1971

Biogeography of the Blue Crab Fishery, Barataria Estuary, Louisiana.

Eugene Jaworski

Louisiana State University and Agricultural & Mechanical College

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BIOGEOGRAPHY OF THE BLUE CRAB FISHERY, BARATARIA ESTUARY, LOUISIANA

A Dissertation

Submitted to the Graduate Faculty of the Louisiana State University and Agricultural and Mechanical College in partial fulfillment of the requirements for the degree of Doctor of Philosophy

in

The Department of Geography and Anthropology

by

Eugene Jaworski
B.S., University of Wisconsin, Madison, 1966
January, 1971
ACKNOWLEDGMENT

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ABSTRACT

The blue crab fishery is one of the major commercial fisheries of Louisiana. A large portion of the total soft- and hard-crab landings are derived from the water bodies of the Barataria Estuary. A field investigation of the crab fishery of the Barataria Estuary generated data on the crab fishing patterns of a single estuary. By integrating field observations with available data on the natural environment and life history of the blue crab, an overview of the estuarine ecology of the crab was obtained.

Crabbing has long been important in the Barataria Estuary. Over the years the crabbers have developed fishing practices which reflect the seasonal distribution of the crabs. Field data were collected on the fishermen's annual activities, types and use of crabbing gear, and on the soft- and hard-crab fishing areas. Attention was given to seasonal distribution of the crabs and to the composition of the catch by water body. The field data were used to establish crab migration patterns and biotopes. Five crab-migration patterns were recognized in the estuary. The spawning, maturation, and winter habitat biotopes were delineated by associating large numbers of crabs with specific environments.

In the past decade the crab harvest from the Barataria x
Estuary has decreased. The hard- and soft-crab catch of the upper estuary show the greatest decline. Some of the crabbers blame the decline on the use of crab pots which capture gravid females. Evidence suggests that pollution and alteration of shoreline environments where the crabs feed and molt are associated with the decrease in catch. Land-use accommodation in coastal Louisiana is needed to protect the blue crab biotopes from ecological alteration.
INTRODUCTION

The blue crab, *Callinectes sapidus* Rathbun, is the only commercial crab species in Louisiana. Louisiana crab landings in 1969 amounted to 11,915,000 pounds and were valued at $1,391,000. In terms of pounds landed the crab industry in Louisiana ranks third, after menhaden-industrial fish, and shrimp. In terms of dollar value, the blue crab catch ranks fourth, behind shrimp, menhaden-industrial fish, and oysters (Bureau of Commercial Fisheries, 1969, *Landing Records*).

Research in the United States on the blue crab includes the work of Hay (1904), Churchill (1919), Truitt (1939), Cronin (1954), Van Engel (1958), Tagatz (1968b), and More (1969). Much of the research has centered on the biological cycles and migration patterns. Because of the importance of the blue crab industry in Virginia and Maryland, many investigations were carried out in Chesapeake Bay. Recently, emphasis has been placed on the variations in annual harvests (Fischler, 1965; Tagatz, 1965; Cronin and Cargo, 1968).

Only a few scattered blue crab investigations have been made in Louisiana. The studies include research on the food habits (Darnell, 1958) and life history of the crab in Lake Pontchartrain (Darnell, 1959); a description of the Louisiana crab fishery (Padgett, 1960); and, an article on trawl sampling of Vermilion Bay (Perret, 1964). Also, the
Louisiana Department of Conservation and the Wildlife and Fisheries Commission have published general articles on crabs and crabbing. In Louisiana research on shrimp and oysters has always taken priority over the blue crab.

Although there have been numerous blue crab investigations, little is known about the blue crab ecology (Cronin and Cargo, 1968:25). The difficulty of estimating the size and growth of the crab population is partially to blame. Moreover, emphasis on estuarine research and on management of the renewable resources has just recently come about. Advancements in instrument technology and data manipulation have already been made, but more data on the organism and its habitat are needed.

This investigation focuses on the ecology of a blue crab population of a life cycle region, or bioregion. As the crab population passes through its larval, juvenile, and adult stages it successively utilizes particular environments of its bioregion. These functional environments were identified in the study region, an estuary and adjacent marine area. Where data were available, hydrological factors, to include salinity, circulation, and water temperature were related to the distribution and migration patterns of the crab population.

Data were collected by field observation of crab fishermen's seasonal activities, their crabbing gear and its use, and crabbing areas. Attention was given to the seasonal distribution of the crabs, crab migrations, and size and type
of crabs landed. The knowledge and lore of the fishermen were not overlooked. Field observations provided some insights into the growth and recruitment of the crab population. No estimation was made of the crab population.

The Barataria Estuary and the adjacent marine area, located in southeastern Louisiana, were selected as the study region. The region was chosen because the entire life history of the blue crab takes place therein, and the estuary is a natural hydrological unit. Moreover, blue crab fishing has long been established in the Barataria Estuary, and the region is a major center of Louisiana's blue crab industry. In addition to providing field data on the blue crab and its environment, the goal of this study is to assess the Barataria Estuary and its adjacent marine area as a habitat of the blue crab. Descriptive material on the blue crab fishery was included in the appendices.

The field procedure consisted of accompanying crab fishermen as they went about their fishing activities. Seafood dealers, crab buyers, and other individuals connected with the crab industry were informally interviewed. Fishermen in each of the eleven fishing settlements were contacted. Field trips were taken from June 1969 to May 1970 so that the fishing patterns of an entire year could be studied. Data on the number of fishermen, gear types, and catch statistics were obtained from the Bureau of Commercial Fisheries, New Orleans. Much of the material on the life history of the blue crab and on the environments of the bioregion came from
the literature.
CHAPTER I

DESCRIPTION OF THE PHYSICAL ENVIRONMENT

The Blue Crab Bioregion

The Barataria Estuary is located west of the Mississippi River and south of the city of New Orleans (Fig. 1). The estuary is an interdeltaic feature that has formed between the main distributary of the present Mississippi River delta and the abandoned distributary complex of the older Lafourche-Mississippi delta (Morgan, 1967:119). Low-lying environments of swamp and marsh flank the estuary, and together with the water bodies, form what is referred to as the Barataria Basin.

An estuary is a "semi-enclosed coastal body of water having a free connection with the open sea and within which the sea is measurably diluted with fresh water runoff" (Pritchard, 1967:3). The Barataria Estuary conforms to that definition, though it does not have a river discharging into its head as is often the case in other estuaries. The estuary includes all the interconnected water bodies extending inland of the tidal inlets, or passes. Caminada and Barataria bays make up the lower estuary. The nearshore area in the Gulf of Mexico, south of the tidal inlets, is the adjacent marine area.
Fig. 1 The Barataria Estuary, Louisiana.
The entire history of the various life stages of the blue crab takes place within the estuary and adjacent marine area. The upper estuary, lower estuary, and adjacent marine area together constitute a blue crab bioregion (Fig. 2). Because the bioregion has the open Gulf for a boundary, some exchange of crabs, especially among the larvae and very small juveniles, probably takes place in the marine area. Commercial size crabs, however, do not migrate between estuaries, but limit their migrations to the estuary and adjacent marine area (Fischler and Walburg, 1962:278).

Estuaries can be subdivided into positive, neutral, and inverse types based on the balance between fresh water inflow, tidal exchange, and evaporation (Carriker, 1967:442). Positive types are characterized by greater fresh water inflow, whereas inverse estuaries tend toward hypersalinity because evaporation exceeds the fresh water input and tidal exchange. Water balance calculations (Table 1) indicate that the Barataria Estuary is a positive estuary with neutral conditions prevailing in May, June, August, and October. The water balance of Louisiana's estuaries has been investigated by Gagliano and Muller, 1970.

The blue crab bioregion is a shallow, interconnected hydrologic network which extends inland for 65 miles. The marine area extends out to about 15 miles where water depths are about 90 feet. Offshore slope, beyond the surf zone, is approximately 6 feet per mile. The lakes and bays of the estuary vary in width, but in general are relatively flat-
Fig. 2 Schematic model of a blue crab bioregion. The upper estuary, lower estuary, and adjacent marine area constitute the bioregion.
TABLE 1
MONTHLY WATER BALANCE IN INCHES, PARADIS, 1945 - 1968

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<td>4</td>
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<td>1967</td>
<td>3</td>
<td>7</td>
<td>0</td>
<td>-1</td>
<td>-1</td>
<td>-5</td>
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<td>4</td>
<td>2</td>
<td>1</td>
<td>-1</td>
<td>8</td>
<td>19</td>
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<tr>
<td>1968</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>-6</td>
<td>-2</td>
<td>1</td>
<td>0</td>
<td>-1</td>
<td>3</td>
<td>7</td>
<td>9</td>
</tr>
</tbody>
</table>

Mean 4 4 4 1 0 -1 0 0 1 -1 2 4 20
floored (U.S. Coast and Geodetic Survey Map no. 1050, 1968). Lake Salvador is 12 to 15 feet deep, while depths in Little Lake and Barataria Bay average 6 to 8 feet. The tidal inlets and tidal channels, as well as the artificial canals and waterways, are the deepest passages in the estuary.

**Hydrological Conditions in the Bioregion**

The principal factors controlling the abundance of blue crabs in a given ecosystem are environmental (Hargis, 1968: 49). Of major importance are the salinity, circulation, tides, and water temperature. Because of the bioregion's shallowness, climatological elements such as precipitation, evaporation, wind, and air temperature can change the hydrological conditions relatively quickly. As it passes through its life stages the blue crab occupies various environments of the marine area, lower estuary, and upper estuary. The dynamic hydrological conditions characterize the bioregion and affect the blue crab population therein.

A variable hydrologic condition of the bioregion is the salinity, or total dissolved salts. Salinity affects the osmoregulation of the crab, and it is an important property of the ecosystem. A salinity classification which can be used to describe an estuary is presented in Table 2. Except in the vicinity of the tidal inlets, and during the spring floods of the Mississippi River (Mackin and Hopkins, 1962: 43), the salinity of the marine area is more stable than in the estuary. Average monthly salinities seven miles south
of Grand Isle at depths of 15 feet range from 16 to 36 ppt., with lows occurring during April to June (La. Wildl. & Fish. Comm., 1969: Table 11).

TABLE 2

CLASSIFICATION OF WATER BASED ON SALINITY

<table>
<thead>
<tr>
<th>Salinity Range</th>
<th>Salinity Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0 to 0.5 ppt.</td>
<td>Limnetic</td>
</tr>
<tr>
<td>0.5 to 5.0 ppt.</td>
<td>Oligohaline</td>
</tr>
<tr>
<td>5.0 to 18 ppt.</td>
<td>Mesohaline</td>
</tr>
<tr>
<td>18 to 30 ppt.</td>
<td>Polyhaline</td>
</tr>
<tr>
<td>30 to 40 ppt.</td>
<td>Euhaline</td>
</tr>
</tbody>
</table>

\textsuperscript{a}Classification was taken from Symposium on the Classification of Brackish Waters, 1959.

The horizontal salinity gradient in the bioregion is distinct (Fig. 3). Though there are vertical salinity stratifications in the tidal inlets (Gagliano and Muller, 1970: 6), the waters of the estuary are well mixed (Barlow, 1955: 7). Lake Des Allemands is classified as limnetic, or fresh. Bayou Des Allemands, Lake Cataouatche, Lake Salvador, and Bayou Perot are oligohaline most of the time. The mesohaline zone can extend up into southern Lake Salvador, but the zone is generally confined to Little Lake and northern Barataria Bay. Although the marine area is classified as euhaline, the polyhaline zone extends considerably Gulfward in the winter and spring.
Fig. 3 Horizontal salinity gradient and salinity zones in the Barataria Estuary. Salinity values on the map are in ppt., and were measured in mid-October 1969. Data for zones were taken from U.S. Army Corps of Engrs., 1963.
The crab fishermen associate good summer crab fishing with the mixing of fresh and brackish water. Organic detritus being carried into the estuary by local drainage through the flanking swamp and marsh environments plays a major role in the food chain of Louisiana estuaries (Darnell, 1961:560). Fresh water input in the estuary is primarily a result of local precipitation and runoff (Barlow, 1955:7). The tidal inlets and tidal currents are the source of salinity intrusion (Gagliano and Muller, 1970:6).

Short-term salinity changes in the upper estuary can be attributed to the wind, but periods of higher salinity follow extended periods of low rainfall (Barlow, 1955:14). A rainy period in the region occurs from mid-December to mid-March, and from June to September. April, May, October, and November are dry months (Fig. 4). Based on water balance calculations (Table 1), fresh water input into the estuary takes place primarily from November to March.

Because of the low hydraulic gradient and low tidal amplitude, circulation in the estuary is poorly developed. Except in the tidal inlets and channels, current velocities seldom exceed 1.0 knot (Table 3). Estuarine currents are important in the transport of organic and inorganic substances, dissolved minerals, oxygen and heat. Currents also flush the estuary, carry chemical clues to predators, and transport eggs, larvae, and drift organisms (Carriker, 1967:450). Stagnant portions of the estuary are less productive and are subject to changes in water quality.
Fig. 4 Monthly precipitation and evapotranspiration in the Barataria Estuary. Data were taken from La. Wildl. & Fish. Comm., 1969: Table 1, and U.S. Dept. of Commerce, 1964:15.
### TABLE 3
CURRENT VELOCITIES, DEPTHS & FLOW VOLUMES, LOWER BARATARIA ESTUARY

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>WATER DEPTH</th>
<th>MEAN CURRENT VELOCITY</th>
<th>MAXIMUM CURRENT VELOCITY</th>
<th>MINIMUM FLOW VOLUME</th>
<th>MAXIMUM FLOW VOLUME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bayou Lafourche near Leeville bridge</td>
<td>10.5'</td>
<td>0.4 knots</td>
<td>1.0 knots</td>
<td>58.5</td>
<td>80 million cusecs/24 hours</td>
</tr>
<tr>
<td>Upper Barataria Bay in Bayou St. Denis</td>
<td>18.0</td>
<td>0.5</td>
<td>1.3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Barataria Bay, 2 miles SE of Manila Village</td>
<td>5.0</td>
<td>0.3</td>
<td>0.8</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Barataria Pass</td>
<td>165</td>
<td>1.3</td>
<td>2.9</td>
<td>3229</td>
<td>3438</td>
</tr>
<tr>
<td>Quatre Bayou Pass</td>
<td>29</td>
<td>1.1</td>
<td>2.2</td>
<td>874</td>
<td>1005</td>
</tr>
<tr>
<td>Caminada Pass</td>
<td>16</td>
<td>1.5</td>
<td>2.4</td>
<td>627</td>
<td>653</td>
</tr>
<tr>
<td>Pass Abel</td>
<td>11</td>
<td>1.2</td>
<td>2.5</td>
<td>129</td>
<td>212</td>
</tr>
</tbody>
</table>

\[a\] Data were taken from Mackin (1962:270-271) and Mackin and Hopkins (1962:28).
Diurnal tides are the main cause of currents in the estuary. Equatorial tides in the lower estuary range from 0.2 to 0.4 feet, whereas tropic tides range from 1.4 to 1.8 feet (Mackin and Hopkins, 1962:25-26). Tidal amplitude on the Barataria Bay side of Grand Isle averages 0.7 feet per year (Marmer, 1954:109). Lowest tides occur from December through February, and highest tides from June to October (Mackin and Hopkins, 1962:27). In the upper estuary, where tidal currents are very weak, the direction and rate of flow are greatly influenced by wind and thunderstorms (Barlow, 1955:9). In the marine area surface water currents are generally directed northwesterly, except for westerly currents in January and northerly currents in July and August (Scruton, 1956:2906).

Since blue crabs are poikilothermic, or cold-blooded, the water temperature of the ecosystem affects their activity. Adult female and juvenile blue crabs survive temperatures ranging from 0 to 39°C, but are slightly less tolerant of extremes at low salinity (Tagatz, 1969:714-715). During the winter months the absence of crabs in the upper Barataria Estuary is associated with low water temperatures. Optimum temperatures for hatching of eggs and survival of the larvae are 19 to 29°C (Sandoz and Rodgers, 1944:216) and 20 to 35°C. (Costlow, 1967:93), respectively.

