

## ABSTRACT

Jonathan Haywood Whitehurst. THE MENHADEN FISHING INDUSTRY IN NORTH CAROLINA. (Under the direction of Professor Philip Shea) Department of Geography, February 1970.

The purpose of this study is to present an analysis of the North Carolina menhaden fishing industry, which exemplifies to a high degree the menhaden industry as practiced along both the Atlantic and Gulf coasts of the United States. The approach is geographical; that is, the paper concerns mainly the spatial distribution and interrelationships of certain, selected aspects of the industry. Major emphasis is placed on the locational factors associated with the resource base, and the early and contemporary fisheries.

Menhaden, Genus Brevoortia, are relatively small herring-like fish occurring in large numbers along both the Atlantic and Gulf coasts of the United States. Captured in a highly efficient commercial fishery, two species (Brevoortia tyrannus, the Atlantic menhaden, and Brevoortia patronus, the Gulf menhaden) support an industry which was distributed in eight states from New York to Texas in 1968. The fishery in North Carolina constitutes the major menhaden operation in the South Atlantic region.

Exploitation of the menhaden resource began just prior to settlement by northern Europeans on the North American continent. Although the fish were first used by the Indians and later by the Massachusetts colonists, an organized fishing enterprise did not develop in New England until the middle of the nineteenth century. Following the

Civil War, numerous attempts were made to establish the menhaden fishery in North Carolina. Late in the nineteenth century a successful operation was carried on near Beaufort. Since that early period menhaden have been captured regularly in Tar Heel waters.

The natural resource of this important marine activity is based mainly on stocks of Atlantic and Gulf menhaden. These fish travel in schools and during the warmer months undertake extensive migrations along the coastal waters of the Continental Shelf. In North Carolina waters, the menhaden are abundant during two separate seasons: the summer months from May through August, and the fall months from October through December.

Presently the vast majority of menhaden are taken in a specialized ocean fishery, the largest by volume of catch in the United States. The fish are captured with purse seines, highly effective encircling-type nets, during their characteristic seasonal migrations. The purse seine fishery in North Carolina accounts for approximately ten percent of the annual catch in the United States. In 1968 six Tar Heel reduction plants converted menhaden into the three major commercial products: oil, meal and condensed solubles.

Although the menhaden industry has retained the greatest commercial fishery based on catch tonnages, a severe drop in annual production on both the Atlantic and Gulf coasts has been recorded in the last decade. The North Carolina fishery reflects the over-all menhaden situation in the United States.

THE MENHADEN FISHING INDUSTRY

IN NORTH CAROLINA

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## CHAPTER I

### INTRODUCTION

With a history more ancient than agriculture, fishing is certainly one of the oldest occupations. Having survived over the ages, the capturing of marine animals has developed from simple, crude beginnings to highly complex activities constituting livelihoods for millions of people in various locations throughout the planet. On a world scale ocean fisheries are distributed in close association with large population centers which provide markets for the sea products (Peru is an exception) and shallow continental margins where food is readily available for the fish. In North America the Pacific and Atlantic fishing grounds, which rank fourth and fifth in international catches, respectively, are adjacent to the main concentrations of people and are over the continental shelf.

In the United States commercial fishing has a long tradition, and at the present time ranks fifth behind the piscatorial occupations of Peru, Japan, Communist China, and the Soviet Union. Shrimp is by far the most important species caught in terms of value. Following shrimp are Pacific salmon and tuna, and menhaden, in that order.<sup>1</sup> Although ranking fourth in value, menhaden rank first in terms of tonnage of catch, making the fishery for this species the largest in

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<sup>1</sup>Richard S. Thoman, Edgar C. Conkling, and Maurice H. Yeates, The Geography of Economic Activity (New York: McGraw-Hill Book Company, 1968, pp. 382-395.

the United States. Not only is the menhaden fishery the largest, but it is also one of the oldest marine industries in the States.

The utilization of menhaden in North America predates the settlement of the continent by Europeans. Along the northeast Atlantic coast of that region now called the United States indigenous Indian tribes placed raw, whole fish in their corn fields in an attempt to increase soil fertility. The first Massachusetts settlers adapted the method of fertilization established by the Indians, and within the first quarter of the seventeenth century colonists were actively fertilizing their own crops with menhaden. Thus, from an early, rather crude beginning, exploitation of the vast menhaden resource was expanded into an enterprise that eventually became the largest commercial fishery, by volume of catch, in the United States.<sup>2</sup>

Since the early nineteenth century menhaden have been processed, for the most part, as industrial fish.<sup>3</sup> Although for many years the fish were caught as a raw material in the manufacture of fertilizers, throughout the last four decades only a negligible amount of the annual catches has been used in this manner.<sup>4</sup> Almost all menhaden are now

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<sup>2</sup>Exteen Corbett, "The Outlook for the Menhaden Industry of the Atlantic Coast," Proceedings of the Gulf and Caribbean Fisheries Institute, Vol. 5 (1952), p. 12.

