabs are often found around oyster reefs, or other bottoms with shells, where they live concealed under shell fragments.

Shellfish, such as oysters and clams, are an important part of the stone crab's diet. The powerful claws can easily crush the shells, breaking off a piece at a time until the oyster or clam is exposed and can be eaten. In spite of its formidable claws, the stone crab, if found, can be captured easily by hand, since it is sluggish in its movements and is not particularly pugnacious. Caution should be exercised in picking up a stone crab, however, as its claws are so powerful that a carelessly placed finger may be crushed.

The flesh of the stone crab is considered a great delicacy and is said to resemble lobster in flavor. The yield of meat from the body is slight, and only the claws of stone crabs are marketed. The crabs are captured mainly with pots, and it is the usual practice of the fishermen to release the crabs after breaking off their claws. Nothing definite is known concerning the survival of crabs whose claws have been removed, but crabs are able to grow new claws.

Stone crab claws are either boiled and chilled prior to sale, or are sold fresh-frozen. The 1961 catch amounted to 478,000

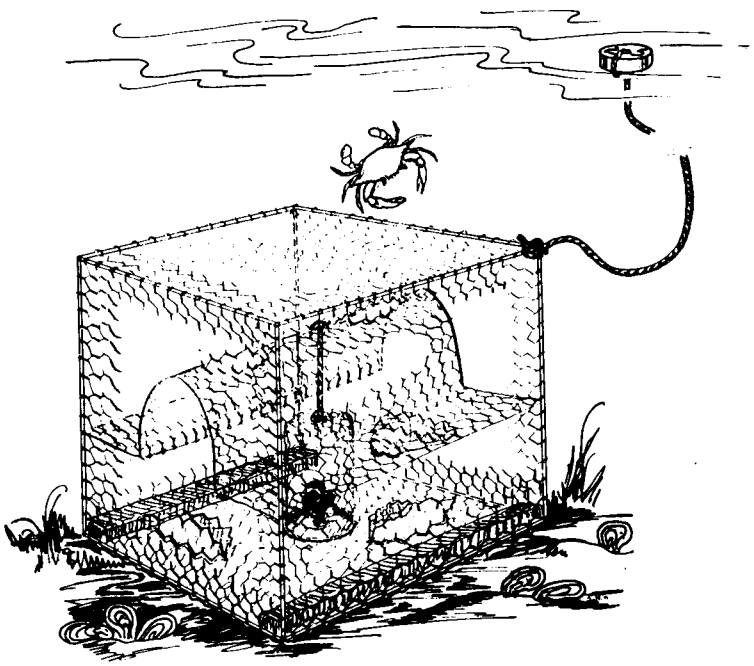

Figure 6.--Crab pot. This cubicle trap has four openings, or funnels, inward. There are two compartments, and in the lower one is a bait-holding device. The upper one is a holding chamber. (After Cargo.)

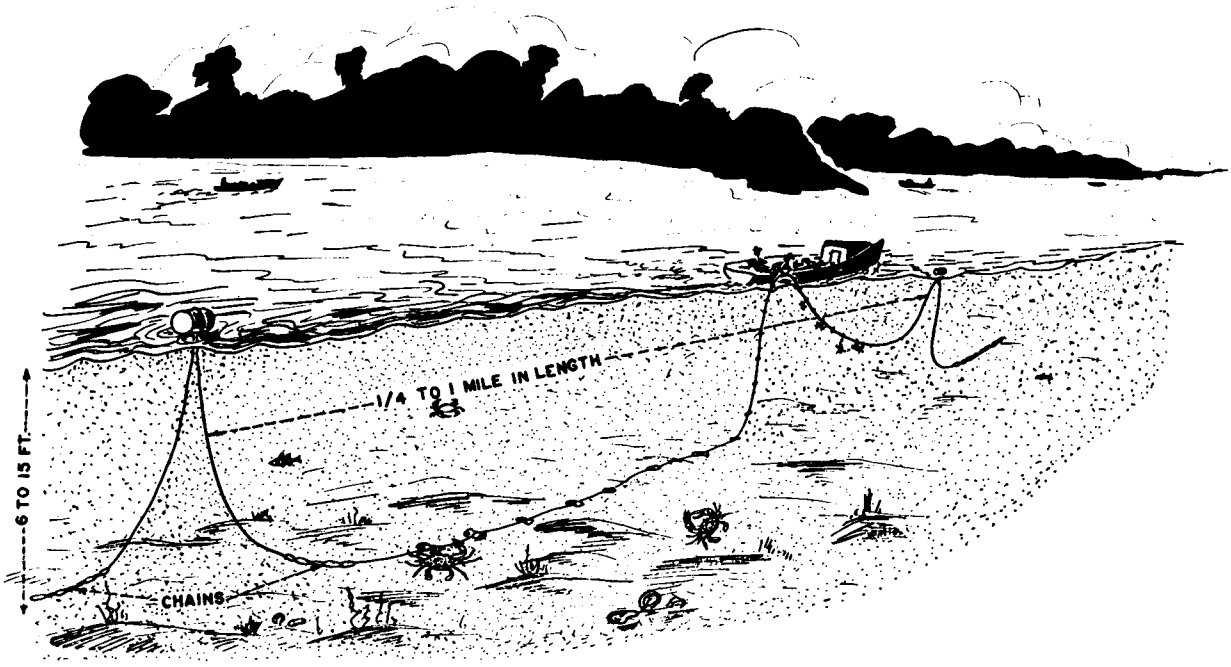


Figure 7.--Trotline. Sketch of a typical Maryland trotline being fished. Shows the anchored and buoyed line, with baits in place, passing over the roller on the side of the boat. The fisherman dip nets the crabs as they are brought to the surface. (After Cargo.)

pounds, valued at $165,000. Although individuals in all the South Atlantic and Gulf States occasionally catch and eat stone crabs, or offer them for sale, the present commercial fishery is confined almost entirely to Florida.