Water temperatures in the estuary are greatly influenced by the air temperatures (Fig. 5). Water in the upper estuary is slightly cooler in winter and warmer in summer than in the
Fig. 5 Relationship of air temperature to water temperatures, Barataria Estuary. Data were taken from La. Wildl. & Fish. Comm., 1962-63: 152; Walsh, 1969:44; and U.S. Dept. of Commerce, 1964: Table 1.
lower estuary (La. Wildl. & Fish. Comm., 1962-63:152). Temperatures in the lower estuary are moderated through tidal exchange with Gulf waters of the marine area. Summer temperatures in Caminada and Barataria bays average 27 to 32°C., but reach 40°C. in the marsh lakes and ponds (Mackin and Hopkins, 1962:35). Winter water temperatures in the estuary are highly variable and range from 8 to 22°C. (Mackin and Hopkins, 1962:36). Temperatures in July and August may approach the upper limits for the hatching of eggs.

The climate of the bioregion is controlled by both maritime tropical and continental air masses. From April to mid-September maritime tropical air dominates. Prevailing southeast to southwesterly winds transport warm, maritime air inland resulting in frequent summer thunderstorms. From mid-November to mid-March the area is subjected alternately to tropical and continental air masses (U.S. Dept. of Comm., 1968:1). During this period recurrent cold fronts are experienced. Cold fronts are accompanied by cooler temperatures and by stronger than average wind velocities (La. Wildl. & Fish. Comm., 1969:17).

A relationship exists between wind direction and air mass source (Fig. 6). From September through March strong, northerly winds are more frequent, whereas from April through August relatively mild, southerly winds prevail (Walsh, 1969:85). Southerly winds tend to move saline waters from the Gulf of Mexico through the tidal inlets and up the estuary. Northerly and northwesterly winds, on the other hand, tend
Fig. 6 Monthly surface wind directions, Burrwood, Louisiana. Data were taken from Walsh, 1969:85. Observations of winds were made from 1942 to 1945.
to lower water levels and move fresher, upper-estuary waters toward the lower estuary. Hurricanes and tropical storms are not uncommon in the region, but their effect on the blue crab has not been documented (U.S. Army Corps of Engrs., 1970).

The blue crab bioregion, which includes the Barataria Estuary, is shallow and dynamic. Because of the close relationship of the hydrological and climatological elements, the salinity, circulation, water temperature, and other conditions are subject to changes. The blue crab population must be able to adjust to such a dynamic bioregion. In the following section on the life history of the blue crab the significance of salinity, food supply, and life stage on the distribution and migration of the crab will be demonstrated. The data section on the crab fishing patterns contains field data on the relationships between the crab and the environments of its bioregion.
CHAPTER II

LIFE HISTORY OF THE BLUE CRAB

Description of the Blue Crab

The blue crab, *Callinectes sapidus* Rathbun, belongs to the decapod family of Portunidae, the swimming crabs. Swimming crabs are characterized by the last pair of walking legs which have been modified to form swimming paddles (Leary, 1967:10). *Callinectes sapidus* is identified by four ridges

Plate 1. The Blue Crab, *Callinectes sapidus* Rathbun. The photograph of a large female blue crab was adapted from Leary, 1967:6.
between the eyes on the carapace (Plate 1). The blue crab is a common inhabitant of the East and Gulf Coasts of North America, but it ranges from Nova Scotia to Uruguay (Williams, 1965:169). The distribution of the crab is assumed to result from habitat variations and physiological requirements of the various life stages. No spatially expressed genetic differentiation is assumed concerning the blue crab in this study.

The carapace of the blue crab is moderately convex, smooth, and is two and a half times as wide (including the lateral spines) as long. The abdomen of the male has an inverted T shape. On the immature female the abdomen is triangular, whereas on the mature female it is broad and rounded. Mature males attain a carapace width of 125 to 200 mm. Adult females are slightly smaller and average 125 to 165 mm. in width. Overall color of the crab varies from grayish brown to yellowish brown to bluish green (Williams, 1965: 168). Immature males and females have fuchsia colorations on the chelipeds (pinching claws). Mature males have blue chelipeds, while mature females have reddish-orange colorations.

The only other common crab species of the genus Callinectes in Louisiana is Callinectes similis sp. n. C. similis is a small crab that closely resembles the juvenile blue crab. C. similis can be distinguished from C. sapidus by the six ridges between the eyes on the carapace. In addition, C. similis attains a carapace width of only about 80 mm.
Shrimp fishermen in the Barataria Estuary catch *C. similis* in shrimp trawls in Caminada and Barataria bays.

The Effect of Salinity

Estuarine organisms can be classified on the basis of salinity tolerance (Table 4). Because it is capable of passing through the entire salinity gradient, the blue crab is classed as a migrant (Carriker, 1967:444). Much of the juvenile and adult stages are spent in the estuary, but the larval stage is pelagic. Salinity zones in the estuary and adjacent marine area are delineated in Figure 3.

Ecologically, blue crabs are wide-ranging, motile, epibenthic organisms. Because salinities in the shallow Barataria Estuary change relatively quickly, the crab must adjust to the salinity changes or suffer extinction. Crabs

**TABLE 4**

CLASSIFICATION OF ESTUARINE ORGANISMS BASED ON SALINITY*

<table>
<thead>
<tr>
<th>Type of Organism</th>
<th>Tolerated Salinity Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limnetic</td>
<td>0.0 to 0.5 ppt. (fresh water)</td>
</tr>
<tr>
<td>Oligohaline</td>
<td>0.5 to 5.0 ppt.</td>
</tr>
<tr>
<td>True Estuarine</td>
<td>Between fresh and sea water</td>
</tr>
<tr>
<td>Euryhaline</td>
<td>From sea water to oligohaline</td>
</tr>
<tr>
<td>Stenohaline</td>
<td>Along open seashore or near estuaries</td>
</tr>
<tr>
<td>Migrant</td>
<td>Capable of passing through entire salinity continuum</td>
</tr>
</tbody>
</table>

*After Carriker, 1967:443.*
adjust to the salinity of their ecosystem by active osmotic and ionic regulation, a process known as osmoregulation.

In waters of high salinity the blood concentration of Na, K, and Cl ions is allowed to rise while the concentration of Mg and SO_4^2- ions are kept low. The antennary gland appears to function in the regulation of the Mg and SO_4^2- ions (Gifford, 1962:177, 122). In low salinity waters the blue crabs show a lowering of blood osmococoncentration as the chief means of easing the stress on their osmoregulatory mechanisms (Tan and Van Engel, 1966:33). Slight urine and stomach fluid hypertonicities, combined with a large flux of water through the crab, also play some part in the hypo-regulation (Gifford, 1962:22).

Optimum salinity for the survival and growth of the blue crab's pelagic larvae is in the 15 to 45 ppt. range (Sandoz and Rodgers, 1944:219; Costlow, 1967:93). Salinities within the marine area of the study region are well within this range. Unlike mature males, the mature female blue crabs have difficulty osmoregulating in waters of low salinity (Tan and Van Engel, 1966:34). The movement of newly inseminated females from the upper estuary to areas of higher salinity may be due to osmoregulation stress as well as to spawning (More, 1969:27).

Food Chain

The blue crab is a detritivore, bottom predator, and general scavenger (Darnell, 1958:411). Food items of three
size categories of blue crabs are listed in Table 5. As a detritivore, crabs consume decaying organic debris and inorganic material. Clams (especially *Rangia cuneata*), small crabs (including *Callinectes sapidus*), mussels, and snails are important prey to this bottom predator. As a scavenger, the blue crab feeds on fresh and decomposing flesh of all kinds (Darnell, 1958:410-411). Predation on fish may be much more important than Darnell suggests (Van Engel, 1958:15; Tagatz, 1968b:30).

With their stalked, compound eyes the blue crabs perceive movements and are capable of responding with quick thrusts of their chelipeds. Chelipeds are large, powerful claws that are used to seize and crush the prey, tear it apart, and guide it to the mandibles. Water currents are sensed by tactile and chemoreceptors located on the antennules and antennae. The antennules move jerkily in the direction of the approaching current. Associated with the activity of the antennules is the rapid beating of the maxillipeds which force a current of water across the head. In this manner the blue crab is able to sense its surroundings so that it can respond when an appropriate stimulus is discovered (Lockhead, 1962:447-450).

In the trophic spectrum of the estuarine community the blue crab is a major component both as a predator and as a food item (Darnell, 1961:566). A large number of organisms prey heavily on the blue crab (Table 6). That juvenile crabs feed at night, or in the very early morning hours,
TABLE 5
FOOD ITEMS OF BLUE CRABS, LAKE PONTCHARTRAIN, LOUISIANA

<table>
<thead>
<tr>
<th>FOOD ITEM</th>
<th>CRABS 30 to 74 mm.</th>
<th>CRABS 125 to 147 mm.</th>
<th>CRABS 148 to 197 mm.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crabs (undetermined)</td>
<td>13.8</td>
<td>2.7</td>
<td>16.7</td>
</tr>
<tr>
<td>Rithropanopeus harrisii</td>
<td>4.2</td>
<td>0.2</td>
<td>5.0</td>
</tr>
<tr>
<td>Callinectes sapidus</td>
<td>10.3</td>
<td>1.4</td>
<td>8.3</td>
</tr>
<tr>
<td>Cirripedia</td>
<td>4.2</td>
<td>0.2</td>
<td>5.0</td>
</tr>
<tr>
<td>Crustacea (undetermined)</td>
<td>31.0</td>
<td>31.7</td>
<td>20.1</td>
</tr>
<tr>
<td>Odonata</td>
<td>4.2</td>
<td>0.2</td>
<td>10.0</td>
</tr>
<tr>
<td>Annelida</td>
<td>4.2</td>
<td>0.2</td>
<td>1.0</td>
</tr>
<tr>
<td>Mollusca</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ranqia cuneata</td>
<td>41.4</td>
<td>32.4</td>
<td>70.8</td>
</tr>
<tr>
<td>Mytilopsis leucophea</td>
<td>25.0</td>
<td>19.4</td>
<td>20.0</td>
</tr>
<tr>
<td>Gastropoda</td>
<td>13.8</td>
<td>1.9</td>
<td>5.5</td>
</tr>
<tr>
<td>Hydroids</td>
<td>3.4</td>
<td>0.3</td>
<td>2.5</td>
</tr>
<tr>
<td>Vertebrata</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fish remains</td>
<td>3.4</td>
<td>0.5</td>
<td>16.7</td>
</tr>
<tr>
<td>Bottom diatoms</td>
<td>4.2</td>
<td>0.7</td>
<td>2.5</td>
</tr>
<tr>
<td>Algae, filamentous</td>
<td>6.9</td>
<td>0.4</td>
<td>0.3</td>
</tr>
<tr>
<td>Vascular plants</td>
<td>17.2</td>
<td>7.7</td>
<td>5.5</td>
</tr>
<tr>
<td>Organic matter, undetermined</td>
<td>37.9</td>
<td>12.1</td>
<td>12.7</td>
</tr>
<tr>
<td>Detritus, inorganic</td>
<td>37.9</td>
<td>9.1</td>
<td>1.7</td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SUMMARY**

<table>
<thead>
<tr>
<th></th>
<th>CRABS 30 to 74 mm.</th>
<th>CRABS 125 to 147 mm.</th>
<th>CRABS 148 to 197 mm.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crabs &amp; Crustacea</td>
<td>35.8</td>
<td>22.4</td>
<td>10.4</td>
</tr>
<tr>
<td>Mollusks</td>
<td>34.3</td>
<td>54.9</td>
<td>63.4</td>
</tr>
<tr>
<td>Ranqia cuneata</td>
<td>32.4</td>
<td>30.0</td>
<td>46.5</td>
</tr>
<tr>
<td>Fish remains</td>
<td>0.5</td>
<td>1.6</td>
<td>5.4</td>
</tr>
<tr>
<td>Miscellaneous vegetation</td>
<td>0.7</td>
<td>1.5</td>
<td>2.3</td>
</tr>
<tr>
<td>Inorganic material</td>
<td>28.9</td>
<td>20.3</td>
<td>18.5</td>
</tr>
</tbody>
</table>

aData were taken from Darnell, 1958:409.

bThe first number in each size category is percentage of stomach tracts containing the food item, and the second number is percentage of total stomach volume.
TABLE 6
PREDATORS OF BLUE CRABS,
LAKE PONTCHARTRAIN, LOUISIANA

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alligator gar</td>
<td><em>Lepisosteus spatula</em></td>
</tr>
<tr>
<td>Spotted gar</td>
<td><em>Lepisosteus oculatus</em></td>
</tr>
<tr>
<td>Sea catfish</td>
<td><em>Galeichthys felis</em></td>
</tr>
<tr>
<td>Blue catfish</td>
<td><em>Ictalutus furcatus</em></td>
</tr>
<tr>
<td>Yellow bass</td>
<td><em>Roccus mississippiensis</em></td>
</tr>
<tr>
<td>Fresh water drum</td>
<td><em>Aplodinotus grunniens</em></td>
</tr>
<tr>
<td>Atlantic croaker</td>
<td><em>Micropogon undulatus</em></td>
</tr>
<tr>
<td>Black drum</td>
<td><em>Pogonias cromis</em></td>
</tr>
<tr>
<td>Red drum</td>
<td><em>Sciaenops ocellata</em></td>
</tr>
<tr>
<td>Fresh water eels</td>
<td><em>Anguilla rostrata</em></td>
</tr>
<tr>
<td>Perch</td>
<td><em>Bairdiella chrysura</em></td>
</tr>
</tbody>
</table>

aData was taken from Darnell, 1958:411.

bAccording to the fishermen, fresh water eels, perch, and blue catfish prey on soft crabs.
suggests that young crabs come under severe predation (Lambbou, 1952:17). Although some data are available on the seasonal abundance of various fish in Caminada and Barataria bays (Fox and Mock, 1968:46-47), the effect of predation on the blue crab population has not been studied in Louisiana. Except the adult females spawning offshore, large blue crabs probably have fewer predators than small juveniles.

**Life History in an Estuary**

The life span of the blue crab is two to four years, but they are fished as soon as commercial size is attained, 12 to 18 months after hatching (Rees, 1963:5). The life history is generally understood to be as outlined in Table 7. Spawning of adult females takes place in the saline waters of the lower bays and nearby Gulf of Mexico (More, 1969:11). Female crabs bearing egg masses under the abdomen, called "sponge crabs", are common in the lower estuary and marine area from March to September. As many as 700,000 to 2,000,000 eggs are laid by a single female in one spawning (Van Engel, 1958:9). Most females spawn only twice in their lifetime; the spawning may be in the same year or over two seasons (Tagatz, 1968b:21).

The blue crab has two sequential larval stages, the zoea and megalops. The zoea stage lasts about a month during which several molts take place. A short megalops stage is next. After just one molt the megalops larva metamorphoses into a tiny crab which is about 1/10 of an inch long. Only
### TABLE 7

**LIFE HISTORY OF THE BLUE CRAB IN A BIOREGION**

<table>
<thead>
<tr>
<th>STAGE - LIFE CYCLE</th>
<th>DURATION</th>
<th>LOCATION</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eggs</td>
<td>15 days</td>
<td>Lower Estuary &amp; Marine Area</td>
<td>Females spawn in saline waters during warm months.</td>
</tr>
<tr>
<td>Larval Zoea</td>
<td>29-43 days</td>
<td>Marine Area</td>
<td>Larval stages are pelagic. Zoea undergo 4-5 molts.</td>
</tr>
<tr>
<td>Megalops</td>
<td>6-20 days</td>
<td>Marine Area &amp; Tidal Inlets</td>
<td>Molts once; passes into first true crab stage of 2-2 1/2 mm. size.</td>
</tr>
<tr>
<td></td>
<td>35-49 days</td>
<td></td>
<td></td>
</tr>
<tr>
<td>True Crab 1st Year Juvenile</td>
<td>1-9 months</td>
<td>Lower to Upper Estuary</td>
<td>Molts 4-17 times and attains size of 6-100 mm. in first year. Forced out of upper estuary with onset of cold season.</td>
</tr>
<tr>
<td>2nd Year Juvenile</td>
<td>2-9 months</td>
<td>Upper Estuary</td>
<td>Molts an additional 3-16 times, and matures at 125-200 mm.</td>
</tr>
</tbody>
</table>

Total Maturation Time 12-18 months

5-6 Larval Molts

18-20 Post-Larval Molts

23-26 Total Molts

aData were taken from Darnell (1959), More (1969), Tagatz (1968b), Van Engel (1958), Williams (1965) plus field observations.

bWinter habitation is in the lower estuary and in the marine area.
about 1/10,000 of the larvae survive to become adults (Van Engel, 1958:9). Ratios of zoea to megalops of 164 to 1 have been found (Tagatz, 1968b:24). Highest survival rates of the megalops larvae are in water temperatures of 20 to 35°C. and in salinities of 15 to 45 ppt. (Costlow, 1967:93).

