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Virginia Fisheries Laboratory of the College of William and Mary and Commission of Fisheries

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The Biology and Conservation of the Blue Crab

by

CURTIS L. NEWCOMBE

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Figure 1.—Showing tidewater Virginia and the extent of the crab sanctuary established by the Commission of Fisheries in 1941 to protect the egg-bearing crabs. (Drawn by G. M. Moore.) Annual average surface-bottom salinity records are indicated (after Wells, Bailey and Henderson, 1929).
The Biology and Conservation of the Blue Crab*

by

Curtis L. Newcomb†

Virginia Fisheries Laboratory

Blue crabs numbering about 200 millions are removed annually from the waters of Virginia and Maryland. Each female crab on spawning once produces around two millions of eggs, and yet times of shortages come and result in heavy losses to the crab industry. The causes of crab shortages may be better understood if an explanation is given of the life history of the crab and its periodic migrations. Also, attention should be given to the general characteristics of a hard-shell crab, a soft-shell crab, a "peeler" crab, a "buster" crab, a "sponge" crab, an immature female and a mature female crab, a male crab, and to the two larval stages called zoea and megalops. These are shown in the Laboratory's school exhibit and moving picture entitled "The Biology of the Blue Crab." Crab investigations have been conducted in Chesapeake Bay at different times during the past twenty-five years by the Federal Government and the Maryland and Virginia fishery commissions. Studies are still being conducted by these agencies.

Thanks are expressed to Roy L. Robertson and George M. Moore for preparation of figures; and to the Virginia Chamber of Commerce for making numerous photographs.

LARVAL STAGES

Crab eggs (0.01 inch in diameter) numbering around two millions in a single "sponge" or egg mass are attached by a glandular secretion to hair-like branches of the swimmerets under the abdomen or "apron" (figure 2). It probably takes a crab two hours or more to deposit a "sponge" and approximately two weeks are required for hatching in nature under favorable conditions. During the first seven or eight days of the hatching period,

*Requests for copies of the Educational Series should be sent to the Director, Virginia Fisheries Laboratory, Williamsburg, Virginia.
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FIGURE 2.—Upper, showing blue crab eggs attached to appendages of the “apron” or abdomen—about eleven days before hatching; lower, eggs about three days before hatching (drawings by R. L. Robertson).
Figure 3.—Upper, eggs about five hours before hatching; lower, empty egg shells or cases after larvae have emerged (drawings by R. L. Robertson)
the "sponge" is yellow in appearance. Then the eggs become progressively darker until hatching out takes place.

Hatching occurs chiefly during the months of June, July, and August. The first larval stage or zoea is formed when the embryo emerges to the water. The empty egg shells remain for a time attached to the appendages, known as pleopods, of the "apron" or abdomen (figure 3). The zoa larva is about 1/25 of an inch in length, shrimp-like in appearance with a conspicuous dorsal spine, prominent eyes and mouth parts (figure 4). The zoa moults about five times, the period between two successive moults being known as an instar.

Following the last instar of the first larval stage, a moult characterized by conspicuous change marks the beginning of the second larval stage or megalops (figure 4). The megalops larva is somewhat more crab-like in appearance, being broader in proportion to its length, having biting claws and pointed joints at the ends of the legs. This larva is about 1/7 of an inch in length and results to date indicate that it moults directly into the "first crab" stage which has proportions similar to those of an adult but is only about 1/10 of 1 inch in width. About one month is probably required to complete the zoa and megalops stages.

Egg-bearing crabs are most abundant in the southern waters of the Bay and the zoa larvae are most numerous near Cape Henry. In 1941, eggs were removed from the "sponge" mass and hatched into zoa larvae at the laboratory in Yorktown. After that, it was found possible to rear the larvae through the third zoal stage and to determine the environmental conditions in the Chesapeake Bay most likely to be suitable for hatching and larval development. Figure 1 shows the location and extent of the State sanctuary established by the Commission of Fisheries of Virginia to protect the egg-bearing crabs. Studies of the Laboratory have shown that the environmental conditions in this area of the Bay are the best for development of the larval crabs.

**POST-LARVAL STAGES**

The "first crab" stage is very small. Moulting every few days at first and then progressively less often, the young crab soon reaches a marketable size, and during the last four moults about twenty-five days may elapse between moults. Crabs around
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3/4 inch in width increase about 11 per cent during moulting whereas those 4 inches in width increase as much as 40 per cent. The average intervening percentage increase is around 30. Altogether, the crab moults about sixteen times during its post-larval life. In search of better environmental conditions and protection, the moulting crabs are present in largest numbers in shallow waters. Here the “peeler” crabs, those preparing to shed, and soft crabs are gathered for commercial purposes (figure 5).