**Rock crab and Jonah crab.**--The rock crab, *Cancer irroratus* (from Latin *cancer*, crab and *irroratus*, speckled), and the Jonah crab, *Cancer borealis* (from Latin *borealis*, northern), range from Nova Scotia to the South Atlantic States but are most abundant on the New England coast. Both crabs are found from the low tide level to depths of several hundred feet. The rock crab is more frequently found in bays than the Jonah crab which, when it is found close to shore, appears to prefer the more exposed locations on the outer coasts.

These crabs are similar in appearance and may sometimes be mistaken for one another. Both have the broadly oval carapace that is characteristic of the genus *Cancer* and moderately large claws. The back and the tops of the legs of the rock crab (fig. 9) are an ivory color and covered with small purple bumps on granules. The color underneath is white to ivory. The Jonah crab is more heavily built than the rock crab and has a much rougher surface. The color is brick red above and yellowish beneath.

These crabs have scarcely been exploited commercially, but there is no reason why they should not be. Both are rather abundant, range up to 6 inches in width, contain as much meat as the blue crab, and are its equal in flavor. They are commonly taken along with lobsters in lobster traps, and the few individuals who fish exclusively for these crabs often use modified lobster pots instead of crab pots.

Since the crab meat is more difficult to pick and is less profitable than lobster, many dealers and fishermen feel that handling crabs is not worth their time. Thus, the crabs, which otherwise might be a major source of income, are neglected in favor of the lobster. Some dealers, however, handle small amounts of crab meat in connection with lobster meat, mainly as a convenience to the buyer.

The *Cancer* crabs of New England lend themselves to small, family-type industry. Wives of lobstermen often pick and pack crab meat for local grocery stores.