<sup>3</sup>"Industrial fish are any fish from which industrial products are prepared, such as menhaden." U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, U.S. Fish-Reduction Industry, by F. Bruce Sanford and Charles F. Lee, Technical Leaflet 14 (Washington: Government Printing Office, 1960), p. 4.

<sup>4</sup>Robert G. Lowe, Jr., "An Outline of the Menhaden Industry," Proceedings of the Gulf and Caribbean Fisheries Institute, Vol. 5 (1952), p. 15.

processed into three industrial products: 1) fish meal; 2) oil; and 3) condensed solubles.<sup>5</sup> Whole meal and condensed solubles constitute important ingredients in food supplements for certain animals, particularly poultry and swine. Menhaden oil is used in various commercial products including margarine, paints, and detergents.<sup>6</sup>

Exploitation of the menhaden resource has been confined to the United States, even though the fish are found in Latin American waters. In recent years the menhaden fishing industry has been in operation along both the Atlantic and Gulf coasts. In 1968, thirty-three reduction plants were located in eight states from New York to Florida, (east and west coasts), and from Mississippi to Texas (see Map 1).<sup>7</sup> The fishery for menhaden is conducted over approximately 45,000 square miles of sea surface, extending along the Atlantic coast from central Maine to central Florida (east coast), and along the Gulf coast from Pascagoula, Mississippi, to Port Arthur, Texas.<sup>8</sup>

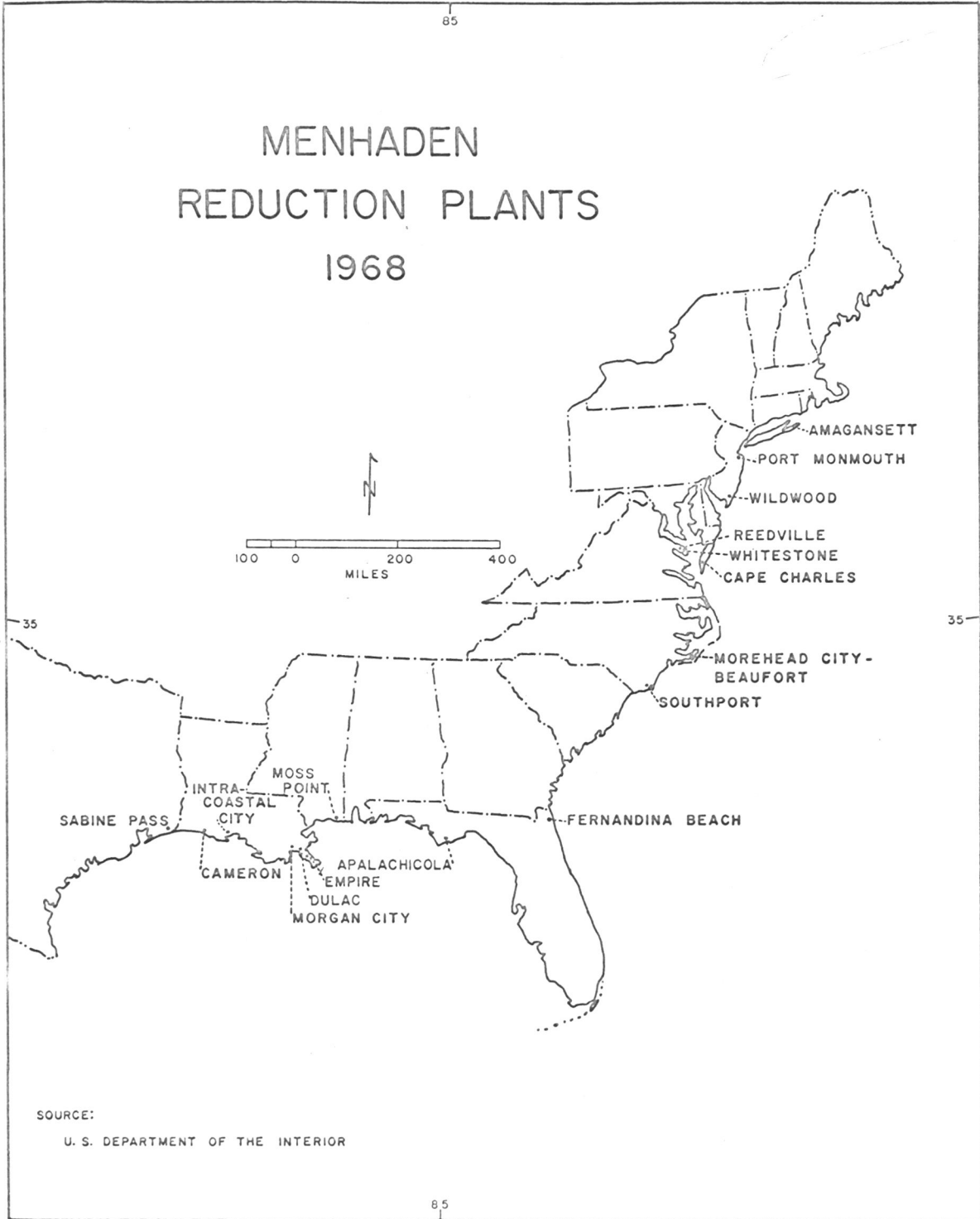
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<sup>5</sup>Meal: the ground up body of the fish after the liquids are removed; Oil: the body oils consisting of about 25 per cent fatty acids and 75 per cent unsaturated fatty acids; Condensed solubles: a soluble solution evaporated to a 50 per cent solids syrup from the body liquids after the oil and suspended particles have been removed. T. M. Miller, "Menhaden Fish Scrap and Meal," Technical Bulletin, Morehead City, North Carolina, 1958, pp. 1-3. (Mimeographed).