The tiny, postlarval crabs begin active predation early in their juvenile stage, and migrate through the tidal inlets into the lower estuary in search of food and perhaps to escape predation (Carriker, 1967:474). At any one time, there are probably three age groups of juveniles in the estuary (More, 1969:13). Because maturation requires 12 to 18 months, the juveniles do not mature in a single growing season (Van Engel, 1958:14). With the onset of the winter season they migrate from the inland portions of the estuary to the lower estuary.

The winter habitat of the immature crabs and the adults is the lower estuary and the adjacent marine area. In the spring, as the estuarine waters begin to warm up, the juveniles and the adult males migrate to the upper estuary. Maturation of the juveniles takes place in the upper estuary. Adult males tend to remain in the upper estuary all through the warm months and migrate to the lower estuary only during the winter. The adult females, on the other hand, remain in the saline waters of the lower estuary to spawn. "Spent females" (those that have completed spawning) are found dead in large numbers along the Texas (More, 1969:12) and Louisiana coasts in August.
As the juvenile blue crab grows, it repeatedly sheds its exoskeleton, a process known as ecdysis. Hormones produced by the eyestalks and second maxillae regulate the molting, or shedding. It takes from 10 to 24 hours for the new exoskeleton to harden (Van Engel, 1958:14), and crabs that have just molted are called "soft crabs". Mating takes place while the female is a soft crab as it undergoes the final molt and reaches sexual maturity. The term "peeler" is applied to crabs that are in the various stages of ecdysis.

The crab fishermen in the vicinity of the Barataria Estuary catch two types of blue crabs -- hard crabs and peeler crabs. Hard crabs include large juveniles that are not undergoing ecdysis at the time as well as mature, or adult, crabs. Because soft crabs are a seafood delicacy, crabbers catch peelers and then produce crabs by artificially completing the molting process. Peeler crabs are abundant only during certain months, whereas hard crabs are caught throughout the year.

The blue crab is a migrant. It occupies particular environments of its bioregion depending on the physiological requirements of each life stage, and on the salinity, water temperature, and food supply of the bioregion. Since both hard and peeler crabs are intensively fished in the Barataria Estuary, an analysis of the crab fishing patterns can provide data on the distribution, growth, and migration of the crab population. Much of the material is of a general nature.
because no estimation has been made of the bioregion's crab population.
CHAPTER III

DEVELOPMENT OF CRABBING IN THE BARATARIA ESTUARY

History of Crabbing in Louisiana

One of the earliest blue crab fisheries in the United States developed near the city of New Orleans, Louisiana. Initially the fishery was characterized by folk harvesting and local consumption; therefore only near large cities was there a market for the live hard and soft crabs (Rathbun, 1884:777-778). Most of the crabs that were fished in the vicinity of New Orleans were resold in the New Orleans French Market live by the dozen. The crabs were sold principally to proprietors of hotels and restaurants, steamboat operators, or were shipped to nearby cities (Stearns, 1887: 577-578).

Louisiana's hard and soft blue crab production for the period 1880 to 1969 is presented in Table 8. By 1915 the fishery was valued at $45,000 and the main source of the crabs was from Lake Pontchartrain, Barataria Bay, and Bay Adams (La. Cons. Bull., 1914-1916:117). According to elderly fishermen from Bucktown, Louisiana, soft crabs were being produced as early as 1900 along the southern shore of Lake Pontchartrain. The first crabmeat plant in Louisiana was constructed in Morgan City in 1924 (Morgan City Review,
TABLE 8
LOUISIANA BLUE CRAB LANDINGS, HARD AND SOFT, 1680-1969

<table>
<thead>
<tr>
<th>Year</th>
<th>HARD CRABS</th>
<th>SOFT CRABS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pounds</td>
<td>Value</td>
</tr>
<tr>
<td>1880</td>
<td>288,000</td>
<td>$7,000</td>
</tr>
<tr>
<td>1887</td>
<td>837,000</td>
<td>13,000</td>
</tr>
<tr>
<td>1888</td>
<td>851,000</td>
<td>13,000</td>
</tr>
<tr>
<td>1889</td>
<td>842,000</td>
<td>14,000</td>
</tr>
<tr>
<td>1890</td>
<td>851,000</td>
<td>13,000</td>
</tr>
<tr>
<td>1891</td>
<td>244,000</td>
<td>8,000</td>
</tr>
<tr>
<td>1892</td>
<td>332,000</td>
<td>8,000</td>
</tr>
<tr>
<td>1893</td>
<td>1,091,000</td>
<td>51,000</td>
</tr>
<tr>
<td>1894</td>
<td>2,320,000</td>
<td>78,000</td>
</tr>
<tr>
<td>1895</td>
<td>2,673,000</td>
<td>78,000</td>
</tr>
<tr>
<td>1896</td>
<td>4,186,000</td>
<td>63,000</td>
</tr>
<tr>
<td>1897</td>
<td>4,985,000</td>
<td>53,000</td>
</tr>
<tr>
<td>1898</td>
<td>5,078,000</td>
<td>57,000</td>
</tr>
<tr>
<td>1899</td>
<td>11,676,000</td>
<td>164,000</td>
</tr>
<tr>
<td>1900</td>
<td>12,576,000</td>
<td>168,000</td>
</tr>
<tr>
<td>1901</td>
<td>14,717,000</td>
<td>195,000</td>
</tr>
<tr>
<td>1902</td>
<td>10,533,000</td>
<td>106,000</td>
</tr>
<tr>
<td>1903</td>
<td>11,228,000</td>
<td>129,000</td>
</tr>
<tr>
<td>1904</td>
<td>14,062,000</td>
<td>172,000</td>
</tr>
<tr>
<td>1905</td>
<td>31,280,000</td>
<td>1,418,000</td>
</tr>
<tr>
<td>1906</td>
<td>21,310,000</td>
<td>608,000</td>
</tr>
<tr>
<td>1907</td>
<td>17,674,000</td>
<td>555,000</td>
</tr>
<tr>
<td>1908</td>
<td>13,196,000</td>
<td>599,000</td>
</tr>
<tr>
<td>1909</td>
<td>8,710,000</td>
<td>461,000</td>
</tr>
<tr>
<td>1910</td>
<td>7,354,000</td>
<td>314,000</td>
</tr>
<tr>
<td>1911</td>
<td>8,131,000</td>
<td>333,000</td>
</tr>
<tr>
<td>1912</td>
<td>7,085,000</td>
<td>294,000</td>
</tr>
<tr>
<td>1913</td>
<td>10,811,000</td>
<td>449,000</td>
</tr>
<tr>
<td>1914</td>
<td>9,402,000</td>
<td>433,000</td>
</tr>
<tr>
<td>1915</td>
<td>8,559,000</td>
<td>419,000</td>
</tr>
<tr>
<td>1916</td>
<td>9,336,000</td>
<td>402,000</td>
</tr>
<tr>
<td>1917</td>
<td>9,570,000</td>
<td>461,000</td>
</tr>
<tr>
<td>1918</td>
<td>10,050,000</td>
<td>497,000</td>
</tr>
<tr>
<td>1919</td>
<td>11,910,000</td>
<td>514,000</td>
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<tr>
<td>1920</td>
<td>9,523,000</td>
<td>463,000</td>
</tr>
<tr>
<td>1921</td>
<td>7,982,000</td>
<td>447,000</td>
</tr>
<tr>
<td>1922</td>
<td>5,692,000</td>
<td>379,000</td>
</tr>
<tr>
<td>1923</td>
<td>9,284,000</td>
<td>635,000</td>
</tr>
<tr>
<td>1924</td>
<td>7,986,000</td>
<td>537,000</td>
</tr>
<tr>
<td>1925</td>
<td>7,559,000</td>
<td>520,000</td>
</tr>
<tr>
<td>1926</td>
<td>9,550,800</td>
<td>807,294</td>
</tr>
<tr>
<td>1927</td>
<td>11,718,560</td>
<td>1,229,868</td>
</tr>
</tbody>
</table>

aData were taken from Lyles, 1969:6, 12.

Data for 1908 and 1909 were taken from Bur. of Comm. Fish., 1968 and 1969, Landing Records.
By 1931 there were eight crabmeat plants in the Morgan City-Berwick area (Fisher, 1931:18).

The increase in the hard crab landings in the 1920's was due to the development of the commercial processing of canned crabmeat. Soft-crab production increased when fishermen from the upper Barataria Estuary discovered a technique for the catching of peeler crabs (Frost, 1938:53, 57). Both hard- and soft-crab production reached a peak during World War II. In the past 20 years the hard-crab harvest ranged from 7 to 11 million pounds annually, and the soft-crab production has slowly declined. Nearly all the crabs are caught in the estuaries and not in the marine areas along the coast.

Crabbing in the Barataria Estuary

The development of the commercial blue crab industry in the Barataria Estuary was preceded by the settlement of the Barataria Basin and lower portions of Bayou Lafourche and Mississippi River. Settlement by whites of the Mississippi River floodplain first took place on the broad natural levees of the main waterways (Smith, 1937:66). French-speaking Acadian farmers from Nova Scotia were the early settlers of upper Bayou Lafourche and of the nearby Mississippi River (Bowie, 1935:11, 16). Early settlers of the area also included Spanish, Germans, Slavonians, Chinese, Filipinos, and Italians (Kammer, 1941:3-20). Pressure for agricultural land and displacement of the earlier inhabitants
began to increase in the mid-1800's as Anglo-American planters sought land for their plantations (Comeaux, 1969:17). In the late 1800's and early 1900's small groups of the earlier inhabitants moved into the interleeve basins and to the coastal portions of the rivers and bayous (Lyell, 1849, Vol. 2:113; Smith, 1937:66).

From 1890 to about 1930 there existed in the Barataria Basin a number of extended-family settlements of marsh- or swampdwellers. The settlements were located on the banks and shell mounds bordering Bayou Des Allemands, Lake Salvador, Bayou Barataria, Bayou Dupont, and Bayou St. Denis. Other settlements were established along lower Bayou Lafourche (Rome, 1966) and Mississippi River. Bois Choctaw, formerly located on the northwestern shore of Lake Salvador, consisted of four or five families with 8 to 10 children per family (Plate 2). Small vegetable gardens were cultivated in spring, and alligators were hunted in the summer. In the cooler winter months the swampdwellers turned to crabbing, fishing, and the hunting of ducks and snipe (Wilkinson, 1892:406-407).

The introduction of boat motors and the construction of highways in the 1930's promoted the abandonment of many swampdwelller settlements. The settlements with highway connections tended to grow. Also, during this period the shrimp and fur trapping industries grew tremendously. Commercial soft-crab production in the estuary began about 1927. Though a crabmeat plant was constructed in Westwego in 1934,
the fishing of hard crabs in the Barataria Estuary for processing did not become significant until World War II.

Plate 2. Bois Choctaw, a former swampdweller village along Lake Salvador. Photograph was taken about 1910. A family from Des Allemands retained the photograph and granted permission for its use.

A commercial blue crab fishery has long been established in the estuaries of Louisiana, including the Barataria Estuary. The crab fishery in the Barataria Estuary was begun by small groups of swampdwellers who also engaged in other activities such as shrimping and fur trapping. The development of crabmeat processing plants provided a much larger market for the hard crabs. Today, both hard and peeler crabs are fished, but in recent years the soft-crab production has declined considerably. In 1969, by weight, 24 per
cent of the hard crabs and 40 per cent of the peeler crabs taken from Louisiana waters were derived from the Barataria Estuary (Bur. of Comm. Fish., 1969, Landing Records).
CHAPTER IV

THE CRAB FISHERMEN AND CRABBING GEAR

The Crab Fishermen

Most of the crab fishermen who crab in the Barataria Estuary are native to the area and are descendants of the former swampdwellers. There are approximately 250 hard-crab fishermen and 90 soft-crab fishermen in the Barataria Basin (Table 9). Many of the hard-crab fishermen and nearly all

<table>
<thead>
<tr>
<th>Settlement</th>
<th>Hard-Crab Fishermen</th>
<th>Soft-Crab Fishermen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Des Allemands</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Bayou Boeuf</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Bayou Gauche</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Westwego</td>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>Lafitte-Barataria</td>
<td>125</td>
<td>86</td>
</tr>
<tr>
<td>Larose</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>Golden Meadow</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Leeville</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Grand Isle</td>
<td>40</td>
<td>0</td>
</tr>
<tr>
<td>Myrtle Grove</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Lake Perez (Lake Hermitage)</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td><strong>252</strong></td>
<td><strong>86</strong></td>
</tr>
</tbody>
</table>
the soft-crab fishermen live in the adjacent settlements of Lafitte and Barataria. Except some of the hard-crab catch during the winter in Caminada and Barataria bays, most of the crab catch in the estuary is made by fishermen who live in the Barataria Basin.

Commercial crab fishermen can be divided into three types: full-time, seasonal, and casual (Table 10). Full-time crabbers derive most of their income from the fishing of hard crabs. Because the full-time crabber must be able to catch crabs all year round, he is an "ace", or unusually skillful fisherman. Soft-crab fishermen and those hard-crab fishermen whose annual round include other activities compose the seasonal category. A third type, the casual or part-time fisherman, is also recognized. Casual crab fishermen are usually persons who have in the past been more fully engaged in the fishery, but because of the unreliable nature of crabbing have taken jobs in industry. On the days off, weekends, and vacations, these men crab.

Most of the fishermen who crab in the Barataria Estuary are seasonal crab fishermen. The main activity, in terms of income, is the trawling of shrimp in the inland waters. Inland shrimpers compose the "mosquito fleet", and do not include the shrimpers with large, offshore-type vessels. In addition to inland shrimping and crabbing, the seasonal crabber's annual round may include catfish fishing, fur trapping, and temporary winter employment (Fig. 7). The seasonal crab fisherman's activities are structured around
<table>
<thead>
<tr>
<th>Type of Fisherman</th>
<th>Full-Time</th>
<th>Seasonal</th>
<th>Casual</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Jefferson Parish (excluding Grand Isle)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crab Pot</td>
<td>38</td>
<td>115</td>
<td>5</td>
</tr>
<tr>
<td>Trotline with Baits</td>
<td>29</td>
<td>44</td>
<td>16</td>
</tr>
<tr>
<td>Bush Lines (Brush Traps)</td>
<td>4</td>
<td>82</td>
<td>0</td>
</tr>
<tr>
<td>Otter Trawl Shrimp</td>
<td>351</td>
<td>41</td>
<td>94</td>
</tr>
<tr>
<td>Total Fishermen in Parish</td>
<td>446</td>
<td>--</td>
<td>156</td>
</tr>
</tbody>
</table>

| Crab Pot                   | 0         | 34       | 0      |
| Trotline with Baits        | 0         | 17       | 0      |
| Bush Lines (Brush Traps)   | 0         | 0        | 0      |
| Otter Trawl Shrimp         | 235       | 14       | 127    |
| Total Fishermen in Parish  | 255       | --       | 133    |

| Crab Pot                   | 0         | 5        | 3      |
| Trotline with Baits        | 0         | 2        | 10     |
| Bush Lines (Brush Traps)   | 0         | 0        | 0      |
| Fish\(b\)                 | 57        | 30       | 15     |
| Total Fishermen in Parish  | 63        | --       | 27     |

| Crab Pot                   | 0         | 25       | 0      |
| Trotline with Baits        | 0         | 15       | 25     |
| Bush Lines (Brush Traps)   | 0         | 0        | 0      |
| Otter Trawl Shrimp         | 380       | 10       | 135    |
| Total Fishermen in Parish  | 518       | --       | 245    |

\(a\)Data were taken from Bur. of Comm. Fish., 1968, Op. Unit Data.

\(b\)Catfish fishing in St. Charles Parish is as important as is shrimping in the other parishes bordering the Barataria Estuary.

\(c\)Crabbers from Lafourche Parish fish in the Barataria Estuary and in adjacent Terrebonne Parish.
Fig. 7 The annual round of the seasonal crab fishermen in the Barataria Estuary.
the May-July and August-Christmas inland shrimp seasons.