Figure 8.--The stone crab, *Menippe mercenaria.*

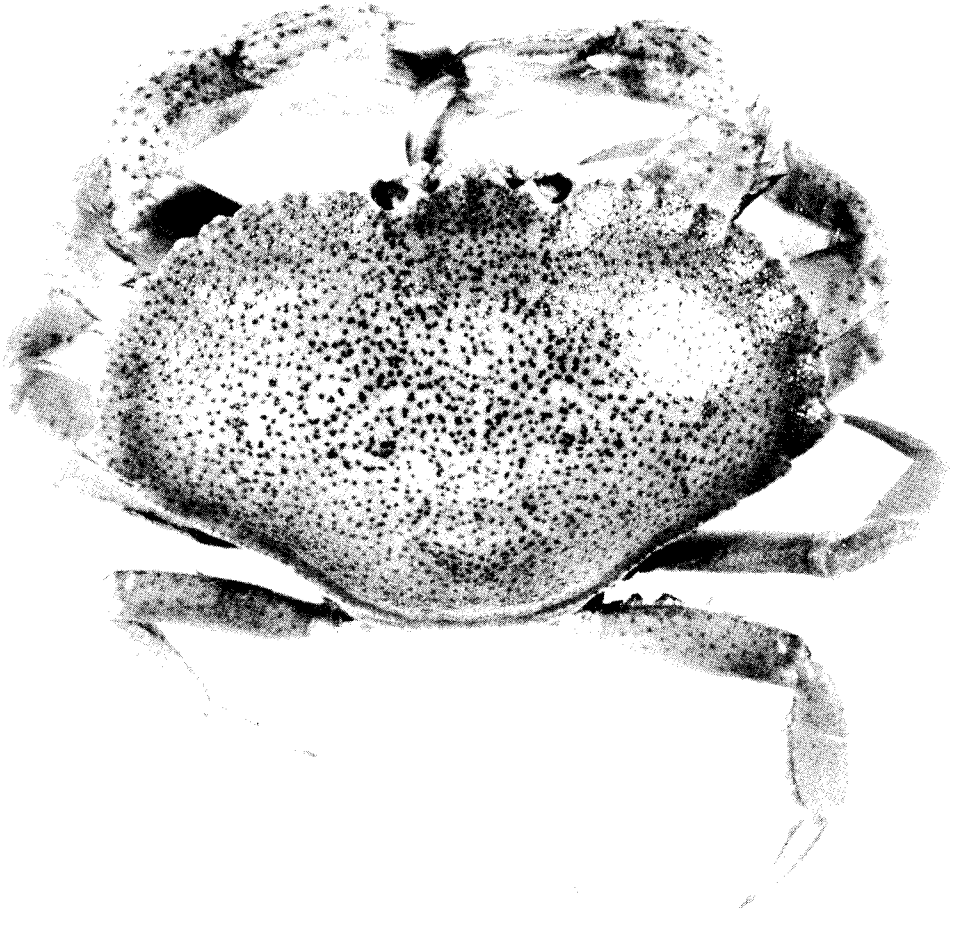

Figure 9.--The rock crab, *Cancer irroratus.*

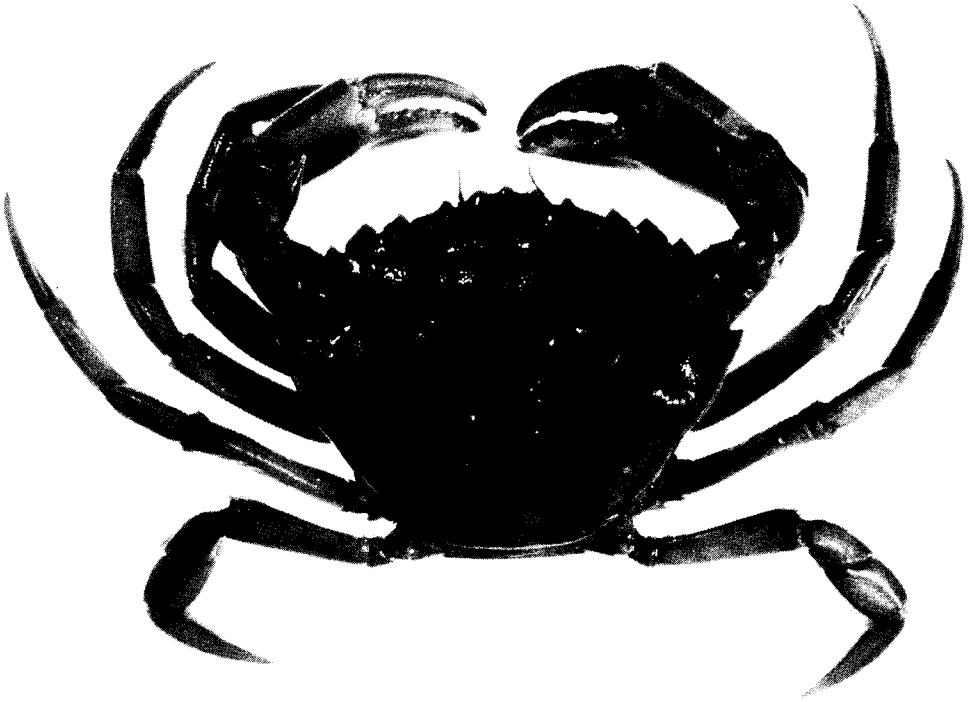

Figure 10.--The green crab, *Carcinus maenas*. *(Photo courtesy of the Smithsonian Institution.)*

In some areas, particularly in Maine, this practice is apparently quite common. For this reason, the statistics on the catch of rock and Jonah crabs are no doubt somewhat less than the actual total. The combined catch for both species in 1961 was 2,096,000 pounds, valued at $102,000.

**Green crab.**--The green crab, *Carcinus maenas* (from Greek *karkinos,* a crab and *Maenas,* a mythical Greek priestess), is of interest in this country, not because of its qualities as an edible crustacean, but because of the extensive damage which it has done in recent years to the soft clam industry of New England.

Green crabs are temperate water crustaceans which apparently moved northward in response to the trend towards milder winters during the past 50 years. Prior to 1900, the green crab was reported to occur from Cape Cod southward to New Jersey. By 1930, it had extended its range about half-way up the coast of Maine, and today it is not uncommon in Nova Scotia.

The green crab (fig. 10) is not a large crab. The males, which are larger than the females, reach a width of 3 to 4 inches across the back. The color of the males is green, mottled with black on the back and yellowish underneath. The female is orange, mottled with black on the back and deep orange underneath. Green crabs are members of the family of swimming crabs, but differ from the other members of this family in having the last pair of legs flattened, with pointed tips, rather than expanded as oval paddles.

Green crabs burrow into the mud and sand flats to obtain their food. They use the large front claws to hunt through the sediments for animal life upon which they feed. Their choice food item is the soft clam, *Mya arenaria,* which has a rather thin shell that the green crab is able to crush with its claws, thus exposing the meat. Experiments at the Bureau of Commercial Fisheries Biological Laboratory at Boothbay Harbor, Maine, showed that one medium-size green crab eats about 15 small ($\frac{1}{2}$-inch diameter) clams each day. Some experimental clam beds have had nearly all the clams eaten by green crabs in a matter of weeks. Two methods that have been developed for controlling green crabs are (1) enclosing the clam flats with a low wire fence and (2) surrounding the

flats with lines to which poisoned baits are attached. Both methods are expensive and not completely effective.

The fishery for green crabs is a modest operation carried on, especially in Massachusetts, with traps similar to lobster pots. All of the catch is sold as bait for marine sport fishing. The green crab is common on the coast of Europe and is used there as food. The total catch in the United States in 1961 was 126,000 pounds, valued at $11,000.

**Deep sea red crab.**--The deep sea red crab, *Geryon quinquedens* (from Latin *Geryon,* a mythical three-bodied monster and *quinque,* five + *dens,* tooth), is worthy of mention since it has the possibility of some day supporting a commercial fishery.