<sup>6</sup>"Menhaden--Our Largest Commercial Catch," Monthly Review, Federal Reserve Bank of Richmond (August 1960), p. 3.

<sup>7</sup>U.S., Department of the Interior, Firms Manufacturing Menhaden Products, Scientific Leaflet 160, Revised 1968 (Washington: Government Printing Office, 1968), pp. 1-2.

<sup>8</sup>U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, The Menhaden Fishery of the United States, by Fred C. June, Fishery Leaflet 521 (Washington: Government Printing Office, 1961), p. 5.



SOURCE:  
U. S. DEPARTMENT OF THE INTERIOR

Map 1

North Carolina constitutes the major production area<sup>9</sup> of the South Atlantic fisheries region (see Map 3).<sup>10</sup> In 1968 eight firms were engaged in the manufacture of menhaden products on the North Carolina coast.<sup>11</sup> In Tar Heel waters the menhaden present a unique fishing situation. Menhaden are caught during two distinct periods of the year. A "spring" fishery is in operation from May until August, and a "fall" fishery is conducted from the middle of October through December. During the latter season menhaden are caught only along the North Carolina coast.<sup>12</sup>

### The Problem

#### Statement of the purpose

The main objective of this study is to present a geographical description and analysis of the menhaden fishing industry in North

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<sup>9</sup>U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Fishery Statistics of the United States, 1965, by Charles H. Lyles, Statistical Digest 59 (Washington: Government Printing Office, 1967), p. 268.

<sup>10</sup>The South Atlantic fisheries region, as designated by the Bureau of Commercial Fisheries, encompasses the states of North Carolina, South Carolina, Georgia, and Florida (east coast). Ibid., p. 267.

<sup>11</sup>U.S., Department of the Interior, Firms Manufacturing Menhaden Products, p. 1.

<sup>12</sup>William A. Ellison, Jr., "The Menhaden," in Survey of Marine Fisheries of North Carolina, ed. by Harden F. Taylor (Chapel Hill: University of North Carolina Press, 1951), pp. 94-95.

Carolina.<sup>13</sup> Specifically, the study is concerned with an analysis of the spatial distribution and interaction of various selected aspects of the fishery.

#### Importance of the study

The selection of the menhaden fishing industry as the object of this study seems particularly appropriate at this time. The industry supported by menhaden constitutes "the largest and one of the oldest fisheries in North America."<sup>14</sup> Concerning this important fishery, Sanford and Lee have stated that "despite the importance of menhaden to our fishing economy, this species is relatively unknown even to many users of menhaden products, and the large industry that it supports has not received due recognition."<sup>15</sup>

It seems that "geographers have given only slight attention to fisheries and other marine industries."<sup>16</sup> In an article entitled

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<sup>13</sup>This paper emphasizes the fishing industry, or fishery for menhaden rather than the reduction industry, or processing and distribution of menhaden products. Certainly, the menhaden reduction industry might be the subject of a later study in which various aspects such as the production and marketing of menhaden products would be covered.

<sup>14</sup>Fred C. June, "The Menhaden Fishery," in Industrial Fishery Technology, ed. by Maurice E. Stansby (New York: Reinhold Publishing Corporation, 1963), p. 146.

<sup>15</sup>U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Menhaden Industry, by F. Bruce Sanford and Charles F. Lee, Technical Leaflet 31 (Washington: Government Printing Office, 1961), p. 1.

<sup>16</sup>Herbert R. Padgett, "Some Physical and Biological Relationships to the Fisheries of the Louisiana Coast," Annals of the Association of American Geographers, Vol. 56, No. 3 (September, 1966), p. 423.