Sexual maturity of the male is reached at a width* of about 3 3/4 inches, but there are no known external characteristics for indicating this stage of development. The mature female is readily recognized by the change in the “apron” or abdomen from a triangular to a broad, rounded form. When the female is in a soft condition at this moult, which is considered to be the last one, mating may occur. The crab now in the less saline waters of the Chesapeake Bay and the tributaries, stores the male germ cells, known as spermatozoa, in a sperm sac where they remain during the southern migration of the crab to saltier waters of the lower bay. When the eggs are released the following spring, they are fertilized by these spermatozoa as they pass to the outside for attachment to the ventral surface of the apron to form a so-called “sponge”, whence the name “sponge crab,” “cushion crab,” or “berry crab.” It is known that female crabs may spawn twice. The extent to which this occurs is not known. Crabs are about twelve months old when they reach sexual maturity, and their life span is two or three years.

FOOD

Little is known of the kind of food the larval crabs eat in nature. Studies at the Virginia Fisheries Laboratory show that blue crab larvae are highly specialized in their feeding habits. The zoea feed on small plant and animal organisms strained from the water. By feeding them a particular single-celled animal in large quantities, it was possible in August, 1941, to induce them to moult under laboratory conditions. The megalops larvae are able to eat larger particles than the zoeae.

*The width measurement is the distance between the tips of the so-called spikes or prominent lateral spines.
Figure 4.—Upper, showing first zoea larva of the blue crab, about three days after hatching; lower, the megalops or last larval stage of the blue crab (drawings by R. I. Robertson).
The adult crabs take a variety of foods, consuming some plant food material as well as animal life. They will devour fish, other crabs, shrimp, and shellfish such as conchs, snails, and ribbed mussels. There are records of their eating roots of marsh grasses and sedges that occur in shallow estuaries.

FOOD VALUE

Crabs are a highly nutritious food. White crab meat is as rich or richer in calcium, magnesium, phosphorus, iron, and copper than most seafoods. It contains about six times as much iodine as milk and over forty times as much as beef. Crabs are a rich source of vitamins, especially vitamins A, B, and C.

MIGRATORY HABITS

Most female crabs move from the different estuarine waters of Chesapeake Bay to the salty waters near the mouth region for purposes of egg-laying. In May, egg-laying or “sponge” formation among crabs begins and continues throughout the summer until about the middle of September.

The larval crabs that hatch out during the summer in the southern waters of the bay, especially around the region of Cape Henry and Cape Charles, grow and develop, and by late fall these crabs are considered to reach less saline waters of the bay, i.e., part way up the rivers and about half way up the bay near the interstate boundary line. Here they hibernate during winter and in the following spring start growing by successive molts and continue their movements toward the less saline waters of the rivers and the bay.

The crabs reach sexual maturity during the following summer and then mate. After mating the male crabs remain, in large part, in the less saline waters, while the female crabs start to return south to the more saline waters of the lower bay where they are ready to spawn the following spring. About two years elapse from the time the larval crabs hatch out until they become mature enough to spawn.

Seasonal migrations take place to assure most favorable conditions for survival. Thus, with the approach of winter, hard crabs move off shore to the deeper water. It is believed that, in the summer, “sponge” crabs congregate in certain areas
of the lower bay where the salt content of the water is high and hence a favorable place for hatching of the eggs. "Peeler" crabs preparing to shed seek shallow water with luxuriant vegetation so that they are sheltered from enemies when in the soft condition and less able to protect themselves.

**CONSERVATION**

The purpose of crab conservation is to protect the present population so as to assure a profitable fishery during future years. Small, immature crabs and the "sponge" crabs need protection. The soft crab fishery is based on the use of crabs about ready to shed or those that have just shed. To help protect these, the law prohibits the taking of soft crabs below 3 3/4 inches in width and "peeler" crabs below 3 inches in width. During certain years a sanctuary is needed in the less saline waters of the bay to protect peeler crabs.

To protect hard crabs, the law prohibits taking those under five inches in width. The trot-line fishery which takes about three-quarters of the hard crabs caught in Virginia lasts from April 1 to December 1. In certain months the taking of "sponge" crabs is prohibited. During July and August of 1941 and 1942, and from April 1st to August 31st, 1943, "sponge" crabs were given additional protection through the establishment by Virginia of a large sanctuary near the mouth of the bay (figure 1). The winter dredge fishery for hard crabs that takes about one-fifth of the total catch of hard crabs is limited to the period from December 1 to April 1.