This crab occurs off the east coast from Nova Scotia southward at least as far as Cuba in depths ranging from about a hundred to a few thousand feet. It appears to be most abundant beyond depths of 600 feet.

The body of the red crab (fig. 11) is squarish and the walking legs are long and slender. The color is red or deep orange. On each side of the front edge of the carapace are five short spines or teeth to which the scientific name *quinquedens* refers.

Most specimens captured by exploratory trawling were between 4 and 6 inches across and weighed between 1 and 2 pounds. The meat of these crabs is delicious. As trawlers become equipped for fishing in greater depths, this species may some day become the source of a commercial fishery. At present, the deep sea red crab remains an untouched resource of unknown value and extent.

**Samoan crab.**--The Samoan crab, *Scylla serrata* (from Latin *Scylla,* a legendary monster and *serra,* saw), although not native to the United States, may someday be an important commercial species here. This crab (fig. 12), also known as the mangrove crab, is the common edible crab of India and is widely distributed in the western tropical Pacific. Like the blue crab, the Samoan crab is a swimming crab which thrives in estuaries, mouths of rivers, and shallow bays. Its chief advantage over the blue crab as a commercial species is its larger size. Individuals 8 inches or more wide are not uncommon, and some specimens are reported to reach a weight of 5 to 6 pounds.

The Samoan crab was successfully introduced into Hawaiian waters and apparently is well established there, although it now supports only a very small fishery.

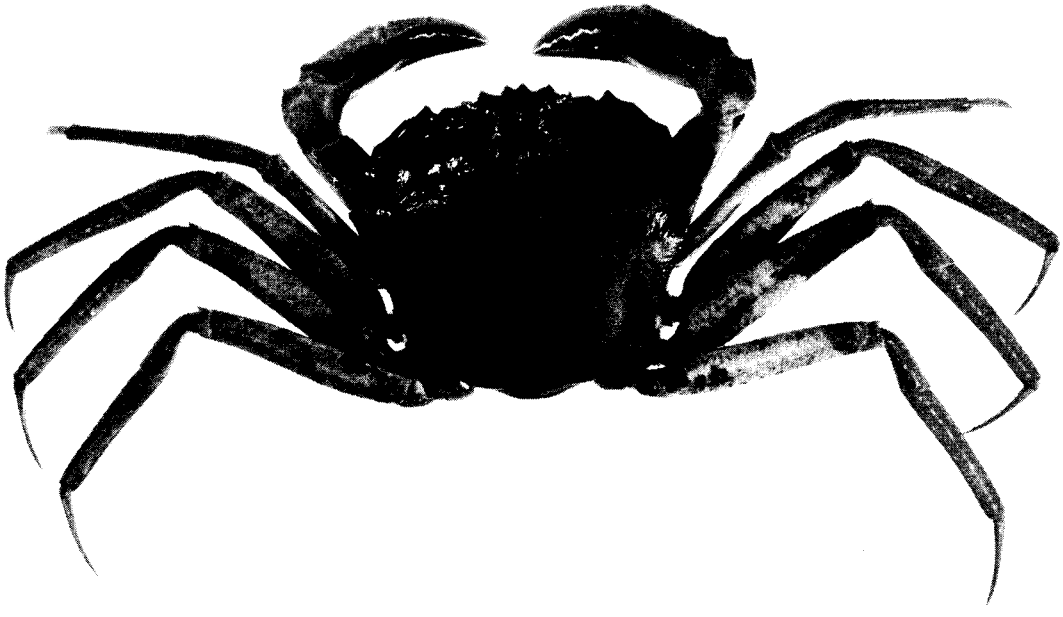

**Figure 11.--The deep sea red crab,** *Geryon quinquedens. (Photo courtesy of the Smithsonian Institution.)*

After considerable deliberation, the Florida Board of Conservation decided to introduce the Samoan crab into Florida waters. Experimental plantings were begun in September 1961 at several spots along the southern tip of the peninsula and at one spot on the west coast. It remains to be seen if the Samoan crab will thrive in Florida and eventually support a commercial fishery.

## Pacific Coast and Alaska Crabs

The crab fisheries of the Pacific coast and Alaska are based almost entirely on two species, the Dungeness crab and the king crab. The fishery for Dungeness crabs began on the West Coast before 1900, and, among the crab fisheries of the United States, it ranks third, being exceeded in value only by the blue crab and king crab. The fishery for king crabs was very small prior to World War II, and millions of pounds of canned king crab meat were imported from Japan annually. Since World War II, the king crab resource has begun to be exploited and is now one of our most rapidly expanding fisheries. Another crab which lives in Pacific coast and Alaska waters is the tanner crab; this crab has scarcely been exploited but has the potential for supporting a commercial fishery.

**Dungeness crab.**-- The Dungeness crab, *Cancer magister* (from Latin *cancer,* crab and *magister,* chief), is found from the Alaskan Peninsula to southern California, but reaches its greatest abundance in the area between San Francisco and Southeastern Alaska. It is one of the largest edible crabs of the United States, reaching a width of 9 inches across the back. The crab gets its name from the small fishing village of Dungeness, Wash., where commercial fishing for this crab started.