"Sea Industries: A Neglected Field of Geography," Herbert Padgett expanded this theme and explained that:

Geographers have in the main neglected what seems to be one of their more rewarding subjects for investigation, sea industries . . . The noticeable lack of research into sea related industries stands without justification. For is not the sea a prime high-way of transportation, a major source of food for at least some sections of the world, a significant and growing reservoir of useful raw materials, and a frontier for scientific exploration and research?<sup>17</sup>

A review of geographical literature will show few studies concerning sea industries published by geographers. However, there have been some major studies with varying approaches to the subject. In 1942 Edward Ackerman used the regional approach in his study of fishing in New England.<sup>18</sup> Ten years later Erhard Rostlund wrote about the relationship of fishing to the primitive economies of North America.<sup>19</sup> In 1956 British geographer Robert Morgan published an outstanding volume on the world fisheries.<sup>20</sup> More localized in his approach,

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<sup>17</sup>Herbert R. Padgett, "Sea Industries: A Neglected Field of Geography," The Professional Geographer, Vol. 13, No. 6 (November, 1961), pp. 26-27.

<sup>18</sup>Edward A. Ackerman, New England's Fishing Industry (Chicago: University of Chicago Press, 1942).

<sup>19</sup>Erhard Rostlund, Freshwater Fish and Fishing in Native North America, University of California Publications in Geography, Vol. 9 (Berkeley: University of California Press, 1952).

<sup>20</sup>Robert Morgan, World Sea Fisheries (New York: Pitman, 1956).

Astvaldur Eydal used the regional technique in his study of "Some Geographical Aspects of the Fisheries of Iceland."<sup>21</sup>

A further examination will reveal almost no geographical studies dealing with sea industries of the southern United States. It has been stated that "although the fisheries have received some attention in port cities of the South for more than a century, they are still among the most neglected of all its recognized resources."<sup>22</sup> One of the most neglected of the sea industries is the fishery supported by menhaden. Indeed, there has been no detailed study of the menhaden industry published by a geographer. The author knows of only two studies in the geographical literature that deal with the menhaden industry and both works are short articles published in the journals.<sup>23</sup> Written nearly half a century ago, Gabriel's brief article, while fine for some of the early historical aspects of the industry, covers only that portion in New England and completely leaves out coverage of the southern fishery, which was well established in

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<sup>21</sup>Astvaldur Eydal, "Some Geographical Aspects of the Fisheries of Iceland" (unpublished Ph.D. dissertation, University of Washington, 1963).

<sup>22</sup>Herbert R. Padgett, "The Sea Fisheries of the Southern United States: Retrospect and Prospect," The Geographical Review, Vol. 53, No. 1 (January, 1963), p. 22.

<sup>23</sup>Ralph H. Gabriel, "Geographical Influences in the Development of the Menhaden Fishery of the Eastern Coast of the United States," The Geographical Review, Vol. 10 (August, 1920), pp. 91-100; and Leonard C. Roy, "Menhaden--Uncle Sam's Top Commercial Fish," National Geographic Magazine, Vol. 92, No. 6 (June, 1949), pp. 813-823.

North Carolina, Georgia, and Florida at that time.<sup>24</sup> Roy's article, containing eleven photographs in ten pages, was written more in a popular vein.

Certainly, the few published studies have displayed various approaches and diverse emphases in their investigations. These aspects or factors "will differ according to the geographer's background and interest. What is needed, for the present at least, is more studies."<sup>25</sup> Astvaldur Eydal elucidated the lack of fishery studies in economic geography and explained the task of the geographer when he wrote:

In the economic geographic field attention has been paid mainly to the use of land resources, and the utilization of marine resources has been largely disregarded. However, the vast ocean harbors immense physical, chemical, and biological resources, and millions of people gain their livelihood from the hydrosphere, particularly through piscatorial activities. These activities are very unevenly distributed spatially and they are of varying importance for the concerned aggregates of population. It appears to be an appropriate task for the economic geographer to map and analyse the quantitative and economic aspects of fisheries in their spatial arrangement and to explain the reasons for their areal differentiation.<sup>26</sup>

It is hoped, then, that this study will help fill the gap in this phase of economic geography.

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<sup>24</sup>U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Fishery Statistics of the United States, 1965, p. 301.

<sup>25</sup>Padgett, "Sea Industries: A Neglected Field of Geography," p. 27.

<sup>26</sup>Eydal, p. 1.

The present report deals with the various aspects of the menhaden fishing industry as they have developed along the Atlantic and Gulf coasts, but is focused on the North Carolina fishery in greater detail. Thus, the main emphasis of the paper is concerned with the geographical description and analysis of the menhaden enterprise of North Carolina in terms of: 1) the historical aspects of the fishery; 2) the development of the modern industry; and 3) the significance of the modern functions of the fishing operation. The location of the industry and the importance of this factor is treated in great detail. The particular approach used in this report is systematic in that the various component sectors of the industry are analyzed separately, proceeding from the general (over-all development of the industry) to the specific (regional phase of North Carolina). Some of the questions asked in this paper are:

1. What has been the early pattern of development of the industry from its inception in New England through the shift down the Atlantic coast? What part did the North Carolina fishery play in the distribution of the industry?
2. What are the contemporary areal patterns of the various menhaden species? What are some of the major factors behind the spatial arrangement and seasonal migrations of the fish?
3. What are the various geographical aspects of the fishery in respect to fishing areas and seasons, fishing methods, and catch distribution?