The annual hard- and soft-crab catch from the Barataria
Estuary (Fig. 8) reflects the seasonal nature of crab fishing.
Because of the relatively high market price of shrimp, there
is a reduction of crab fishing effort during the inland
shrimp seasons. The hard-crab catch is highest in April,
July, August, and September, and lowest from November to
March. The soft-crab production is much more seasonal.
April and September are generally the months of peak soft-
crab production.

The Crab Fishing Gear

The crab fishing gear can be separated into hard-crab
fishing gear and soft-crab fishing gear. Hard-crab fisher-
men in the Barataria Estuary use either the trotline with
baits, or crab pots. Soft-crab fishermen use bush lines
and crab shedding cars. The bush lines are employed to
catch the peeler crabs, and the shedding cars are used to
artificially complete the shedding, or molting, process.
A description of the gear types previously utilized in the
estuary is contained in Appendix I.

The trotline with baits. - The trotline is a baited,
hookless line that is placed on the bottoms of lakes and
channels of the estuary. The crabber usually sets up two
or more trotlines which are a mile or more each in length.
Each trotline is stretched out between two poles which hold
the lines in place. Durable baits, usually beef lips and
Fig. 8  Hard- and soft-crab landings by months, 1967 and 1968, New Orleans and Lower Mississippi River Area. Data were taken from U.S. Bureau of Comm. Fish., 1967 & 1968:9-10, Market News Service.
ears, are tied directly to the lines with slip knots. As the lines are raised from the water bottoms, the crabs do not flee, but tenaciously cling to the baits with their chelipeds. An outrigger, or arm, extending from the side of the fishing craft raises the trotline from the bottom and knocks the crabs off the baits (Pl. 3).

In the past the crab fisherman would sit on the side of his boat near the outrigger and catch the crabs that were being knocked off the baits with a hand dip net. In the 1950's crab fishermen in the estuary began replacing the hand dip net with a mechanized crab cage (Pl. 4). Using the crab cage the crabber can use longer, or a larger number of trotlines, and thereby increase the daily catch. With both methods of catching the crabs, a motor is needed to propel the boat forward at a steady speed so that the trotlines are continually passing over the outrigger.

The crab pot. - In 1965 and 1966 the crab pot (Pl. 5) began to appear in large numbers among the gear of the crab fishermen of the Barataria Estuary. Though the design of the crab pot varies, most are constructed of chickenwire. Each pot has a bait container in the bottom center. Like the trotline, the crab pot is used to catch hard crabs that are actively feeding. Generally there are two funnel-shaped entrances on the sides of the pots through which the crabs enter. Some of the pots have an upper and lower chamber. To locate and identify the pots in the water, the fishermen use painted plastic bottles, or corks, as floats.
Plate 3. The trotline with baits gear type in operation. The blue crab (center) clinging to a bait will be knocked off and will drop into the crab cage below.

Plate 4. Use of the crab cage with the trotline with baits. A crabber is in the process of emptying the crab cage.
Plate 5. The chickenwire crab pot, or crab trap. Hard crabs feeding on the water bottoms are attracted to the baits inside the pots.

According to the operator of a large, crabmeat processing plant in Westwego, approximately 90 per cent of the hard crabs from the Barataria Estuary that are sold to crabmeat processors are taken with crab pots. A fisherman using crab pots can average a larger daily catch than the trotline crabber. In 1970, only about 50 fishermen continued the use of the trotline with baits. A small percentage of the hard crabs in the estuary are caught with shrimp trawls, drop nets, and butterfly nets. The use of shrimp trawls exclusively for the catching of crabs is prohibited in Louisiana. Hard crabs smaller than 5 inches across the
carapace are under the legal size limit.

The bush lines. - In about 1927 a swampdweller living along Lake Cataouatche discovered that peeler crabs were attracted to fresh willow branches being placed in the lake to catch river shrimp and eels. When the branches were raised from the water, blue crabs undergoing ecdysis were found inside the mass of branches. Peeler crabs commonly bury themselves in the mud of the shorelines, and are observed among the roots and stumps of the shoreline vegetation. In Chesapeake Bay (Wharton, 1954:5) and in Lake Pontchartrain, Louisiana, molting crabs are found in beds of submerged aquatics.

The fishermen soon found that wax myrtle (Myrica cerifera) branches were more effective in attracting peeler crabs than willow branches (Frost, 1938:53), and that clumps of branches could be tied to trotlines. Wax myrtle, locally known as the "seria" bush, is an evergreen shrub that is widely distributed in south Louisiana (Brown, 1965:38). To prepare a "bush", the crabber takes 6 or 7 fresh branches about 3 feet in length and binds them together at the base (Pl. 6). The bushes are attached to a line, about 15 feet apart, forming a trotline. In the past a soft-crab fisherman used about 200 bushes, but in 1969 the fishermen were using from 500 to 1,000 bushes.

The shedding ears. - The soft-crab fishery involves an extra step that of artificially shedding the peeler crabs. Attracted to the bushes are "green" crabs (crabs that will
Plate 6. The "seria" bushes of the bush lines. The soft-crab fisherman places the bushes in the water bottoms where the crabs are molting.

Plate 7. Two empty crab shedding cars. Peeler crabs are kept in the cars until they undergo ecdysis.
undergo ecdysis in about a week) and "busters" (those crabs with cracked exoskeletons, indicating that ecdysis is in an advanced stage). Only a small number of soft crabs (freshly shed crabs) and hard crabs are shaken, or picked, from the bushes.

For the purpose of artificially completing the shedding process, the fishermen have converted fish cars into crab shedding cars (Plate 7). Fish cars are large, open boxes that are used to keep fish alive before the fish are marketed. Shedding cars are hand made of cypress, and are usually 8 feet wide by 12 feet long. The cars are only three to four feet deep, and windlasses serve to raise and lower them. Generally two or four shedding cars are operated at a time. Approximately 250 to 500 live peelers can be kept in a single car. When the busters wiggle out of the old exoskeletons, they are soft crabs. The soft crabs are removed from the cars and are placed under refrigeration until they are marketed. The manner in which the fishermen sell their hard and soft crabs is discussed in Appendix II.

Crab fishing in the Barataria Estuary is primarily a seasonal activity. For most crabbers inland shrimping is the main economic activity. Both hard and soft crabs are fished in the estuary. Hard crabs are caught with either trotlines with baits, or with crab pots. Since 1965 the crab pots have become the main hard-crab fishing gear. Peeler crabs are fished with bush lines, and the shedding process is completed in crab shedding cars.
CHAPTER V

FUNCTIONING OF THE CRABBING GEAR

Field observations of the use of the various types of fishing gear and the associated activities of the crab fishermen provide detailed field data regarding the ecology of the blue crab. Use of the hard-crab fishing gear, the trotlines and crab pots, reflects the feeding habits and distribution of the larger juveniles and adult crabs. Use of the soft-crab fishing gear, the bush lines and shedding cars, provides data concerning the process by which the larger juveniles undergo ecdysis.

Use of the trotline with baits. - Trotlines are used primarily in the upper Barataria Estuary during the warm months. Elderly fishermen and crabbers who sell hard crabs to the public tend to retain the use of trotlines. Crabbing is carried on seven days a week. Each trotline crabber maintains two to as many as six baited trotlines; the lines are laid out and picked up every day. Fishermen begin crabbing in the early morning and crab until mid-afternoon. From December through March crabbing with trotlines is less effective and crabbing is begun later in the day after the shallow estuarine waters have warmed up somewhat. When the estuary waters are cold, the activity of the crabs is
decreased and the crabs are less able to cling to the trotline baits.

Crabs that are caught with a trotline are actively feeding; therefore the crabber must continually "run" the trotlines. According to the fishermen, crabbing in the upper estuary is best from 5 A.M. to 9 A.M. Crabs feed in the early part of the day along the edges of the lakes and channels. In summer the crabs appear to drift toward deeper waters as the sun heats up the top foot or two of water. Trotline crabbing in the summer is not effective in deep water because as the trotlines are raised from the cool water of the bottom to the warmer surface water the crabs release the baits.

Since the waters of the estuary are turbid, the fishermen can not see the crabs responding to the baits. Fishing success is measured by the size and number of crabs clinging to the baits as the lines are lifted out of the water by the outrigger. A crab every four to five baits is considered good and seldom are two crabs clinging to one bait. Only when there is a concentration of actively feeding crabs can the trotline crabber surpass the catch of a crab pot fisherman. A daily catch with a trotline of 25 to 35 baskets (35 to 40 pounds per basket) is common.

Fresh beef lips and ears are commonly used for bait on the trotlines. Catfish heads and skins, and other meat scraps, can also be used with success, but such baits are not very durable. Fresh baits attract crabs better than
older baits. Baits are changed every two to three days in summer and every two weeks in cooler months. When the crabs are "biting" in large numbers the trotlines are placed closer together and are run as fast as possible to prevent the crabs from eating the baits off the lines.

Generally the trotlines are stretched out at an angle, or perpendicular, to the shorelines (Fig. 9). In spring when the crabs are migrating to the upper estuary, the crabbers know that the crabs tend to move within the areas of current. When the crabs are migrating out of the upper estuary in late fall they tend to migrate closer to the shorelines. In summer the trotline crabbers fish near points along the shorelines where there are tidal currents. The center of the upper estuary lakes are seldom crabbled.

Crabs which have recently shed are taken in large numbers in the upper estuary with the trotlines. Recently shed crabs are brightly colored and light in weight. The lightest and hungriest crabs respond better than do "fat" crabs. Females that have finished spawning and are returning to the estuaries are also active feeders. Crabs smaller than 3 to 4 inches across the carapace are seldom taken with trotlines.

During the hot months of June, July, and August the trotline with crab cage can not be used in the lower estuary. Crabs caught in the lower estuary in summer are called "saltwater crabs", whereas crabs caught in the upper estuary are referred to as "brackish-water crabs". The crabbers know
Fig. 9 Orientations of the trotlines in the Barataria Estuary.
that "salt-water crabs" must be shaded and iced as soon as possible to prevent the crabs from dying. However, crabs caught in the lower estuary in summer with crab cages die in the cages, or soon afterward in the fishing boats. Apparently, in saline waters the blue crab can not osmoregulate efficiently while being dragged through the water in the cages. Female crabs which have recently spawned appear to be easily killed.

Use of the crab pots. - Most of the hard-crab catch in the Barataria Estuary is taken with crab pots. A crab pot fisherman can consistently catch more crabs than a trotline crabber. Crab pot fishermen generally use about 200 pots at a time, and a daily catch of 1,200 pounds is common. Because the pots remain on the water bottom at all times, the pot fishes longer hours and remains in place even when the crabbers do not go out. The pots are emptied daily, usually in the forenoon. Crabs caught with pots are in good condition and the loss of crabs in the pots is rare.

Like the trotline, the pot employs a bait to attract feeding crabs. Most crabbers in the estuary use fresh, frozen croakers for bait. A few fishermen have used mullet with equal success. The low cost and year-round availability of the frozen croakers accounts for their wide-spread use. About a pound and a half of bait are stuffed into each bait changer. The use of the crab pot is illustrated in Plate 8.
Plate 8. Use of the crab pot in the Barataria Estuary.
The fisherman is about to empty the crabs from the pot into
his boat.

Since the crabs tend to stay in the pots once they
enter, the pots need not be emptied at the same time the
crabs are feeding. Once the bait has deteriorated the crabs
do escape, and after a day or two, only stone crabs and a
couple of very large blue crabs will be left in the pots.
Baits are changed daily because the croakers deteriorate
rapidly. During the months of September through December,
in the lower estuary, the baits also attract stone crabs,
oyster drill snails, and hermit crabs.

Because of the turbidity of the water, the fisherman
can not see the gear function. He must rely on the actual
catch for assessing the effectiveness of the gear. Small juveniles either do not enter the pots, or else the size of the entrances allows them to escape. Recently caught crabs tend to be in the lower chamber, whereas crabs caught for some time tend to be in the upper chamber. Several crabbers have stopped constructing two-chamber pots because they are more difficult to empty.

The pots must be placed in areas of moving water because large crabs do not feed in shallow, poorly circulated environments. Tidal channels, connecting waterways, and shorelines where tidal exchange takes place are excellent crabbing areas. To facilitate locating and emptying of the pots, the crabbers string out the pots in lines. Pots are spaced about 100 feet apart in winter, somewhat less in summer.

In the upper estuary the pots are placed in the same locations as the trotlines. In the lower estuary the crabbers prefer an area which has oyster beds and direct tidal exchange. Crab pot fishermen do catch "salt-water crabs", but the crabs are shaded and iced. The fishermen are aware that large concentrations of gravid females congregate in the lower estuary near the tidal inlets during the period from November through March. In winter gravid females, which do not respond well to trotlines, are taken in very large numbers by the crab pot fishermen. Male crabs are also taken, but the males tend to be more scattered and are not confined to environments near the tidal inlets.
The successful hard-crab fisherman must frequently move his gear. The crabbers know that the crabs move about and that the stock in a given area can be depleted. Having well-maintained gear, fresh bait, and a willingness to work seven days a week are success-promoting qualities. Young and inexperienced men often follow the movements and practices of an experienced crabber.

Use of the bush lines. - The bush line technique is employed only in Louisiana for the catching of peeler crabs. Soft-crab fishermen, primarily from Lafitte-Barataria, use the bush lines from March through October. In early March, when fur trapping and other winter activities are over, the crabbers begin cutting branches from the "seria" shrubs. By mid-March the bush lines are prepared and the fishermen begin laying out bush lines in Lake Cataouatche, Lafitte Pens, and other water bodies. A crabber loading bushes in a Lafitte skiff is shown in Plate 9. Bush lines are stretched out between two poles which hold the lines in place. The weight of the leaves and branches causes the bushes to settle to the bottom of the water.

Freshly prepared bushes are more effective in attracting peeler crabs than older bushes. After about two weeks in the water the resinous leaves of the wax myrtle turn black. Crabs appear to avoid the bushes at this time. After the black leaves have fallen off and slimy, algal growths cover the branches, the bushes are effective again. Most crabbers prepare new bushes after a month. Two to three sets of
bushes are used each year. According to the crabbers, 1969 was a good year because there was plenty of "slime" on the bushes.

Using a small boat and a hand dip net the crabber will run his lines once a day. The fishermen pull themselves along the lines in the boat. Each bush is raised individually by hand and the dip net is quickly slipped under the bush to catch any crabs that may be falling out. Finding a peeler crab in every third or fourth bush is common, and a peeler in every bush is unusually good. If the crabs are "giving" quite well the crabber will run his lines twice a

Plate 9. A soft-crab fisherman from Lafitte loading bush lines in a boat.
day. A fisherman with 500 bushes can anticipate catching about 150 peelers a day.

In March-May and July-August the catch consists of half green crabs and half busters. In May-July and in September many "doubles" (or "carriers") are taken. "Doubles" consist of a large, hard male crab carrying a large, molting female. Crabs mate while the female is in the soft state of its final molt. "Wild" crabs, or ordinary hard crabs, are also caught on occasion.

After the crabs have been shaken, or picked, from the bushes the crabs are shaded and are placed in baskets in the boat. Busters and soft crabs are kept in one basket, and green crabs in another. Hard crabs, if any, are always kept apart from the peelers. Only small numbers of soft crabs are found in the bushes. The fishermen believe that freshwater eels devour large numbers of soft crabs. Crabbers will occasionally catch an eel in the bushes while running the lines.

Highest catches of peelers are made in quiet, shallow water of high turbidity. In the past four or five years Lake Cataouatche has been the center of bush line crabbing. Crabs that are undergoing ecdysis appear to move to environments that are calm, shallow, and muddy. In less turbid water many of the peelers escape before being caught. Cool weather tends to reduce the number of shedding crabs. Immediately following the cool weather, the catch is somewhat higher than usual. Molting crabs appear to be attracted to
the bushes because the branches provide protection from predators and obstacles to wedge against as the crabs wiggle out of the old exoskeletons.

**Use of the shedding cars.** - A minimum of two shedding cars are required because green crabs must be kept separate from the busters. Green crabs are still able to feed and can attack another crab. Busters and soft crabs are defenseless and do not feed. An injured crab with an obstructed shell will not be able to wiggle free of its old exoskeleton. Hard crabs are never placed in the crab shedding cars.