The Dungeness crab (fig. 13) is light reddish-brown on the back with a pattern of lighter streaks and spots. In some specimens, the anterior portion of the back is purplish. The underside varies from whitish to light orange, and the inner and upper sides of the anterior legs are colored crimson or purple.

The fishery for Dungeness crabs takes place principally in offshore waters from 12 to 120 feet deep, with only incidental

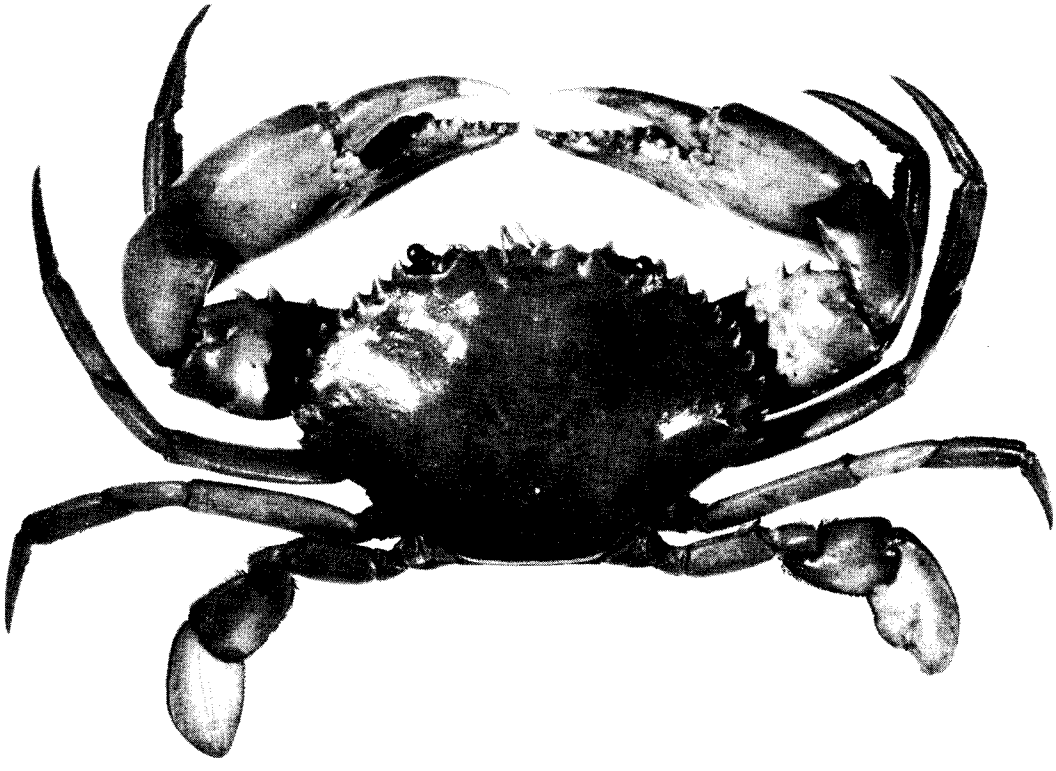

**Figure 12.--The Samoan crab,** *Scylla serrata. (Photo courtesy of the Smithsonian Institution.)*

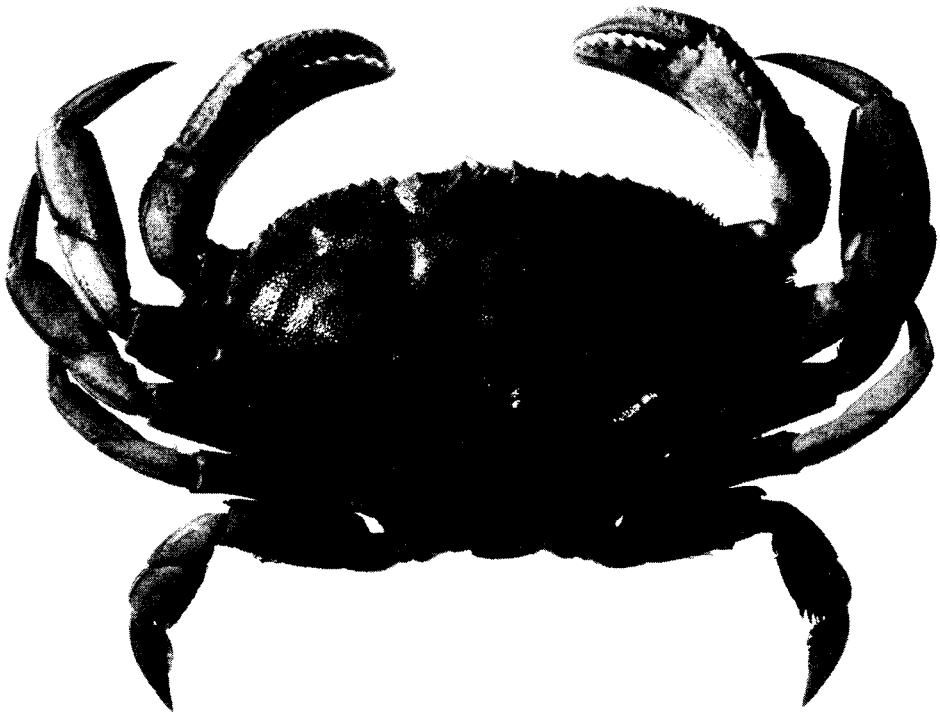

Figure 13.--The Dungeness crab, *Cancer magister. (Photo courtesy of the Smithsonian Institution.)*

catches from estuaries. Although commercial fishing regulations vary in different areas, there is one regulation in effect wherever the Dungeness crab is fished--only male crabs of a specific minimum width of shell may be taken. The minimum legal widths are set by the States, and presently vary from 5 3/4 inches to 6 1/2 inches, depending on the locality from which the crabs are taken. The crabs reach legal size in 3 to 4 years and probably live for about 8 years.