4. What are the current problems and trends associated with the menhaden industry? What measures are being taken to help solve the problems, and what future developments may be anticipated? How does North Carolina reflect the over-all menhaden situation?

#### Methodology

Basically the research methods employed in this study were concerned with: 1) library studies; and 2) field investigations.

##### The use of the library

Library materials were used quite extensively in this study. The use of rare, old documents, which was a particular help in researching the first portions of the report concerned with the historical geography, was made possible by the complete library facilities at the Bureau of Commercial Fisheries and the fine co-operation of the entire staff at the laboratory on Piver's Island, Beaufort, North Carolina. In addition, many scientific reports, out-of-print scientific articles, unpublished manuscripts, statistics, and photographs have been made available by the Bureau's staff. The National Fish Meal and Oil Association also contributed much needed information concerning this project.

##### Field techniques used

The two main field techniques employed in this study were: 1) trips to various factory sites and fishing vessels; and 2) personal interviews. Numerous field trips have been taken in order to observe the actual plant and fishing operations. A number of interviews have been held with factory owners, managers, and workers. Vessel captains

and crew members have also been interviewed in several instances. Of invaluable aid in researching this work were the various discussions held with fishery biologists at the Bureau of Commercial Fisheries Laboratory, Beaufort.

### The Menhaden

Menhaden<sup>27</sup> belong to the Clupeidae herring family. These fish are considered relatively small in size, generally running less than twelve inches in length and under a pound in weight. However, some adult fish reach up to eighteen inches in length and more than three pounds in weight. Similar in appearance to other herring-like fish, such as the alewife and shad, menhaden are differentiated by their particular scale arrangement. Menhaden range in color from dark blue to blue brown along their upper portions, while the sides are usually silver colored. A single, dorsal fin projects from the center of the back, and along the midline of the belly a number of bony plates are arranged in row fashion.<sup>28</sup> (See Fig. 1).

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<sup>27</sup>For a complete biological description and analysis of the menhaden, refer to Samuel F. Hildebrand, "A Review of the American Menhaden, Genus Brevoortia, With a Description of a New Species," Smithsonian Miscellaneous Collections, Vol. 107, No. 18 (1948), pp. 1-39; and Michael D. Dahlberg, "A Systematic Review of the North American Species of Menhaden, Genus Brevoortia" (unpublished Ph.D. dissertation, Tulane University, 1966).

<sup>28</sup>Fred C. June, "The Menhaden Fishery," in Industrial Fishery Technology, pp. 146-147.

All menhaden belong to the Genus Brevoortia, four species of which occur along the Atlantic and Gulf coasts of the United States. Atlantic waters are inhabited by Brevoortia tyrannus, commonly called the Atlantic menhaden, and Brevoortia smithi, the yellow fin menhaden. In the Gulf of Mexico the two dominant species are Brevoortia patronus, the Gulf menhaden, and Brevoortia gunteri, the fine-scaled Gulf menhaden.

The two most common and distinct species, Brevoortia tyrannus, the Atlantic menhaden, and Brevoortia patronus, the Gulf menhaden, virtually support the commercial fisheries in their respective areas. The other two species, yellowfin and fine-scaled menhaden, are caught in such small quantities that the total landings of these species are insignificant when compared with the landings of the Atlantic and Gulf menhaden.<sup>29</sup>

#### Popular names

Long before any scientific names were assigned to menhaden people in different parts of the country referred to the fish by a variety of vernacular appellations. The persistent use of many different common names to identify the various species of the Genus Brevoortia has undoubtedly contributed to the general lack of recognition acquired by the menhaden industry. Still today, throughout different geographical areas Brevoortia fish are known by numerous popular names, among which are "pogy," "fatback," "mossbunker,"

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<sup>29</sup>U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, The Menhaden Fishery of the United States, by Fred C. June, pp. 1-2.