All crabs need protection against wasteful methods of handling. Since all available crabs are usually needed, those killed due to improper methods of handling represent a loss to the fishery. The "peeler" crab fishery is based on the catch of crabs that show signs of preparing to shed (figure 5). They are brought to a crab house, placed on shedding floats, and held until they actually do moult—sometimes for several days (figure 5). The actual mouling process may be accomplished in about half an hour or less. Only "pink" or "red line" crabs about ready to shed and having a new soft shell fully formed under the outer hard shell should be held on floats. There has, in the past, been a marked tendency to place so-called "green" crabs
Figure 5.—Upper, showing a blue crab in the process of shedding its shell (Courtesy of C. M. Coker); lower, showing how soft crabs are packed with seaweed in boxes. The float in the background is used for shedding out crabs (Courtesy of the Virginia Chamber of Commerce).
Figure 6.—Upper, showing a crab pot that during recent years has been extensively used in Virginia waters (Courtesy of G. M. Moore); lower, showing a trot-line crab fisherman (Courtesy of the Virginia Chamber of Commerce).
on the floats, i.e., those not far enough along in the process of shedding to be able to survive well on the floats. High losses in the “peeler” crab fishery have resulted, indicating the need for more care in selecting crabs for shedding purposes.

Crabs are caught in shallow water by means of dip nets and hand scrapes. In deep waters, a trot-line is used (figure 6). This gear includes a ground line, baited with tripe or salted eel, which is run over a roller that extends from the side of the boat. The crabs holding on to the bait are brought to the surface as the boat goes forward forcing the roller under the line and the crabs into a basket made of fish net that is suspended below. One barrel of crabs will average about twelve pounds of meat, about one ounce per crab.

In recent years, “crab pots,” cubical in shape, 2 feet on a side, and made of galvanized chicken wire, have been used extensively for catching crabs (figure 6). Study is needed to find out more about the effect of their use on crab production and conservation.

The need for study of the blue crab fishery and for action aiming to conserve it has been thoroughly demonstrated by the scarcity of “peeler” crabs in the bay during 1940 and 1941. As a result of the scarcity, the Commission of Fisheries of Virginia established a large sanctuary* in the spawning area of the lower bay and since that time the abundance of crabs has greatly increased. The inauguration of a complete system of collecting records of crab catches in Virginia is urgently needed. Such information will provide an indication each year of the condition of the fishery. Decline in production will thereby be noted early so that remedial measures may be taken then instead of later when a much longer time for recovery would be required. The ill effects of a scarcity of crabs resulting from a severe winter may be materially reduced by the establishment of a sanctuary the following summer, thus protecting the surviving female crabs and hastening greatly the recovery of the fishery. Other possible remedial measures include prohibiting the purchase of “peeler” or shedder crabs that do not have a soft shell fully formed under the outer hard shell, prohibiting the catch of buckram crabs (those not recovered from shedding and hence in poor condition)

*Approximately 400 square miles in area.
at all times, prohibiting the holding of "green" crabs on floats for shedding purposes, shortening the season of the winter dredge fishery, and limiting somewhat the use of crab pots in certain intensively fished areas. These measures represent reasonable possibilities for maintaining higher average levels of production and for effecting a rapid recovery in times of severe shortage.

In general, remedial measures should not be restricted to a single branch of the fishery thus making one particular group of crabbers such as the crab pot fishermen, the winter dredge crabbers or the soft crab fishermen, bear the burden alone of restricted fishing. The biology and migratory habits of the crab are such that an equitable distribution of the responsibility of saving crabs to speed up recovery can be made so that all groups will share in a reasonable curtailment of their particular type of fishing. More information is needed to make such an equable distribution possible.

Until 1930, the Chesapeake states of Maryland and Virginia dominated the blue crab fishery, producing around 68 million pounds as compared with the South Atlantic and Gulf States where the total net output in 1930 was only 7 million pounds. By 1936, the Chesapeake figure had dropped to 43½ million pounds (to about 30 millions in 1941) and the South Atlantic and Gulf states had increased to nearly 30 million pounds. Louisiana, North Carolina, and Florida contributed most among the Southern states. With the development of the most southern fishery, fresh cooked crab meat from this area is becoming a factor of increasing importance in the northern markets.
VALUE OF THE CRAB FISHERY

Table showing the poundage and value of hard and soft crabs in the two Chesapeake states during the period 1929-1941. (Data from U. S. Fish and Wildlife Service Reports.)

<table>
<thead>
<tr>
<th>Year</th>
<th>SOFT CRABS</th>
<th>HARD CRABS</th>
<th>TOTAL VALUE OF HARD AND SOFT CRABS IN VIRGINIA AND MARYLAND</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maryland</td>
<td>Virginia</td>
<td>Maryland</td>
</tr>
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<td>1929</td>
<td>2,644,548</td>
<td>1,700,200</td>
<td>25,455,130</td>
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<td>1,712,400</td>
<td>29,930,550</td>
</tr>
<tr>
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<td>1,449,000</td>
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<tr>
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<td>1941</td>
<td>836,300</td>
<td>1,709,500</td>
<td>11,975,400</td>
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</table>

LITERATURE SOURCES