Dungeness crabs are caught by pots and ring nets, using fresh or frozen razor clams, squid, or fresh fish for bait. Contrary to common belief, fresh bait is much more effective than old or spoiled bait. Since the majority of Dungeness crabs are caught in the open coastal areas, the pot must be designed and constructed so that it will remain in an upright fishing position on the ocean floor regardless of heavy wave action or tidal currents. The pots are of two types, circular and rectangular.

The circular pot is the most common type, and is typically about 42 inches in diameter and 14 inches deep, with two entrance tunnels. The bottom of the pot is about 2 inches larger in diameter than the top and has two iron bars reaching across the bottom frame. Iron weights are often attached to the bottom frame to give the pot added stability on the ocean floor. The pots are covered with stainless steel wire mesh and weigh about 90 pounds without the iron weights. A line connects the pot on the ocean floor with cork or plastic buoys on the surface and is used for hauling the pot up to the fishing boat. The surface buoys are brightly colored and not only mark the location of the pot but also serve to identify the owner.

Rectangular pots are lightly constructed and weigh about 35 pounds. The dimensions are about 30 inches square and 12 to 14 inches in height. The frame is covered with chicken wire. Because of the light weight and boxlike shape of this type of pot, its use is confined to the inside, protected waters where it can be fished from small boats and lifted or hauled by hand. The large ground swells and strong tidal currents which occur in the open exposed areas will cause this type of pot to tumble on the ocean bottom. For this reason it is not suitable for fishing in open areas.

The ring net is less complicated than the pot but requires greater skill in operation. It consists of a pair of iron rings, the outer ring being 40 to 55 inches in diameter and the inner ring about half that size. A single thickness of coarse netting covers and connects the rings. A bag of small mesh containing the bait is tied in the center of the small ring. When the ring net is lowered to the bottom, it lies flat; but when it is hoisted up, it forms a basket-shaped structure. Because the ring net must be hoisted before the crabs can crawl off, fishing with this gear is limited to waters less than 60 feet in depth.

Dungeness crabs are marketed whole as cooked, "dressed" crabs, or the cooked meat is sold fresh, frozen, or canned. Crabs are "dressed" by removing the digestive and reproductive systems and gills after cooking, and then freezing the crabs in plastic bags. Prior to 1957, nearly the entire production of fresh crab meat was marketed on the Pacific coast. Since that time, however, the market has been extended throughout the United States, and frozen "dressed" Dungeness crabs are a common sight in East Coast food stores.

California is the leading State in Dungeness crab catches at present, followed by Oregon, Washington, and Alaska, in that order. This crab also supports an important fishery in British Columbia, Canada. The U.S. catch in 1961 amounted to 32,699,000 pounds, valued at $4,977,000.

**King crab.**-- The king crab, *Paralithodes camtschatica* (from Greek *para,* beside--this is a prefix used in scientific names to mean "closely resembling" + *Lithodes,* a closely related genus, whose name comes from the word *lithos,* stone, and *camtschatica,* from the Kamchatka Peninsula which extends into the Bering Sea), is not closely related to the other commercially important crabs of the United States. In fact, it is not even a true crab. The king crab (fig. 14) is an anomuran, and a member of the family of lithode, or stone crabs. The name refers to their heavy, rough shell which resembles a stone.

The lithode crabs at first glance appear to have only four pairs of walking legs; however, they all have a small fifth pair of legs that are bent upward and often inserted under the carapace. It is one of the distinctive features of the suborder Anomura that the fifth legs are reduced in size.

Lithode crabs are characteristically found in the cold waters toward the poles and in the deep sea. The home of the king crab is the cold waters of the North Pacific Ocean, the Bering Sea, and the Okhotsk Sea. It occurs in the eastern Bering Sea, where bottom water temperatures are at times below $0^{\circ}$ Centigrade, and ice covers much of the fishing ground during the winter.

Perhaps the most spectacular and commercially important feature about king crabs is their large size. Male crabs with an overall spread of 4 to 5 feet and weighing 15 pounds or more are not uncommon in Alaska waters. Female king crabs run much smaller in size than the males and it is illegal to have them in possession. The fishery, consequently, is based entirely on males.

Adult king crabs migrate to relatively shallow waters (60 to 200 feet deep) in early spring for molting and spawning. In general, crabs more than 4 inches in carapace length are sexually mature and are probably 4 to 6 years old at this length. Females molt just before spawning. Eggs are attached to fine hairs on the abdominal appendages of the newly molted female and are fertilized externally. Males probably molt somewhat earlier than females, but it is not entirely clear whether or not newly molted males participate in spawning. Eggs are carried by the female for about 11 months and hatch just before the next spawning and molting season.