"old wife," "bony-fish," "white-fish," "bugfish," "alewife," and "yellowtail shad."<sup>30</sup> Simmons and Breuer have described the general, geographical distribution of common names in recent years:

In Maryland and Virginia fishermen call them bugheads, bugfish, oldwives, alewives, greentails, and chebugs. Delaware fishermen add the name mossbunker to this list; Connecticut fishermen call them whitefish, bonyfish, and bunkers; and in North Carolina they are fatbacks, shad, and pogies. This last name is the one commonly used among fishermen of the Texas coast. All of the names apply to a bony, mealy fleshed, oily, shadlike fish which normally travels in large schools in nearshore salt water.<sup>31</sup>

However, the employment of a number of local names is not restricted to contemporary times, for most of the common names now used in connection with menhaden have long histories, some dating back to Indian words. In 1884 Goode discussed the various common names and their origins:

North of Cape Cod the name "Pogy" is almost universally in use while in Southern New England the fish is known as the "Menhaden." The two names are derived from two Indian words of the same meaning; the first being the Abnaki name "pookagan," or "Poghaden," which means "fertilizer," while the latter is the modification of a word which in the Narragansett dialect meant "that which enriches the earth." About Cape Ann, "Pogy" is partially replaced by "Hardhead," or "Hard-head Shad," and in Eastern Connecticut by "Bony Fish." In Western Connecticut the species is usually known as the "White-fish," while in New York the usage of two centuries is in favor of "mossbunker." This name is a relic of the Dutch colony of New Amsterdam, having evidently been transferred from the "Shad," or "Horse Mackerel," *Trachurus lacerta*, a fish which visits the shores of Northern Europe in immense schools, swimming at the surface in much the same manner as our Menhaden, and known to the Hollanders as the "Marshbanker." In Delaware Bay, the Potomac, and the Chesapeake, we meet with the "Alewife," "Bay Alewife,"

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<sup>30</sup>U.S. Department of the Interior, Fish and Wildlife Service, Menhaden Industry--Past and Present, by Charles F. Lee, Fishery Leaflet 412 (Washington: Government Printing Office, 1953), p. 3.

<sup>31</sup>Ernest G. Simmons and Joseph P. Breuer, The Texas Menhaden Fishery, Bulletin No. 45, Series No. 2, Coastal Fisheries (Austin, Texas: Texas Parks and Wildlife Department, 1964), pp. 3-4.



"Pilcher" (Pilchard), and "Greentail." Virginia gives us "Bugfish," "Bug-head," and "Bug-shad," referring to the parasitic crustacean found in the mouths of all Southern Menhaden. In North Carolina occurs the name "Fat-back," which prevails as far south as Florida, and refers to the oiliness of the flesh. In this vicinity, too, the names "Yellow-tail" and "Yellow-tailed Shad" are occasionally heard, while in Southern Florida the fish is called "Shiner" and "Herring."<sup>32</sup>

Goode also commented on the popular names associated with the menhaden of the Gulf coast:

The Gulf Menhaden has several vernacular names. At Key West it is called 'Sardine,' in common with other fish of the same general appearance. At Apalachicola, Pensacola, and Mobile it is called 'Alewife'; at New Orleans the names 'Sardine' and 'Alewife' are both in use, the latter perhaps more generally. On the Texan coast it is known as 'Herring,' 'Alewife,' 'Sardine,' and 'Shad,' each locality having its peculiar name.<sup>33</sup>

#### Zoological names

In the 1802 Transactions of the American Philosophical Society Benjamin Latrobe, an engineer-architect with a penchant for natural history, first named menhaden as Clupea tyrannus. By 1861 Theodore Gill, an ichthyologist writing in the Proceedings of the Academy of Sciences, Philadelphia, had established the species as genus Brevoortia.<sup>34</sup> Eighteen years later Goode wrote that the terms "tyrannus" as given by Latrobe and "Brevoortia" as established by Gill referred undoubtably to menhaden, and

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<sup>32</sup>U.S., Commission of Fish and Fisheries, The Fisheries and Fishery Industries of the United States, Sec. 1, Vol. 3, by George Brown Goode and associates (Washington: Government Printing Office, 1884), p. 569.

<sup>33</sup>Ibid., p. 576.

<sup>34</sup>U.S., Commission of Fish and Fisheries, "The Natural and Economical History of the American Menhaden," by George Brown Goode and associates, Report of the United States Commissioner of Fish and Fisheries, 1877, Part 5, Appendix A (Washington: Government Printing Office, 1879), pp. 15-18.

that "the laws of priority demand that the species shall henceforth be known as *Brevoortia tyrannus*."<sup>35</sup>

Thus, by the latter half of the nineteenth century, the Atlantic menhaden was identified by a single scientific name and at least thirty common appellations. There is little doubt that consistent use over the years of many different names in reference to menhaden has definitely contributed to the general lack of familiarity associated with the menhaden industry.

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<sup>35</sup>Ibid., p. 15.