A molting crab takes 10 minutes to 2 hours to wiggle out of the old exoskeleton. The newly shed crab is soft, defenseless, and wrinkled. After a copious absorption of water the crab increases in size from 8 to 50 per cent (Tagatz, 1968a:284). In about 12 hours the new exoskeleton is firm and leathery (Viosca, 1953:16). The increase in size is illustrated in Plate 10. From the time of the cracking of the old shell (the buster stage) to the formation of a leathery "paper shell", about 24 hours elapse.

In the early morning and again in the evening the crabber will raise the buster car and remove all the soft crabs. If the weather is hot and the sun is bright this must be done quickly, or some of the crabs will die. Every other day the crabber will raise the green crab car and "grade" (check) all the crabs. If a crack under the carapace is found, the crab is gently tossed over into the nearby buster car. Crabs remain in the green car for about 2 to 7
days and in the buster car from 12 to 36 hours.

Plate 10. Illustration of the size increase of the blue crab after molting. The soft crab (left background) has just emerged from the old exoskeleton (left foreground). On the right is an empty exoskeleton from another crab. A quarter coin shows the scale.

The producing of 100 "counters" a day is considered very good. A counter is a large soft crab which is larger than 5 1/2 inches across the carapace. Soft crabs smaller than 4 inches are under the legal size limit. Soft crabs are worth much more than hard crabs. The fishermen, in 1969, were receiving 35 cents a piece for a "counter" soft crab and from 6 to 12 cents a pound for hard crabs. Soft crabs must be kept under refrigeration. Both soft and hard crabs must reach the market alive.

Each crab shedding car can hold 250 to 500 peelers.
depending upon the size of the crabs and on the water temperature. Crowding crabs in June, July, and August can result in the death of large numbers of molting crabs. Since warmer water hastens the molting process, the crabbers maintain shallow water depths in the cars in the early spring. When the water is very warm, stagnant, or when there are heavy rains, the water depths are increased. Using the windlasses, water level in the cars can be varied from 4 to about 24 inches.

The fishermen believe that the salinity of the water does not affect molting. Tagatz (1968a:287) successfully shed blue crabs in both fresh and saline water. A few crabbers stated that losses occur in the shedding cars following an exceptionally heavy rain. It was observed that crabs molting in limnetic waters appeared to have slightly smaller chelipeds and thinner exoskeletons as compared to crabs molting in oligohaline waters.

Soft-crab fishermen from Lafitte-Barataria have been experiencing problems producing soft crabs during the hot months of July and August. In very warm water the peelers molt faster, but deaths are more common in the shedding cars. At times 50 per cent losses occur, especially among those crabs emerging from the old shells. Some of the crabbers report that male crabs die more easily than females. High water temperature in mid-summer may be a limiting factor in the Barataria Estuary. Wave wash and mud in the bottom of the crab shedding cars are also considered
undesireable.

In addition, during periods of lower water levels in the upper estuary, the crabbers complain of "bad water". Associated with the "bad water" are crabs swimming on top of the water and crab kills in the shedding cars. When water levels are low in the estuary, water drains into the lakes from the surrounding swamps and marshes. Crabs tend to avoid areas that receive drainage from agricultural fields, sugar cane mills, oil and pipeline canals, and from reclamation pumping stations. The fishermen have found that the surface water is more adverse than is water from the deeper portions of the canals and bayous.

All of the molting crabs in the upper estuary are covered with small, pink worms. The species and affect of the worms is not known. Barush (1967:353) and Sprague and Beckett (1966:503) have reported pathological diseases common to molting crabs in Chesapeake Bay.

In summary, observation of the use of the various types of crabbing in the Barataria Estuary provides field data on the distribution, size, and type of blue crabs that are responding to the gear. Trotlines are used primarily in the upper estuary during the summer months for hard crabs. Crab pots are the main hard-crab gear. The pots are used throughout the estuary, but are particularly effective in the lower estuary during the winter months. Peeler crabs are caught with bush lines only in the upper estuary during the warm months. The following section on the crab fishing areas
focuses on the crab fishing activities in a geographical context. Therefore, generalizations therein can be made concerning the seasonal distribution and migrations of the crab, as well as on the relationship of the crabs to specific environments.
CHAPTER VI

HARD- AND SOFT-Crab FISHING AREAS

Over the years the crab fishermen have developed crab fishing patterns which reflect the seasonal distribution and migration of the blue crabs. Because many of the fishermen also trawl the estuaries for shrimp, they are aware of the crab movements. Four hard-crab fishing seasons and two-soft-crab fishing seasons were recognized in the Barataria Estuary. A geographical analysis of the seasonal crabbing areas provides data for placing the life history of the blue crab in its spatial context. Most of the field data pertain only to commercial size crabs.

**Hard-crab fishing areas in winter.** During the months of December, January, and February the hard-crab fishing areas are contracted. Most of the winter catch takes place in the lower estuary, in Caminada and Barataria bays (Fig. 10). Caminada Bay, though only 2 to 5 feet deep, is one of the highest yielding water bodies in the lower estuary. Other areas of high catch are along the east side of the Barataria Bay Waterway and from Quatre Bayou Pass up to upper Barataria Bay. Crabbing is not carried on in the tidal inlets because the tidal currents tip the crab pots over and fill them with sand. Boat and barge traffic reduce the crabbing activity near Grand Isle and Barataria Pass.
Fig. 10 Hard-crab fishing areas in the Barataria Estuary in January. Areas in black represent crab fishing areas.
Very little crabbing is done in the nearby Gulf of Mexico, even though seabob and shrimp fishermen occasionally catch crabs in their trawls.

The crab caught during the winter are in good condition and the meat yield per live weight is high. Spawning does not take place in winter, and rarely are any of the crabs molting. However, a small number of the crabs had black cysts in the muscles and among the egg masses.

From December to mid-March many crab pot fishermen crab the waters of the lower Estuary. The crabbers prefer areas with oyster beds and direct tidal exchange. Viosca (1953:17) and Menzel and Hopkins (1956:178) reported that blue crabs feed on oyster spat, small and weak oysters, and on oyster predators. Cultivated oyster beds extend from lower Caminada and Barataria bays up to the middle of Little Lake. Oyster fishermen, while dredging, occasionally dredge up crabs along with the oysters.

Because blue crabs are motile, poikilothermic organisms, they migrate from the upper estuary to the lower estuary as the water temperature of the estuary falls. The outmigration is associated with water temperatures of 15°C and below (Table 11). Mean water temperatures in December, January, and February are below 15°C in the lower estuary, and below 13°C in the upper estuary. In Little Lake and Lake Salvador small numbers of adult male and large juvenile crabs burrow in the bottom muds and feed only during the intermittent warm spells. Because these crabs remain all winter in
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SURFACE WATER TEMPERATURES, UPPER & LOWER BARATARIA BAY\textsuperscript{a}

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\textsuperscript{a}Temperatures are in degrees centigrade. Data were taken from La. Wildl. & Fish. Comm., 1969:Table 8.
the upper estuary they are referred to by the fishermen as "settler crabs". The adult male and large juvenile crabs may be more tolerant of lower temperatures than adult female crabs.

Nearly all the crabs caught close to the tidal inlets are adult, gravid females. Impregnated females from the upper estuary begin migrating toward the tidal inlets in October and November. By cracking open a small sample of adult females, it was found that the gravid females begin developing an egg mass at about mid-December. According to the crab fishermen, the gravid females do not leave the areas of direct tidal exchange which extend from the tidal inlets. In Caminada Bay, near Caminada Pass, very large catches of gravid females are caught during the winter. When concentrations of the gravid females are located, the crabbers often catch a half basket, or more, in each crab pot.

Further away from the tidal inlets proportionally more adult males and immature crabs are caught. In the shallower, less saline portions of the lower estuary about 4 out of 5 adult crabs caught are males. Crabbers who prefer male crabs move further away from the inlets. In Little Lake and Lake Salvador nearly all the winter catch are adult males and immature males and females.

Two phenotypes of female crabs were noticed in the winter catches. Approximately one third of the adult females were not the usually shiny, clean, bright-colored crabs, but
were dull, yellowish brown with barnacles on the carapaces. Tagatz (1968a:21) concluded that the latter have spent part of their lives in saline waters and are probably repeat spawners from the previous spawning season. The shiny, bright-colored crabs are recent migrants from the upper estuary.

The winter crab catch is unreliable. The passing of cold fronts is associated with very low catches. Rough water prevents the running of the crab pots. When the intermittent warm weather prevails, the catch increases, suggesting that the crabs are again actively feeding. During the warm weather the crabs appear to move further away from the tidal inlets and large catches are made in areas of tidal exchange. If the warm spell continues for a week or more, moderate catches of settler crabs are made in Little Lake and Lake Salvador.

In order to improve each day's chance of a successful crab catch the fishermen constantly evaluate the weather trends and the catch of the past few days. The most successful crabber frequently moves the crab pots. Crabbers with experience in the area and well-maintained gear tend to be more "lucky".

**Hard-crab fishing areas in spring.** - The spring season extends from mid-February to about the first of May. The season is characterized by the up-estuary migration of the juveniles and adult males, and by the spawning of females in the lower estuary and marine area. As the season
progresses the crabbing activity shifts away from the tidal inlets and expands inland (Fig. 11). The northern portion of Barataria Bay, Little Lake, and Bayou Perot are important crabbing areas.

Compared to the winter, male crabs are more significant in the spring catches. The gravid females begin to extrude their eggs in early March. By April large numbers of egg-bearing females, called "sponge crabs", force the crabbers to quit the water bottoms of lower Caminada and Barataria bays. Spawning in the lower estuary and adjacent marine area continues until September.

The spring up-estuary migration begins in late February or early March. If the weather is unusually warm in February, the upmigration is initiated sooner. There appears to be two groups of spring up-estuary migrants (Table 12). The early migrants are mostly juvenile males ranging in size from 75 to 125 mm. The crabbers believe that the male crabs are "drawn to the sweet (fresh) water". In spring very large catches of male crabs are taken about the Mississippi River delta where river water mixes with Gulf water. Masses of small juveniles are also among the early migrants. The smaller juveniles were observed in large numbers in northern Barataria Bay.

Many of the early migrants are "clear", or have "paper shells". A "clear crab" is light in weight and brightly colored, indicating recent shedding. As the water of the estuary warms up in spring, the early migrants begin
Fig. 11 Hard-crab fishing areas in the Barataria Estuary in April. Areas in black represent crab fishing areas.
migrating toward the upper estuary and molt continuously.

The crab fishermen believe that south winds prevailing in March and April for a couple of weeks will "push" the crabs up the estuary. The crabs do move at the surface of the water; especially at night. Tidal currents assist in the migrations. The migrating crabs pass through Bayou St. Denis, travel up Little Lake and Bayou Perot, move along the western shoreline of Lake Salvador, and then either move along the north shore of Lake Salvador, or up Bayou Des Allemands. In the spring of 1970 the early migrants had reached lower Lake Des Allemands by mid-April.

TABLE 12

DATES OF UP-ESTUARY MIGRATION OF THE BLUE CRABS

<table>
<thead>
<tr>
<th>Water Body</th>
<th>Early Migrants</th>
<th>Main Body of Crabs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bayou St. Denis</td>
<td>Mid-February</td>
<td>March</td>
</tr>
<tr>
<td>Lower Little Lake</td>
<td>Early March</td>
<td>March</td>
</tr>
<tr>
<td>Upper Little Lake-Bayou Perot</td>
<td>Early March</td>
<td>April</td>
</tr>
<tr>
<td>Lake Salvador</td>
<td>March</td>
<td>May</td>
</tr>
<tr>
<td>Bayou Des Allemands</td>
<td>April</td>
<td>June</td>
</tr>
<tr>
<td>Lake Des Allemands</td>
<td>April-May</td>
<td>June-July</td>
</tr>
</tbody>
</table>

*Dates are based on initiation of crab fishing in the various water bodies.*

The main body of the crabs appears to migrate more slowly. Most of the spring hard-crab fishing centers on this larger group. The composition of this group is mixed, and there is a greater proportion of adult males and immature
females. Also, molting is much less evident than among the early migrants. Many of the larger crabs are dull-colored, have broken chelipeds and missing legs.

Although the spawning females move about in the spring, they do not migrate inland. An elderly crabber stated that he caught only two sponge crabs in his lifetime in Lake Salvador. In the spring of 1970 only a few sponge crabs were caught in lower Little Lake. A line, therefore, can be drawn through lower Little Lake. In general, sponge crabs do not migrate beyond that line. Crabs that migrate to the upper estuary are referred to by the crabbers as "brackish-water crabs". Crabs caught below this general area in summer are known as "salt-water crabs".

The up-estuary migration is not a continuous movement. Cold fronts accompanied by lower temperatures, northerly winds, and lower water levels can delay and reverse the migration. During the passing of a cold front the crabs often burrow into soft muds near the shorelines. With the return of warm weather the migration resumes, but many crabs caught the first day or two are covered with mud.

The northern portion of the lower estuary is crabbed for males and non-spawning females until the May inland shrimp season. Until several years ago, crabbers would catch sponge crabs and remove the sponges before selling them. Today, only very small numbers of sponge crabs and hard crabs smaller than 5 inches are sold to the processors. During the past few years, the crab catches in the spring in
the Barataria Estuary have been low.

**Hard-crab fishing areas in summer.** - The summer months include May, June, July, and August. The location of hard-crab fishing in July is shown in Figure 12. Crabs are fished from Lake Des Allemands to Bayou St. Denis in summer. Highest catches are made in Lake Salvador and Bayou Perot. According to the fishermen, the largest catches of crabs in Lake Salvador are made in June, July, and August.

Because crabs molt in the upper estuary in summer, many of the crabs are light. The fattest crabs tend to be taken from Bayou Perot. The crabbers believe that brackish water from Bayou Perot brings "food" for the crabs. Specifically, the fishermen mentioned flounders, spot, small catfish, and silverfish, or "many fish". If the water in Lake Salvador is unusually fresh, the crabbers often to to Little Lake for fat crabs. In summer crabs are commonly observed moving about with the tidal currents, probably in search of food.

The salinity of the upper estuary is highly variable (Fig. 13). The crab fishermen associate good summer crab fishing in the upper estuary with the mixing of "clear water" (brackish water) and "sweet water" (fresh water). Food items of the crab may be more abundant in the zone of mixing.

In addition to the mixing of fresh and brackish water, the crabbers also associate high crab catches in summer with sandy, or shell, bottoms, and tidal currents. Small crabs are found in areas with little water movement, but not large
Fig. 12 Hard-crab fishing areas in the Barataria Estuary in July. Areas in black represent crab fishing areas.
Fig. 13 Variation in the salinity of waters in upper Barataria Estuary.
crabs. Sandier bottoms occur where tidal currents are stronger. Many crab fishermen know the location of clam (Rangia cuneata) reefs and crab along side them. Blue crabs devour large numbers of small Rangia clams (Viosca, 1953:17). In the Barataria Estuary Rangia clams are distributed from Bayou Des Allemands to about the middle of Little Lake.

The western side of Lake Salvador and the mouth of Bayou Perot are considered the best summer hard-crab fishing areas in the estuary. There fresh water from Bayou Des Allemands mixes with brackish water from Bayou Perot (Plate 11). More sandy bottoms and clam reefs are located in western Lake Salvador than on the eastern side. Also, in western Lake Salvador there are points of land, e.g., Grosse

Plate 11. The mixing of fresh and brackish water in western Lake Salvador. The organic-rich drainage waters from Bayou Des Allemands (upper left) is flowing into the lighter colored water of western Lake Salvador.
Point and Point Chico, which extend out into the lake. Stronger tidal currents and sandy bottoms occur about these points of land.

The crab catch in Lake Des Allemands is small and varies from year to year. In 1969 the catch was very low, but in 1967 the catch was above normal. Medium-size juveniles are common in the upper part of the lake, while larger crabs are caught mainly in the lower portion. Highest catches are taken from June to September. Compared to Lake Salvador, crabs caught in Lake Des Allemands are smaller and less abundant. Very seldom are crabs taken in Bayou Chevreuil and Bayou Boeuf.

Male crabs dominate the summer catches in the upper estuary. Adult females appear in June, July, and August. Large numbers of "spent females" (those that have completed their spawning activity) are found dead on the outside beaches of Grand Isle and Grand Terre in August. Apparently some of the females die after spawning, while others return to the estuary. Spent females are caught in the estuary from June to late fall. In the past crabbers from Lafitte-Barataria would catch these returning females at night with trotlines near Pass Abel. Because the females are light and often give off an odor, some crabbers refer to them as "stinky crabs".