King crabs in their first 2 or 3 years of life are shallow water dwellers and may be found in large schools, or "pods", close to shore. As they grow older, they enter into the annual adult migration. In general, this is a movement inshore to specific spawning areas during winter and early spring and a reverse migration offshore to feeding areas in summer and fall. These offshore feeding areas may be in waters up to 1,000 feet in depth.

King crabs in Alaska waters are caught almost entirely by pots and ring nets. The pots, baited with fish or clams, have tunnellike openings leading inside. Some king crab pots are circular, but the most common type is built on a metal frame, 7 feet by 7 feet by $2\frac{1}{2}$ feet.

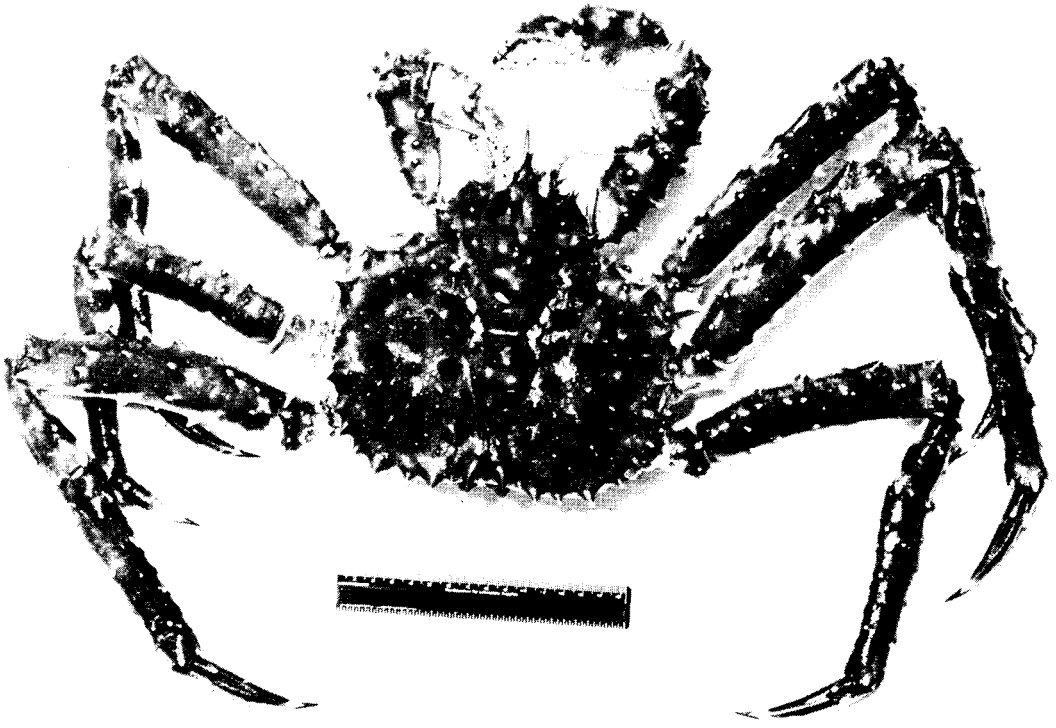

Figure 14.--The king crab, *Paralithodes camtschatica. (Photo courtesy of the Fisheries Research Board of Canada.)*

During the early years of the U.S. king crab fishery, trawls and tangle nets were the principal gear employed. The tangle net consists of a wall of net supported at its upper edge by floats and weighted at the bottom by leads. The net is set so that it stands upright from the bottom. The crabs walked into the net and became entangled in the meshes. Gear restrictions outlawed tangle nets in 1955 and have successively restricted trawls from the inside waters. Only a few thousand pounds of king crab per year are now caught by trawls, and pot fishing is encouraged in all areas.

King crab meat is processed for the market by freezing and canning. Because the meat must be processed quickly to avoid deterioration, floating canneries are used on the coast of Alaska. These self-contained units move from one part of the coast to another and are supplied with crabs by a number of fishing boats. King crabs are canned, stored, and transported back to home port aboard the cannery vessel. The king crab is our most important source of canned crab meat.

Prior to World War II, the U.S. fishery for king crabs was very small, and about 10 million pounds of canned crab meat were imported from Japan each year. This imported pack consisted almost entirely of king crab, a large part of which was taken in waters adjacent to Alaska and packed in floating canneries. Since World War II, this valuable American resource has begun to be exploited by the United States, and the Alaska king crab fishery is now one of our most rapidly expanding fisheries. The U.S. catch of king crab increased from 1.5 million pounds in 1950 to 28 million pounds in 1960 and to 43 million pounds in 1961. The value of the 1961 catch was about $3.9 million.

**Tanner crab.**--The tanner crab, *Chionoectes tanneri* (from Greek *chion,* snow + *nektos,* swimming, and *tanneri* for Lt. Commander Z. L. Tanner, Commander of the U.S. research vessel *Albatross,* whose explorations produced the first specimens of this species), lives in the deeper waters of the Pacific coast of North America, from the Bering Sea to southern California.