## CHAPTER II

### HISTORICAL GEOGRAPHY

#### Introduction

The use of menhaden as a means for increasing soil fertility predates the settling of North America by the white man. Native Algonquin Indians were using menhaden to fertilize their fields when northern Europeans first landed along the northeast Atlantic coast of the area now called the United States. Although the colonists soon learned to apply menhaden to their own fields, widespread employment of the fish was rather limited until the early 1800's when news spread of experiments that seemed to indicate menhaden as a powerful growth agent. In order to have an adequate supply of the much-sought-after resource, eager farmers soon formed small groups to fish during off hours from the fields. During that early period the menhaden business was almost entirely limited to the coastal beaches of Long Island, New York, and Connecticut.<sup>1</sup> The dominant use of menhaden remained fertilizer until about the middle of the nineteenth century when several events combined to shift the emphasis from fertilizer production to oil extraction. By the late 1850's a number of oil businesses had been established along the New England coast. Between 1865 and 1870 the menhaden industry was expanded, and by the late 1870's factories

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<sup>1</sup>U.S. Department of the Interior, Fish and Wildlife Service, Menhaden Industry--Past and Present, pp. 3-4.

were located in the New England states of Rhode Island, Connecticut, Massachusetts, and Maine; in the Middle Atlantic states of New York and New Jersey; and in the Chesapeake Bay region of Virginia.<sup>2</sup> At that time several attempts had been made to establish menhaden fisheries in North Carolina, but all efforts had been unsuccessful. It was not until the late 1880's that menhaden operations were successful in the Tar Heel state.<sup>3</sup>

#### Northern States

According to the 1621 colonial writings of Governor Bradford, the value of fish fertilizer was known to the coastal Indians of that region which later became Massachusetts.<sup>4</sup> The aborigines caught menhaden, or "mannawhatteaug," which were abundant in the coastal waters during the summer, and used the whole fish as fertilizing material in their fields. When the first Europeans arrived, Squanto of the Massachusetts Tribe taught them the method of capturing the fish and pointed out how to place the raw fish under each hill of corn. During colonization the first settlers followed the technique established by the Indians. Although there is no way of knowing how long the colonists used menhaden for fertilizer, local use no doubt did occur for some time. There was, however, no great exploitation of the

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<sup>2</sup>U.S. Department of Commerce, Bureau of Fisheries, The Menhaden Industry, by Roger W. Harrison, Investigational Report No. 1 (Washington: Government Printing Office, 1931), p. 10.

<sup>3</sup>Ellison, pp. 88-90.

<sup>4</sup>William Bradford, Bradford's History of Plymouth Plantation, 1606-1646, ed. by William T. Davis (New York: Charles Scribner's Sons, 1908), pp. 115-116.

multitude of fish that came into coastal waters during the colonial period.<sup>5</sup>

The exploitation of the vast resource for commercial purposes did not begin until the early nineteenth century. Around the turn of the century, Ezra L'Hommedieu, a Long Island landowner of considerable wealth, conducted a series of experiments in which he was attempting to enrich the fertility of his soils by using menhaden as a side dressing. The result was quite successful, and in 1801 L'Hommedieu published the findings of his experiments. On hearing the news, coastal farmers interpreted the claims as a foolproof way of increasing crop yields. Consequently, a number of small "companies" were organized for the purpose of providing menhaden for fertilizer. Most of the companies were operated by farmers who would fish only the inshore waters as a sideline to their farming practices.<sup>6</sup>

Up to about 1850 menhaden activities were limited to the states of New York (Long Island) and Connecticut. That half century period may be described as the "agricultural-fertilizer-inshore fishery" phase of the menhaden industry. During that time operations were very small and widely scattered along the beaches. The major use of the menhaden resource was as a fertilizing material, although small portions of the catches were: 1) used as bait; 2) consumed as human food; and 3) converted into oil. Fishing was restricted to the shallow inshore waters where menhaden came in seemingly endless numbers. Professional

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<sup>5</sup>U.S. Department of Commerce, Bureau of Fisheries, The Menhaden Industry, p. 6.

<sup>6</sup>Gabriel, pp. 92-94.

farmers, using haul seines and gill nets, made up almost the entire lot of "fishermen."<sup>7</sup>

Toward the end of the first half of the nineteenth century a number of companies were established to operate full time in the capturing of menhaden, and as the demand for the fish increased, many fishing associations, known by such names as "Fish Hawks," "Eagles," and "Water Witches," began to engage in what turned out to be very profitable ventures.<sup>8</sup>

By the middle of the nineteenth century several events had taken place which changed the menhaden industry into what may be called the "factory-oil-deep-sea fishery" phase. Previous to the half century mark small amounts of oil had been extracted from menhaden by use of extremely crude methods. The fish were first allowed to rot in barrels, and then the entire contents were pressed in hogsheads in order that the oil could rise to the top. Steam cooking eventually replaced the rotting process and by the late 1850's the mechanical screw press had also been introduced. In conjunction with those developments the Civil War brought into being a great demand for menhaden oil which came into "general use for painting and tanning and for the adulteration of other, more expensive oils."<sup>9</sup>

Prior to those developments what few oil operations that existed had consisted of crude kettles, tubs, and presses, which were seldom

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<sup>7</sup>U.S. Department of the Interior, Fish and Wildlife Service, Menhaden Industry--Past and Present, pp. 4-5.