The difficulty of keeping salt-water crabs alive in summer reduces the crabbing effort in the polyhaline waters of the lower estuary. According to the fishermen, about 3
out of every 4 crabs caught in summer in the lower estuary are females. Crab pot fishermen do catch salt-water crabs, but the crabs are shaded and iced as soon as possible. During the inland shrimp seasons the shrimp fishermen often catch three to four bushels of crabs in the trawls. Large numbers of very small juveniles are inadvertently destroyed by the shrimp trawls during the shrimp seasons.

**Hard-crab fishing areas in the fall.** - The fall hard-crab season extends from September to mid-December. In September, based on fishing activity, the crabs reach their widest distribution (Fig. 14). Crabs are fished from upper Lake Des Allemands to Barataria Bay. Fall crabs tend to be "fatter" and slightly larger than in the summer. In September large crabs are also caught in upper Lake Des Allemands, and crabs appear to be more numerous in eastern Lake Salvador. Though males continue to be more common, spent females are also taken.

In October and November concentrations of adult females begin to gather in southern Lake Salvador, Bayou Perot, and Little Lake. These gravid crabs constitute what is known as the "fall-run-of-the-females". Slowly the females migrate toward the lower estuary. According to the fishermen, in recent years the "fall-run-of-females" appears to involve a smaller number of crabs.

In October and November relatively high crab catches take place in Bayou Des Allemands. By November crabbing has ended in Lake Des Allemands. As the cold season sets in
Fig. 14 Hard-crab fishing areas in the Barataria Estuary in September-October. Areas in black represent crab fishing areas.
the lower portions of lakes and connective channels become the center of activity. In late November and early December the crabbers concentrate on lower Mud Lake, the mouth of Bayou Des Allemands and Bayou Couba, southern Lake Salvador, and on Bayou Perot.

The catch in the late fall is highly unreliable, indicating that outmigration is probably taking place. Gravid females and the small juveniles migrate out first. In early December seabob and shrimp fishermen catch juveniles ranging in size from 40 to 75 mm. in Barataria Bay and in the nearby Gulf of Mexico. Three, or more, weeks of cold weather is required to force the large male crabs out of the upper estuary. In December only large juveniles and adult males are caught in Lake Salvador.

By continually moving their gear the fishermen try to locate the crabs as the outmigration takes place. Trotline crabbers usually quit crabbing at this time. Many crabbers notice crabs moving along the shorelines, often within 500 feet of the shore. By November the fishermen begin catching adult females near the tidal inlets. Male crabs become numerous about the oyster beds in December. As the winter season approaches the catch in the upper estuary "craps out", indicating that most of the crabs have migrated out.

Soft-crab fishing areas - spring season. - The spring season extends from mid-March to the beginning of May. In an unusually warm winter the season may start in February. Generally the peak production is in late March and April.
Much of the crabbing takes place in Lake Cataouatche (Fig. 15). Other important areas are the Lafitte Pens, southwestern Lake Salvador, Bayou Perot, Bayou Rigolettes, and Little Lake.

Molting crabs can be found throughout the estuary, and shrimpers on rare occasions catch molting crabs in winter offshore. A few peeler crabs are caught by recreational fishermen in summer near Grand Isle. In large measure, however, the molting of larger juveniles is restricted to the warm months and to the oligohaline waters of the estuary.

The spring soft-crab season in the estuary is associated with the migration of the early migrants to the upper estuary. These early migrants reach Lake Cataouatche by mid-March. Large numbers of juveniles in the 75 - 120 mm. size range were seen in the fishermen's crab shedding cars in March, 1970. Many of the soft crabs being produced in spring were close to the 4 inch minimum limit.

The fishermen know that in spring the crabs molt faster in warm water than in cooler water. Hence, the bush line fishermen concentrate on the shallow water bodies. Lake Cataouatche is only 3 to 4 feet deep. Should the weather suddenly turn cold, the crabs appear to leave the shallow lakes for deeper water, and the catch falls.

In the spring of 1970, the fishermen quit running their bush lines in April because they could not catch sufficient numbers of busters. Over the past few years the spring run has been declining, and many of the crabbers blame the
Fig. 15 Soft-crab fishing areas - spring season, Barataria Estuary. 
Areas in black represent crab fishing areas.
crab pot fishermen who catch the gravid females.

Soft-crab fishing areas - second season. - In June and July very few peelers are caught with the bush lines. By late July-August the number of molting crabs in the bushes increases and the fishing resumes. A peak of production is reached in September. Soft-crab fishing continues in October and ends with the cold weather. The crabbing areas during the second season remain much the same as the spring season (Fig. 16). Some crabbing extends up into lower Bayou Des Allemands and Mud Lake. Also, Little Lake becomes somewhat more important while the Lafitte Pens decline.

The second season of soft-crab fishing usually lasts longer than the spring season. As in the spring, the crabs molting in the early part of the season are smaller than those caught later in the season. During May-June and September-October not only are the peeler crabs somewhat larger in size, but "doubles", or mating crabs, are more common. The occurrence of mating crabs indicates that female blue crabs reach maturity and mate in the oligohaline waters of the upper estuary.

In the past few years the center of soft-crab fishing has shifted up-estuary. Whereas Bayou Perot and Lake Salvador were formerly the main soft-crab fishing areas (Lenski, 1943:106), now Lake Cataouatche is most important. The northern part of Lake Cataouatche near Bayou Verret produces the largest numbers of peelers. Many crabbers associate the decline in Lake Salvador with the pollution of the south-
Fig. 16 Soft-crab fishing areas - second season, Barataria Estuary. Areas in black represent crab fishing areas.
western part of the lake. Others feel the estuary is getting more saline and that this has something to do with the decrease in the catch of peelers in southwestern Lake Salvador.

The hard- and soft-crab fishing areas in the Barataria Estuary reflect the seasonal distribution and migration of the crab population. Hard crabs are caught in all months of the year, but the crabbing areas change with the seasons. Peeler crabs, in contrast, are taken only during the warm months, and primarily in the oligohaline waters of the upper estuary. The winter habitat of crabs is in the lower estuary and adjacent marine area. In the spring, after the waters of the estuary have warmed up somewhat, the juveniles and adult males begin migrating to the upper estuary. The summer hard- and soft-crab fishing in the upper estuary is dependent on the recruitment of commercial-size crabs. The outmigration of the crabs from the upper estuary to the lower estuary is evidenced by the shift of crabbing activity from Lake Salvador to Caminada and Barataria bays.
CHAPTER VII

INTERPRETATION OF THE CRAB FISHING PATTERNS

A geographical analysis of the crab fishing patterns of the Barataria Estuary provides data on the seasonal distribution and migratory movements of the blue crab in the estuary. Specifically, the composition of the crab catch by water body furnishes data for the establishing of the migration patterns and blue crab biotopes. Five crab migration patterns and three biotopes, pertaining only to the commercial size crabs, are recognized in the bioregion. As assessment of the Barataria Estuary and adjacent marine area as a blue crab bioregion is accomplished through an interpretation of the crab landing records.

Analysis of the Crab Fishing Patterns

The composition of the crab catch by water body reflects the seasonal distribution of the crabs and associates crabs in a given life stage with specific environments. Composition of the hard-crab catch by water body will be discussed first (Fig. 17).

In Lake Des Allemands crabs are caught from April to mid-October. The annual catch is relatively small, and consists mostly of medium to large males. Highest catches are
Fig. 17 Composition of the hard-crab catch by water body, Barataria Estuary.
made in July, August, and September. The lower portion of
the lake, where there are stronger tidal currents, is the
best crabbing area. Very few "doubles", or mating crabs,
are caught in the lake. According to the fishermen, crabs
smaller than 3 inches across the carapace are not common in
Lake Des Allemands.

Crabs are caught in Lake Salvador in all months of the
year. Very small numbers of "settler crabs" are taken in
January, February, and March. Large numbers of juveniles
and adult males migrate into Lake Salvador during March,
April, and May. From April to December male crabs ranging
in size from 140 to 200 mm. dominate the landings. Highest
catches in the lake are taken from June to September. "Spent
females" appear in the landings from June to October. In
October and November gravid, adult females collect in groups
and migrate toward the passes. Crab landings in December
decrease sharply as outmigration takes place.

Most of the crabs caught in Caminada and Barataria bays
are in their winter habitat, or are gravid females. The
gravid females undergo a maturation of the ovaries during
the winter and spring. Large males are caught near oyster
beds and in areas of tidal exchange from November to May.
Gravid females are very important in the catches from Novem­
ber to April. The restriction on sponge crabs, the diffi­
culty of keeping "salt-water crabs" alive, and inland shrimp
trawling reduce the crabbing effort in the lower estuary
during the summer. Though "spent females" appear in the
lower estuary all summer, they are taken mainly in September when the temperature is somewhat cooler.

The composition of the soft-crab catch (Fig. 18) furnishes data on the molting and maturation of the crabs. Most of the "peeler crabs" are caught in the oligohaline waters of the upper estuary from March through September. Lake Cataouatche, southern Lake Salvador, the Lafitte Pens, Bayou Perot, and Little Lake are crabbed for peelers. The spring season is short, and appears to be associated with the arrival of the early migrants. Smaller molting crabs are more common in the early part of both seasons, while larger crabs are more numerous in the latter parts.

"Doubles", or mating crabs, are taken in largest number in May-June and in September. Benedict (1940:48) reported that blue crabs in Louisiana mate in May and September.

The soft-crab fishing patterns east of the Mississippi River reveal a similar pattern. A large number of molting crabs of smaller size is noticed in March-April. June is a slack month. Highest catches of peelers in Lake Pontchartrain are made in July, August, and early September. Mating takes place whenever there are large females molting, and crabs appear to be largest in the fall.

The seasonal crab fishing patterns (Fig. 10-12, 14-16) and the composition of the crab catch by water body (Fig. 17 & 18) provide data for the establishing of the crab migration patterns in the bioregion. Five migration patterns have been recognized in the bioregion.
Fig. 18 Composition of the soft-crab catch in the Barataria Estuary.
Spring up-estuary migration of juveniles and adult males.

Recruitment of juveniles to the upper estuary.

Return of the spent females to the estuary in summer and fall.

Migration of gravid females to the lower estuary.

General outmigration from the upper estuary in November-December.

The spring up-estuary migration of the juveniles and adult males has already been discussed (Table 12). Recruitment of small juveniles appears to take place all during the warm months. Large numbers of small juveniles are encountered by inland shrimp fishermen in the lower estuary in May and June. In July the crabbers commonly observe waves of small juveniles migrating with the tidal currents in the upper estuary. In Chesapeake Bay recruitment of the small juveniles to the upper bay begins in August following the metamorphosis of the megalops larvae and continues until arrested by the winter season (Van Engel, 1958:11). Spent females return to the Barataria Estuary in large numbers from June through September. More (1969:12) reported that in Galveston Bay the spent females did not return to the estuaries. The migration of the gravid females (the fall-run-of-the females) from the upper estuary to the lower estuary takes place in October and November. The juveniles and adult males migrate out of the upper estuary to the lower estuary in November and December as the water temperature of the estuary falls.
In an effort to relate the life history of the blue crab to specific environments of the bioregion, the biotope concept is employed. As used herein, the biotope refers to specific environments of the blue crab bioregion which function with regard to a given stage, or phase, of the crab's life cycle. Three blue crab biotopes were delineated in the Barataria Estuary and adjacent marine area by associating large numbers of crabs in a particular life stage, or phase, with specific environments.

The spawning, maturation, and winter habitat biotopes were recognized in the study region (Fig. 19). In November and December gravid females gather in concentrations about the entrances to the tidal inlets in the lower estuary. According to the crabbers, the females do not leave the areas of direct tidal exchange. Darnell (1959:297) collected ovigerous females in waters of 19 to 30°C., 19 to 32 ppt. salinity, and in depths of 8 to 60 feet. More (1969:12) found that the females spawned in lower Galveston Bay if salinities remained about 20 ppt. Sponge crabs are common in lower Caminada and Barataria bays and in the nearby Gulf from March through August. Charter boat captains and oil field workers reported seeing sponge crabs in summer as far out as 10 to 15 miles in the Gulf of Mexico.

The maturation biotope centers on the summer hard- and soft-crab fishing areas of the upper estuary. Both the hard- and soft-crab catches are dependent on the maturation of large numbers of juveniles. Hard crabs in the upper
Fig. 19 Three blue crab biotopes in the bioregion.
estuary are associated with sandy-shell bottoms, tidal currents, and the mixing of fresh and brackish water. The edges of lakes near eroding shorelines (Darnell, 1961:555, 564) and points of land extending out into the lakes are especially favorable environments for the larger crabs. Food supply is probably a major factor in the distribution of the juveniles in the upper estuary (Tagatz, 1968b:31). Doubles, or mating crabs, are common only in the oligohaline waters of the upper estuary. Female blue crabs attain sexual maturity and mate while undergoing their final molt.

In winter the large crabs are located in the areas of tidal exchange in the lower estuary. Only small numbers of settler crabs remain in the upper estuary. Tidal exchange with the Gulf waters probably provides sufficient warmth to maintain feeding activity. Because very few soft crabs are caught, it is likely that little molting takes place during the winter. Though the gravid females are restricted to the vicinity of the tidal inlets, the larger juveniles and adult males appear to be scattered about in the areas of tidal exchange.

The Barataria Estuary as a Blue Crab Habitat

Because a large portion of the Louisiana blue crab landings are derived from the waters of the Barataria Estuary, the Barataria Estuary and the adjacent marine area constitute an important blue crab bioregion. In order to assess the Barataria Estuary as a blue crab habitat, the annual
crab landings from the period 1959 to 1969 will be analyzed. Data concerning the life history of the blue crab in the bioregion have already been presented.

Records of hard- and soft-crab landings in Louisiana are only estimates of the total annual catch (Allen, 1969, personal comm.). Total annual hard- and soft-crab landings by water in Louisiana are available. However, the catch data are collected through monthly, and in places yearly, canvassing of the crab fishermen, seafood dealers, and crab buyers. In many instances only a yearly estimate of the catch from a given water body can be made. Also, the sale of crabs to the public and the folk harvesting of crabs are difficult to take into account. Nevertheless, the available catch records can be used to establish general trends.

Since 1955 the annual blue crab landings from the Barataria Estuary have been declining (Fig. 20). Both the hard- and soft-crab landings have decreased. Lowest catches were taken in 1964 and 1965. In the last ten years the annual catch from Lake Salvador has declined from 3 million pounds to about 1 million pounds. Since 1964 Caminada-Barataria bays have replaced Lake Salvador as the highest yielding water body. The lower estuary now appears to be more productive than the upper estuary.

There have been changes in the number of crab fishermen and in the crabbing gear. From 1957 to 1969 there has been a small increase in the number of hard-crab fishermen, and an abandonment of trotlines for crab pots (Table 13).
Fig. 20 Crab landings by water body, Barataria Estuary, 1955, 1959-1969.
Data were taken from Bureau of Comm. Fish., 1955, 1959-1969, Landing Records.
Number of soft-crab fishermen, i.e., the bush line crabbers, has dropped. The decline in soft-crab production in the Barataria Estuary may be attributed to a decrease in crabbing effort, but the same can not be said of the decline in hard-crab landings. Since the beginning of World War II, prices paid to fishermen for both hard- and soft-crabs have been increasing (Appendix I).

### TABLE 13

**NUMBER OF CRABBERS, BY GEAR TYPE, 1957-1969**

<table>
<thead>
<tr>
<th>Type of Gear</th>
<th>1957</th>
<th>1960</th>
<th>1964</th>
<th>1967</th>
<th>1969</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crab Pot</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>226</td>
<td>187</td>
</tr>
<tr>
<td>Trotline with Baits</td>
<td>125</td>
<td>190</td>
<td>294</td>
<td>130</td>
<td>90</td>
</tr>
<tr>
<td>Bush Lines</td>
<td>105</td>
<td>85</td>
<td>54</td>
<td>40</td>
<td>86</td>
</tr>
<tr>
<td>Drop Nets(^b)</td>
<td>12</td>
<td>12</td>
<td>44</td>
<td>15</td>
<td>14</td>
</tr>
<tr>
<td>Total Crab Fishermen(^c)</td>
<td>242</td>
<td>287</td>
<td>392</td>
<td>411</td>
<td>377</td>
</tr>
<tr>
<td>Total Fishermen in the Parish</td>
<td>700</td>
<td>749</td>
<td>852</td>
<td>736</td>
<td>701</td>
</tr>
</tbody>
</table>

\(^a\)Data pertain only to Jefferson Parish (county), but includes most of the crabbers in the basin. Data were taken from Bur. of Comm. Fish., 1957-1969, Op. Unit Data.