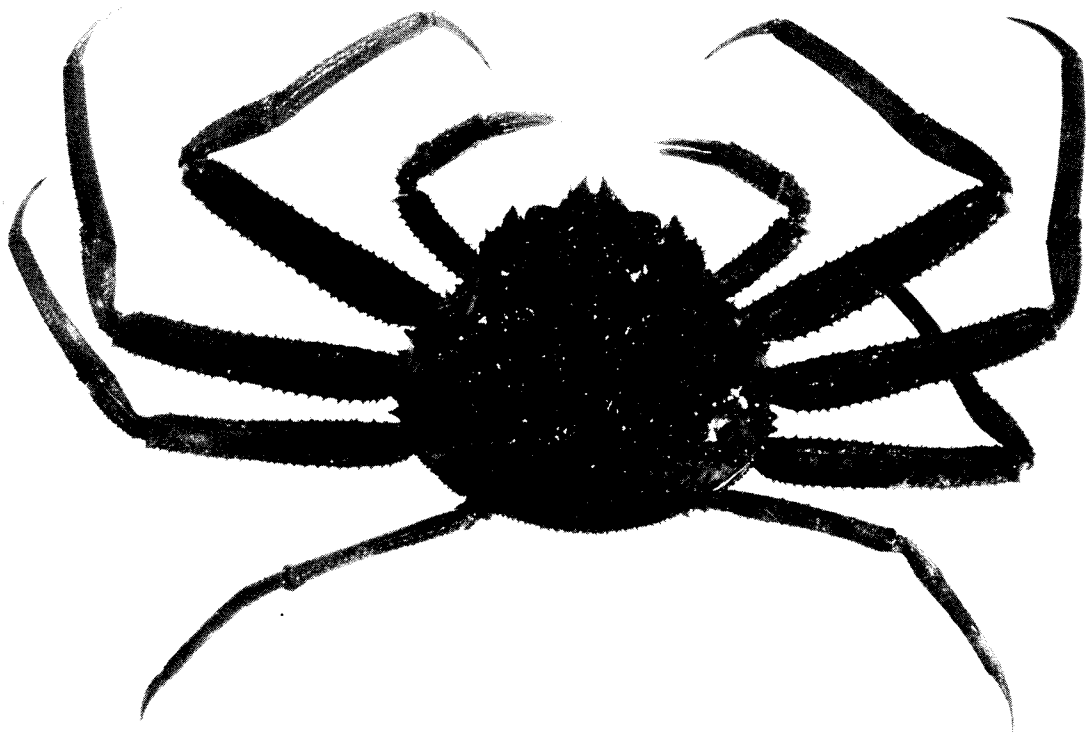

Figure 15.--The tanner crab, *Chionoectes tanneri. (Photo courtesy of the Smithsonian Institution.)*

This crab belongs to the family of spider crabs, so-called because their legs are long and slender in proportion to their bodies.

The tanner crab (fig. 15) grows to a relatively large size. Specimens 5 to 6 inches across the back and $2\frac{1}{2}$ feet between the outstretched legs are not uncommon. The claws are small in relation to the other legs. It is a deep-water crab and is seldom found at depths of less than 500 feet. The tanner crab has a pleasant flavor and, if a market could be developed, might become the basis for a commercial fishery. Small numbers of tanner crabs are taken along with king crabs, but, at present, this species represents an untapped natural resource. The total U.S. catch in 1961 was only 7,000 pounds, valued at $1,000.

## Hawaiian Crabs

The present commercial catch of crabs in Hawaii is small, totaling 29,500 pounds in 1961, worth $18,200. Much remains to be learned about the biology, abundance, and distribution of the Hawaiian crabs of commercial value, but there is no doubt that the potential exists for a much larger crab fishery than the present one.

**Kona crab.**--The Kona crab, *Ranina ranina* (from Latin *rana,* frog) is the most important commercial species of Hawaiian crabs. The Kona crab (fig. 16) is a member of the family *Raninidae,* the so-called frog crabs. These crabs have an elongated body, and the last pair of legs is held in a horizontal position, suggesting the hind legs of a frog.

The Kona crab is caught by vessels employing lift nets baited with fish or fish parts. These nets measure about 3 feet in diameter, if round, and about 3 feet by 3 feet, if square. About 30 to 50 of these are hung from a mainline and hauled in by winch. At times, the nets are set individually by operators of small boats and pulled by hand. This species is usually taken at depths of 90 to 120 feet, on flat, sandy bottoms. The average carapace length of Kona crabs in the commercial landings is about 5 inches. Average weight is about 1 pound. Large individuals with carapace lengths up to 7 inches and widths up to 6 inches have been recorded. The flesh is

Figure 16.--The Kona crab, *Ranina ranina.* *(Photo courtesy of the Smithsonian Institution.)*

highly esteemed for food and is commonly served in restaurants as a specialty.

**Other species.**--Other Hawaiian species of lesser commercial importance are the white crab, *Portunus sanguinelentus;* the red crab, *Podophthalmus vigil;* the Samoan crab, *Scylla serrata;* and the aama crab, *Grapsus grapsus tenuicrustatus*. These constitute a small part of the commercial landings and are usually caught by lift nets or scoop nets. The aama crab is caught by a string loop attached to one end of a bamboo pole. This species inhabits the spray zone of rocky shores where the use of lift nets and scoop nets is practically impossible.

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