\(^b\)Most drop net crabbers crab in Lake Pontchartrain.

\(^c\)Number of crab fishermen includes both full-time and seasonal crabbers.

Many crabbers, especially the soft-crab fishermen, blame the decline in the crab catch on the crab pot fishermen who catch gravid female crabs. Crab pots began to appear in small numbers in the estuary as early as 1964. Because the
crab pots proved to be more reliable than trotlines in all months of the year, the pots quickly became the main commercial hard-crab gear. Crabmeat processors report that the adoption of the crab pots was accompanied by increased winter catch and by a greater proportion of female crabs.

At first glance, when the 1960 and 1969 catch from the Barataria Estuary by water body and gear type are compared (Table 14), there appears to be a relationship between adoption of the crab pots and decline in the total landings. In 1960, when trotlines with baits were the main hard-crab gear, the crab yield in the estuary was 5 million pounds. In 1969, when crab pots accounted for 60 per cent of the total landings, the yield from the estuary was only 2.7 million pounds.

Soft-crab fishermen and trotline crabbers argue that crab pot fishermen catch very large numbers of gravid female crabs which, in turn, reduces crab reproduction. Trotlines are used primarily in summer in the upper estuary, and do not function very well with regard to gravid females. Crab pots, on the other hand, are particularly effective in the capturing of gravid females near the tidal inlets during the winter.

The very high reproductive rate of the blue crab does not support the case against the use of crab pots. Moreover, in 1966, 1967, 1968, and 1969 when the crab pots were in greatest use (Table 13), crab yields in the Barataria Estuary began to increase (Fig. 20). The crab pots have enabled the
TABLE 14

CRAB LANDINGS BY WATER BODY AND GEAR TYPE, 1960 AND 1969, BARATARIA ESTUARY\textsuperscript{a}

<table>
<thead>
<tr>
<th></th>
<th>Lake Salvador</th>
<th>Little Lake</th>
<th>Caminada Bay</th>
<th>Barataria Bay</th>
<th>Total Pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1960</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crab Pots</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Trotlines</td>
<td>2,631,400</td>
<td>1,138,300</td>
<td>996,820</td>
<td>166,500</td>
<td>4,766,500</td>
</tr>
<tr>
<td>Drop Nets</td>
<td>0</td>
<td>0</td>
<td>116,500</td>
<td>166,500</td>
<td>200,000</td>
</tr>
<tr>
<td>Bush Lines</td>
<td>145,200</td>
<td>54,800</td>
<td>0</td>
<td>200,000</td>
<td>5,083,000</td>
</tr>
<tr>
<td></td>
<td>2,776,600</td>
<td>1,193,100</td>
<td>1,113,320</td>
<td></td>
<td>5,083,000</td>
</tr>
<tr>
<td><strong>1969</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crab Pots</td>
<td>543,660</td>
<td>0</td>
<td>1,108,600</td>
<td>1,652,260</td>
<td></td>
</tr>
<tr>
<td>Trotlines</td>
<td>446,400</td>
<td>132,100</td>
<td>311,600</td>
<td>890,100</td>
<td></td>
</tr>
<tr>
<td>Drop Nets</td>
<td>0</td>
<td>0</td>
<td>144,300</td>
<td>144,300</td>
<td></td>
</tr>
<tr>
<td>Bush Lines</td>
<td>50,600</td>
<td>27,300</td>
<td>0</td>
<td>77,900</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1,040,660</td>
<td>159,400</td>
<td>1,564,500</td>
<td>2,764,560</td>
<td></td>
</tr>
</tbody>
</table>

\textsuperscript{a}Data were taken from Bureau of Comm. Fish., 1960 & 1969, Landing Records.
crab fishermen to more effectively crab the lower estuary, particularly in winter, and have made possible the fishing of gravid females -- a segment of the commercial crab population not efficiently harvested by the trotline crabbers.

In Chesapeake Bay there is controversy concerning the effect the harvesting of female crabs has on subsequent crab population (Manning, 1968:10; Cronin and Cargo, 1968:32).

For comparison the annual crab landings of Lake Pontchartrain and Lake Borgne, 1955 to 1969, are represented (Table 15). Lake Pontchartrain and Lake Borgne can be matched with Lake Salvador and Caminada-Barataria bays, respectively. As in Lake Salvador, both the hard- and soft-crab catch in Lake Pontchartrain have declined. Since 1962 the catch from Lake Borgne has exceeded that of Lake Pontchartrain. Data on crab landings from both sides of the Mississippi River indicate a large decline in the hard- and soft-crab catch of the upper estuary.

Many crab fishermen and seafood dealers in the Barataria Basin and in the Lake Pontchartrain-Lake Borgne area associate the decline in the crab catch with the pollution and drainage alteration of the estuary environments. Biglane and LaFleur (1967:690-692) emphasized the seriousness of pollution in coastal Louisiana. Because of low tidal amplitude, poor circulation, and shallowness, the estuaries of coastal Louisiana are predisposed to changes in water quality and drainage. Upper estuary water bodies appear to be more affected than water bodies of the lower estuary which are
TABLE 15

CRAB LANDINGS FROM LAKE PONTCHARTRAIN AND LAKE BORGNE, 1955, 1959-1969a

<table>
<thead>
<tr>
<th>Year</th>
<th>Lake Pontchartrain</th>
<th>Lake Borgne</th>
<th>Total Pounds of both Lakes</th>
<th>Hard Crabs</th>
<th>Soft Crabs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1955</td>
<td>1,044,200</td>
<td>1,113,200</td>
<td>1,978,700</td>
<td>178,700</td>
<td>209,300</td>
</tr>
<tr>
<td>1959</td>
<td>1,875,300</td>
<td>1,182,000</td>
<td>2,315,700</td>
<td>255,200</td>
<td>255,200</td>
</tr>
<tr>
<td>1960</td>
<td>1,682,600</td>
<td>1,233,900</td>
<td>2,861,800</td>
<td>278,100</td>
<td>278,100</td>
</tr>
<tr>
<td>1961</td>
<td>1,806,400</td>
<td>1,433,500</td>
<td>2,315,700</td>
<td>209,300</td>
<td>209,300</td>
</tr>
<tr>
<td>1962</td>
<td>1,450,900</td>
<td>1,217,500</td>
<td>2,691,700</td>
<td>117,100</td>
<td>117,100</td>
</tr>
<tr>
<td>1963</td>
<td>1,045,300</td>
<td>1,150,600</td>
<td>2,191,900</td>
<td>126,420</td>
<td>126,420</td>
</tr>
<tr>
<td>1964</td>
<td>555,600</td>
<td>1,101,400</td>
<td>1,598,400</td>
<td>58,600</td>
<td>58,600</td>
</tr>
<tr>
<td>1965</td>
<td>325,800</td>
<td>1,618,400</td>
<td>1,887,200</td>
<td>57,000</td>
<td>57,000</td>
</tr>
<tr>
<td>1966</td>
<td>357,200</td>
<td>1,312,100</td>
<td>1,624,300</td>
<td>45,300</td>
<td>45,300</td>
</tr>
<tr>
<td>1967</td>
<td>688,300</td>
<td>1,299,900</td>
<td>1,933,200</td>
<td>54,500</td>
<td>54,500</td>
</tr>
<tr>
<td>1968</td>
<td>516,100</td>
<td>1,722,900</td>
<td>2,144,500</td>
<td>94,500</td>
<td>94,500</td>
</tr>
<tr>
<td>1969</td>
<td>577,800</td>
<td>1,875,100</td>
<td>2,377,100</td>
<td>75,800</td>
<td>75,800</td>
</tr>
</tbody>
</table>

aData were taken from Bureau of Comm. Fish., 1955, 1959-1969, Landing Records.
closer to the tidal inlets.

Fishermen from the Barataria Basin associate the pollutants arising from the Valentine area with the destruction of the formerly excellent crab and shrimp fishing in Catahoula Bay of southwestern Lake Salvador. Foamy, dark-colored effluents were observed west of Lake Salvador near the Intracoastal Canal in the fall of 1969 (Plate 12). Over the past several years the crabbers noticed that crabs appeared to be avoiding Catahoula Bay. Complaints of pollution were heard as early as 1962 (Robert, 1962:Letter). In May, 1970, a local industry was ordered to stop the discharging of contaminating effluents (La. Stream Control Comm., 1970:Temp. Order).

Plate 12. Effluents observed near the Intracoastal Canal, west of Lake Salvador. These effluents drain toward Lake Salvador and Bayou Perot.
Also, soft-crab fishermen from Lafitte-Barataria complain that the Gulf Canal leading into western Bayou Couba has caused a reduction in the number of peeler crabs being caught in the bayou. Hard crabs caught in Lake Des Allemands and Lake Cataouatche frequently turn black inside after the crabs are boiled. Some crabbers believe that this is caused by the crabs feeding on a red worm. Dead fish and foamy, brown scum were reported in eastern Lake Des Allemands in August, 1969 (Tregre, 1969:Letter). Bayou Segnette, leading into Lake Cataouatche, has been for many years overloaded with domestic sewage and seafood processing wastes (U.S. Dept. of Int., 1968a:5).

According to the fishermen, the occurrence of pollution, or "bad water", is greatest in the estuary during periods of low water levels followed by heavy rains. Low water levels in the estuary facilitate drainage from the nearby swamps and marshlands. The channels and canals in the swamps and marshes discharge into the edges of the lakes and bayous. Estuarine organisms, including the blue crab, feed along the shorelines (Darnell, 1961:555). Organic detritus and the ilophage (detritus feeder) are important components in the trophic spectrum of Louisiana's estuaries (Darnell, 1967:381). Juvenile blue crabs maturate in the upper estuary water bodies (Fig. 19). Therefore, drainage waters from the swamps and marshes which carry pollutants into the estuary could be adversely affecting the blue crabs feeding and molting along the shorelines.
Pesticides from sugar cane fields (Lauer et al., 1966: 310, 315), oil field and pipeline spills and leaks (La. Stream Control Comm., 1970: Current Files G. P. 100 and G. P. 300), sugar cane mill wastes (La. Wildl. and Fish. Comm., 1952-1953: 142), and corrosion inhibitors (La. Wildl. and Fish. Comm., 1964-1965: 272) are other possible sources of pollution. Spraying for mosquito and water hyacinth control may also be significant. Some evidence of positive pollution has been observed around the seafood houses of Lafitte-Barataria and Grand Isle. With the exception of the crab shedding cars, the crabs are rarely killed by pollutants and adverse drainage water from the swamps and marshes, but appear to be driven away from the areas of contamination.

The decline in the soft-crab production in the upper Barataria Estuary and in Lake Pontchartrain is very significant. The size of the peeler crab catch is an indication of the recruitment of juveniles to commercial size. Since both the soft- and hard-crab yields are dependent on the recruitment of large numbers of juveniles to commercial size, the decline in the landings of the upper estuary may be explained by a reduction in the recruitment of juveniles.

Soft-crab fishermen from the Lake Pontchartrain area suggest that improper handling of the peeler crabs and adverse water quality partially explain the decline in soft-crab production. Many crabbers in the area produce soft crabs in covered floating boxes. The claws of the green crabs are nipped and the crabs are fed. However, several
of the crabbers are building shedding houses along the lake. Water for the shedding houses is pumped from the bottom of the nearby lake into long, concrete troughs. In this way the crabbers try to avoid placing the molting crabs in contact with any adverse surface water that may be in the lake.

A comparison of the crab landings from the Barataria Estuary in 1955 and 1969 with landings from the other water bodies of coastal Louisiana (Table 16) is also informative. In 1955 blue crabs were fished only in a small number of water bodies. A large hard-crab fishery was located in the Atchafalaya Basin and centered on Grand Isle. Large catches of hard crabs were also being taken from Lake Salvador, Barataria Bay (including Caminada Bay), Lake Borgne, Lake Pontchartrain, and Breton Sound. Soft-crab production was relatively high; Lake Salvador and Lake Borgne were the main sources of the peeler crabs.

Though the total 1969 hard-crab landings remained much the same as in 1955, significant changes in the catch by water body took place. Hard-crab fishing expanded and became especially important east of the Mississippi River. The catch in Grand Lake, formerly very high, drastically declined, probably due to fresh-water conditions and sedimentation caused by increased flow of the Atchafalaya River. Lake Borgne, Breton Sound, and Barataria Bay became the main source of hard crabs. Both Lake Salvador and Lake Pontchartrain dropped in relative importance.
<table>
<thead>
<tr>
<th>Water Body</th>
<th>1955</th>
<th>1969</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hard Crabs</td>
<td>Soft Crabs</td>
</tr>
<tr>
<td></td>
<td>1,010,500</td>
<td>102,700</td>
</tr>
<tr>
<td>Lake Borgne</td>
<td>1,844,700</td>
<td>30,400</td>
</tr>
<tr>
<td>Lake Pontchartrain</td>
<td>968,200</td>
<td>532,400</td>
</tr>
<tr>
<td>Breton Sound</td>
<td>914,000</td>
<td>77,600</td>
</tr>
<tr>
<td>Chandeleur Sound</td>
<td>705,300</td>
<td>1,549,500</td>
</tr>
<tr>
<td>Gulf (below Grand Isle)</td>
<td>921,400</td>
<td>16,200</td>
</tr>
<tr>
<td>Barataria &amp; Caminada Bays</td>
<td>11,300</td>
<td>1,564,500</td>
</tr>
<tr>
<td>Lake Salvador</td>
<td>1,406,700</td>
<td>990,060</td>
</tr>
<tr>
<td>Little Lake</td>
<td>1,478,200</td>
<td>132,100</td>
</tr>
<tr>
<td>Bay Adams</td>
<td>727,900</td>
<td>124,400</td>
</tr>
<tr>
<td>Gulf (below Terrebonne Parish)</td>
<td>412,800</td>
<td>124,400</td>
</tr>
<tr>
<td>Timbalier Bay</td>
<td>102,700</td>
<td>76,000</td>
</tr>
<tr>
<td>Terrebonne Bay</td>
<td>104,200</td>
<td>50,600</td>
</tr>
<tr>
<td>Caillou Bay</td>
<td>125,600</td>
<td>113,200</td>
</tr>
<tr>
<td>Lake Barre</td>
<td>168,600</td>
<td>138,600</td>
</tr>
<tr>
<td>Lake Polto</td>
<td>115,200</td>
<td>61,800</td>
</tr>
<tr>
<td>Lake Decade</td>
<td>115,200</td>
<td>61,800</td>
</tr>
<tr>
<td>Lake Merchant</td>
<td>49,500</td>
<td>24,800</td>
</tr>
<tr>
<td>Lake Felicity</td>
<td>130,100</td>
<td>100</td>
</tr>
<tr>
<td>Gulf (below Atchafalaya Basin)</td>
<td>54,700</td>
<td>448,800</td>
</tr>
<tr>
<td>Four League Bay</td>
<td>604,700</td>
<td>100</td>
</tr>
<tr>
<td>Vermilion &amp; Cote Blanche Bays</td>
<td>604,700</td>
<td>100</td>
</tr>
<tr>
<td>Calcasieu Lake</td>
<td>51,780</td>
<td>791,800</td>
</tr>
<tr>
<td>Tchefunte River</td>
<td>791,800</td>
<td>900</td>
</tr>
<tr>
<td>Intracoastal Canal</td>
<td>101,000</td>
<td>100,000</td>
</tr>
<tr>
<td>Lake Des Allemands</td>
<td>101,000</td>
<td>65,800</td>
</tr>
<tr>
<td>Atchafalaya River</td>
<td>203,300</td>
<td>198,900</td>
</tr>
<tr>
<td>Grand Lake (in Iberia &amp; St. Marys Parishes)</td>
<td>2,027,900</td>
<td>113,200</td>
</tr>
<tr>
<td>Lake Verret</td>
<td>433,500</td>
<td></td>
</tr>
<tr>
<td><strong>Total Pounds</strong></td>
<td><strong>10,856,280</strong></td>
<td><strong>580,600</strong></td>
</tr>
</tbody>
</table>

aData were taken from Bureau of Comm. Fish., 1955 & 1969, Landing Records.
The decline in crab landings in the upper estuary and the increase in landings in the lower estuary appears to be a state-wide trend. The adoption of the crab pots by many Louisiana crab fishermen in the 1960's made possible crab fishing in the lower estuaries, especially in winter. In the last few years very large catches, not reflected in Table 17, have also been made near the delta of the Mississippi River. Soft-crab production in 1969 was considerably lower as compared to 1955. Soft crabs from the Breton Sound-Chandeleur Sound area were taken from the inland lakes adjacent to the sounds.

Summary

The ecology of the blue crab must be viewed as a complex interaction between the organism and its various life stages and the environments of its bioregion. The bioregion concept serves to delimit the region in which the life history of the blue crab takes place. In the study region -- the Barataria Estuary and the adjacent marine area, it has been demonstrated that the blue crab successively utilizes specific environments of the marine area, lower estuary, and upper estuary.

The blue crab is a migrant. As it passes through its larval, juvenile, and adult stages the physiological requirements of the organism change. In order to meet the physiological requirements of each of its life stages, or phases, the blue crab migrates from one environment to another.
Five migration patterns were recognized in the bioregion. Through an analysis of the crab fishing patterns in the Barataria Estuary some of the stages, or phases, of the crab’s life history were identified with specific environments of the bioregion. The term biotope was employed to conceptualize such relationships. Three blue crab biotopes, pertaining only to the larger blue crabs, were established in the Barataria Estuary and the adjacent marine area.

Field observations of the fishing of blue crabs in the Barataria Estuary generated considerable data on the seasonal distribution and migration patterns of the crab population. However, the ecology of the blue crab is more complex than the crab fishing patterns indicate and the crab fishermen realize. More refined data on the crab landings and hydrological conditions are needed to better describe the variations in annual crab harvests. The functional analysis of the blue crab biotopes is considered fundamental to the understanding of the ecology of the blue crab in a given bioregion.

Some researchers suggest that it may be wiser to first concentrate on predicting the future crab harvest so that fishing regulations and production expectations can be adjusted accordingly. However, if present trends toward management of coastal environments continue, an input-output, or budget, analysis of the blue crab productivity will become necessary. Moreover, as coastal land use intensifies, the effect of one land use on another will become more
apparent. The blue crab maturation biotope of the upper Barataria Estuary is already showing evidence of ecological alteration by pollution and drainage modification.
CONCLUSIONS

Crab fishing in the Barataria Estuary began in the late 1800's with the swampdwellers supplying crabs to New Orleans markets. Commercial soft-crab production in the estuary started about 1927, and the fishing of hard crabs for crab-meat processing became significant in the 1940's. Soft- and hard-crab landings, as well as crabmeat production, reached the highest levels during World War II. In 1969, in the Barataria Estuary, soft-crab production amounted to 77,900 pounds valued at $65,000, while hard-crab landings totaled 2,752,000 pounds valued at $234,000. Presently there are approximately 90 soft crab and 250 hard crab fishermen in the basin.

Crabbing is a seasonal activity for soft-crab and many hard-crab fishermen. Inland shrimp trawling is the main fishing activity. Excepting the bush lines, crabbing techniques have been introduced from outside the area. Most soft-crab fishermen use bush lines to catch peeler crabs and crab shedding cars to artificially complete the molting process. In 1964 crab pots were introduced in the estuary and quickly replaced the trotline with baits as the main hard-crab gear. Crab pots have enabled fishermen to effectively crab the lower estuary in winter and to capture gravid females.
Soft crabs are caught primarily in oligohaline waters of the upper estuary during March-April and late August-early October. High water temperatures and pollution may be limiting factors to crabs molting in the hot summer months. Hard crabs are caught throughout the estuary. Large catches of hard crabs are made in Lake Salvador from June to October and in Caminada-Barataria bays from November to April.

Mature female crabs spawn biennially in the saline waters of lower Caminada-Barataria bays and adjacent Gulf of Mexico. Recruitment of juveniles to the upper estuary appears to take place mainly in spring and summer. Maturation of juveniles in the oligohaline waters of the upper estuary supports the summer hard- and soft-crab fishery. Larger crabs in the upper estuary are associated with sandy-shell bottoms, tidal currents, and the mixing of fresh and brackish water. In summer crabs commonly feed along the shorelines in the early morning hours; in winter the crabs feed among the oyster beds and in areas of tidal exchange in the lower estuary.

As the blue crab passes through its larval, juvenile, and adult stages it successively utilizes specific environments of the estuary and adjacent marine area. The entire life history of the blue crab takes place in the Barataria Estuary and the adjacent marine area. Therefore, the upper Barataria, lower Barataria Estuary, and the adjacent marine area in the Gulf of Mexico together constitute a blue crab bioregion. The bioregion concept permits the placing of the
crab's life history in its geographical context.

Three blue crab biotopes were recognized in the blue crab bioregion. These are the maturation, winter habitat, and spawning biotopes. The biotope refers to specific environments of the bioregion which function with regard to a given phase in the blue crab's life cycle. Five crab migration patterns were also observed in the bioregion. The up-estuary movements include the spring up-estuary migration, the recruitment of juveniles to the inland waters, and the return of the spent females to the estuaries. Outmigrations include the Gulfward movement of the gravid females and the general outmigration from the upper estuary due to low water temperatures in winter.

During the past ten years the annual crab landings from the Barataria Estuary have declined. Soft- and hard-crab landings from Lake Salvador and Little Lake have dropped considerably, while the hard-crab catch in Caminada-Barataria bays has risen somewhat. A comparison with Lake Pontchartrain and Lake Borgne revealed a similar trend. Because both soft- and hard-crab yields of the upper estuary are lower, it is the recruitment of juveniles to commercial size in the upper estuary that has declined.

The soft-crab and trotline fishermen blame the decline on the crab pot fishermen who catch the gravid females. The increase in crab landings during the 1966-1969 period, when the crab pots were in greatest use, does not lend support to that contention. There is evidence, however, of pollution
and alteration of environments in the upper estuary where the juveniles maturate. Shoreline environments where the crabs feed and molt appear to be most seriously affected. Most fishermen believe that the productivity of the estuary could be improved by adding fresh water inputs and by reducing the pollution draining in from the surrounding swamps and marshes.

The estuarine ecology of the blue crab is more complex than the crab fishing patterns indicate and the crab fishermen realize. Future research should be directed toward the functional analysis of the blue crab biotopes, including estimation of the crab population. Meanwhile, detailed data on the crab catch and environment parameters by water body are needed to better describe variations in the crab harvests. Coastal land use accommodation is necessary to protect the blue crab biotopes from modification beyond the ecological limits of the organism.
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APPENDIX I

DESCRIPTION OF EARLIER TYPES OF CRABBING GEAR
USED IN THE BARATARIA ESTUARY

The first gear type used to catch hard crabs in the Barataria Estuary was the trotline with snood lines (Rathbun, 1884:778; Stearns, 1887:477; Wilkinson, 1892:407). Elderly fishermen in the Barataria Basin stated that the trotline with snoods was the main gear until about 1942. Crabs for the first commercial crabmeat plants in the Morgan City-Berwick area were supplied by trotlines with snood lines (Fisher, 1931:18). In the Atchafalaya Basin the snood lines were known as stagings (Comeaux, 1969:184). In the Barataria Estuary the trotline with snood lines were commonly used for catching catfish, but then hooks were fastened to the short snood lines.

The trotline consisted of 5 to 10 pounds of line with 12 inch long snood lines spaced about 6 feet apart (Fig. 21). Trotlines were as long as 1,200 feet (Stearns, 1887:577). Alligator meat, catfish heads, and other available meat scraps were used as bait on the ends of the snood lines. Crabs are attracted to the baits, and cling tenaciously to the baits when the trotlines are raised from the water bottom. The crabbers pulled themselves along the trotline in a pirogue or skiff, raising the snood lines as they moved.
Fig. 21 Diagram of the trotline with snood lines. Baits attached to the snood lines attract crabs feeding along the bottom.
Hand dip nets were used to catch the crabs before they released the baits and fled back to the water bottom. This gear type has been completely replaced in the Barataria Estuary by more mechanized gear.

Drop nets in Louisiana were probably first used east of the Mississippi River near Lake Pontchartrain and Lake Borgne. In 1938 the drop net was the common crabbing gear of the fishermen from New Orleans, St. Bernard, St. Tammany, and Tangipahoa Parishes (U.S. Dept. of Int., 1950:468). The gear has not been adopted in large extent on the west side of the river. In the Barataria Estuary today only several crabbers from the Myrtle Grove-Lake Perez area use the drop nets.

The drop nets are round, about 20 inches in diameter (Pl. 13). Baits, usually chicken heads, or beef lips and ears, are placed in the center of the nets. A line about 12 feet long connects the drop net to the float. The crabber stands in his skiff and snags the floats from both sides of his craft with a hooked pole. About 300 to 350 drop nets are used at a time.

The trotline with baits, locally known as the patent line, was adopted by fishermen in Lafitte-Barataria about 1942. From Lafitte-Barataria it spread and quickly replaced the trotline with snood lines. In the Chesapeake Bay area trotlines with snoods were used from 1870 to the 1920's until replaced by trotlines with baits (Van Engle, 1962:6-7). Thompson (1946:125) refers to the use of trotlines with
baits in Jefferson Parish during the World War II period. Snood lines are eliminated in the trotline with baits gear. The trotline with baits is one of the gear types used today by the commercial crab fishermen of the Barataria Estuary.

Plate 13. The Drop Net Crabbing Gear
APPENDIX II

RELATIONSHIP OF CRAB FISHERMEN IN THE BARATARIA
ESTUARY WITH SEAFOOD DEALERS AND CRAB BUYERS

The crabbers dispose of their catch in one of three ways: direct sale to the consumer, or the crabs are sold to seafood dealers and crab buyers. The selling of live male crabs to the public by the dozen is common throughout the area. Many crabbers from Bayou Boeuf, Des Allemands, Bayou Gauche, Westwego, and Larose sell crabs directly to the public. Some of the fishermen have regular customers which include the operators of restaurants and bars. In 1969, crabbers were receiving $1.00 a dozen, or $5.00 a bushel, for crabs. The owners of small, stuffed crab factories, which are common in the area, obtain their crabs from these fishermen.

Soft-crab fishermen sell their crabs to seafood dealers. Only a few restaurants deal directly with the soft-crab fishermen. Most hard-crab fishermen from Lafitte-Barataria also sell their catch to seafood dealers. The seafood dealer maintains a boat landing, scales, ice or refrigeration facilities, and a refrigerated truck (Pl. 14). Generally the dealers buy shrimp and fish, and sometimes furs and nutria carcasses, in addition to crabs. Each dealer will have 15 to 20 fishermen who regularly bring their catch to
him. The fishermen are paid in cash immediately after the catch is weighed, or counted. Some seafood dealers do not buy hard crabs in the hot summer months because the crabs die easily and require ice, or refrigeration.

Crab buyers function in the lower estuary where there are fewer seafood dealers. A buyer need have only a refrigerated truck, a portable scale, some boxes or baskets, and in summer, ice to chill the crabs. Crab buyers purchase hard crabs for the large crabmeat plants. A buyer normally has from 4 to 10 crab fishermen who supply the crabs. Each day the buyer routinely comes to the crabbers' boat landings.

A few industrious crabbers also act as buyers. Crab buying is highly competitive. Buyers from the larger crabmeat plants in Houma, Pierre Part, and the New Orleans area compete for the catch of the crabbers. Like the seafood dealers, the crab buyers receive only two cents a pound from the processor for delivering the crabs.

Prices paid to the hard-crab fishermen depend on the season of the year, area landed, and size and quality of the crabs (Bur. of Comm. Fish., 1968:xiv, Market News Service). According to the fishermen, the highest quality crabs come from Lake Pontchartrain-Lake Maurepas, mouth of the Mississippi River, and Lake Verret. The prices paid to fishermen for hard crabs during the 1955-1969 interim have been increasing since World War II (Table 18). In peak supply periods, usually in March-April and July-October, the price drops to 6 to 8 cents a pound live weight. Most crabbers would like to get a minimum of 8 cents a pound. Male crabs are worth slightly more than females because they yield a larger chunk of lump meat (Dunker et al., 1960:46). The operator of a large crabmeat plant reported that 65 per cent of the hard crabs that his plant processes are females.

Crabmeat processors report a seasonal crabmeat market and raw hard-crab supply (Bur. of Comm. Fish., 1967, La. Landings:3). In peak supply periods the supply will occasionally exceed the plant's processing capacity. At such times the crabbers will be asked to stop crabbing, or the excess crabs will be shipped out of the state. Crabs trucked
TABLE 17
PRICES PAID TO FISHERMEN IN LOUISIANA
FOR HARD CRABS, 1955, 1962-1969a

<table>
<thead>
<tr>
<th>YEAR</th>
<th>PRICE/POUND - LIVE WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1955</td>
<td>3 - 5 cents</td>
</tr>
<tr>
<td>1962</td>
<td>2.5 - 7 cents</td>
</tr>
<tr>
<td>1963</td>
<td>4 - 8 cents</td>
</tr>
<tr>
<td>1964</td>
<td>4.5 - 10 cents</td>
</tr>
<tr>
<td>1965</td>
<td>4 - 11 cents</td>
</tr>
<tr>
<td>1966</td>
<td>4 - 10 cents</td>
</tr>
<tr>
<td>1967</td>
<td>4 - 10 cents</td>
</tr>
<tr>
<td>1968</td>
<td>5 - 10 cents</td>
</tr>
<tr>
<td>1969</td>
<td>6 - 15 cents</td>
</tr>
</tbody>
</table>

aData were taken from Bur. of Comm. Fish., 1955, 1962-1969, Market News Service.

in to a plant on a given day will be processed the following morning, but excesses can be held only a day or two. Each crabmeat plant has its regular seafood dealers and buyers that act as middlemen. The operator of one of the larger crabmeat plants also buys furs and shrimp.

The seafood dealers sell the soft crabs directly to the public, or to freezer plant operators, who in turn resell them to restaurant owners, hotel proprietors, and establishments. In the 1930's the fishermen were receiving 2 to 5 cents a piece for large soft crabs. During World War II the price rose to 20 cents. In 1969 the seafood dealers of Lafitte-Barataria received $2.00 to $6.00 a dozen for the live soft crabs. Crabbers reported getting from 25 to 40 cents a piece ($3.00 to $5.00 a dozen) for "counters". Counters are crabs wider than five and a half inches; smaller
crabs are sold as two- or three-for-one. Large male crabs are the preferred market items.

Soft-crab fishermen from Lafitte-Barataria begin crabbing and producing soft crabs a month or so ahead of their competitors from the Lake Pontchartrain-Lake Borgne area. The demand for soft crabs is excellent in the spring following the paucity of the winter months. In late summer and early fall soft crabs from east of the river and from Crisfield, Maryland, lower the market price slightly. Soft crabs from Crisfield, Maryland are not as robust as the crabs from Lafitte (Pl. 15). The seafood dealers buy all the soft crabs the fishermen can produce. A couple of the

Plate 15. Soft crabs from Crisfield, Maryland (left), and Lafitte. Soft crabs from Lafitte (right) appear to be somewhat longer.
dealers are beginning to freeze their crabs in plastic bags so as to be able to hold the crabs in storage awaiting highest prices in the off season.
VITA

Eugene Jaworski was born on January 18, 1941, in Pulaski, Wisconsin. After graduation from Pulaski High School he served three years as an enlisted man in the United States Army. The University of Wisconsin, Madison, was attended from 1962 to 1966. In May, 1966, he graduated cum laude and received a Bachelor of Sciences degree in geography. Nancy Jo Loeffelholz became his wife on June 18, 1966. An NDEA-IV Fellowship for graduate study in geography was awarded him by Louisiana State University. Louisiana State University was attended from September, 1966 to August, 1970.
EXAMINATION AND THESIS REPORT

Candidate: Eugene Jaworski

Major Field: Geography

Title of Thesis: Biogeography of the Blue Crab Fishery, Barataria Estuary, Louisiana

Approved:

[Signatures]

Major Professor and Chairman

Dean of the Graduate School

EXAMINING COMMITTEE:

[Signatures]

Date of Examination:

July 29, 1970