<sup>8</sup>Gabriel, p. 94.

<sup>9</sup>Ibid.

housed in anything more substantial than a lean-to shed, and most often were left open on the beach. As the demand for menhaden oil increased many companies were formed and small factories were constructed for the specific purpose of reducing menhaden to oil. The factory organizations had no fishing fleets of their own and were, thus, wholly dependent on the small fishing associations which were first created to provide menhaden to farmers.<sup>10</sup>

After a half century of fishing the inshore waters, fishermen had to venture out into the open seas in order to capture enough menhaden to fill the new and larger demand for the fish. About 1850 the purse seine was developed and replaced the older, less efficient methods of fishing. With that turn of events, the whole fishing operation was switched from the beaches to large sailing vessels which were able to engage in a deep-sea fishery.<sup>11</sup>

Soon the factory owners grew tired of buying menhaden from the fishing associations, and a number of "floating factories" were put into operation. These sea-going plants, old vessels outfitted with the necessary equipment, were only temporary solutions to the problem of obtaining the needed raw resource, and by the late 1860's most of the oil factories had their own fleets. By the late 1870's the "factory-oil-deep-sea fishery" phase of the industry was fully developed with operations located in Rhode Island, Connecticut, Massachusetts, Maine,

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<sup>10</sup>U.S., Department of the Interior, Fish and Wildlife Service, Menhaden Industry--Past and Present, pp. 4,5,12.

<sup>11</sup>Ibid., p. 12.

New York, New Jersey and Virginia.<sup>12</sup>

New England

The first successful attempt at reducing menhaden to oil was carried out in Rhode Island. In 1811 John Tallman and Christopher Barker set up a very crude operation on the shore near Portsmouth. The fish were boiled in open kettles, and the oil was barreled and sent to market in New York.<sup>13</sup> By the late 1870's the menhaden industry had reached the factory stage, and thirteen menhaden plants were in operation along Narragansett Bay.<sup>14</sup>

The Connecticut industry had its beginnings sometime before 1850 when oil was extracted from bony fish (menhaden) at Poquannock Bridge. By the middle of the century there was a small factory for the manufacture of whitefish (menhaden) oil near New Haven Harbor. In 1852 or 1853 the process of extracting oil by steam cooking was patented by William Hall of Wallingford,<sup>15</sup> and by the year 1877 there were nine factories along the coast of Connecticut.<sup>16</sup>

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<sup>12</sup>Gabriel, p. 96.

<sup>13</sup>U.S., Fish Commission, "The Origin of the Menhaden Industry," by E. T. Deblois, Bulletin, Vol. 1 (Washington: Government Printing Office, 1882), p. 46.

<sup>14</sup>U.S. Commission of Fish and Fisheries, "The Natural and Economical History of the American Menhaden," p. 166.

<sup>15</sup>U.S., Commission of Fish and Fisheries, "The Menhaden Fishery," by George Brown Goode and A. Howard Clark, The Fish and Fishery Industries of the United States, Sec. 5, Vol. 1, ed. by George Brown Goode and associates (Washington: Government Printing Office, 1887), p. 368.

<sup>16</sup>U.S., Commission of Fish and Fisheries, "The Natural and Economical History of the American Menhaden," pp. 166-167.



In Massachusetts during the late 1870's a number of factories were engaged in the production of menhaden oil as a side line to their regular business. Two factories, one located at Provincetown and the other at Wellfleet, produced a small quantity of menhaden oil annually, although their chief activity was concerned with the reduction of blackfish and porpoises to oil. Some of the Cape Cod fishermen would produce a small amount of oil from menhaden, although the main use of the fish was as bait.<sup>17</sup>

In Maine the first crude attempts at oil extraction were carried out at Blue Hill about 1850. That year John Bartlett and his sons had set up their equipment, which consisted of the typical kettles and a crude press used to compress the boiled fish, and produced thirteen barrels of oil.<sup>18</sup> A decade and a half later the first menhaden factory in Maine was built by a company from Rhode Island. By the spring of 1877 there were fourteen factories in the state.<sup>19</sup>

#### Middle Atlantic

The first factory in New York state was built in the vicinity of Greenport, Long Island, by D. D. Wells and his son. Constructed in 1850, the factory was equipped with steam cookers for oil extraction.<sup>20</sup>

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<sup>17</sup>Ibid., pp. 165-166.

<sup>18</sup>U.S., Commission of Fish and Fisheries, "The Menhaden Fishery," pp. 364-365.

<sup>19</sup>U.S., Commission of Fish and Fisheries, "The Natural and Economical History of the American Menhaden," p. 165.

<sup>20</sup>U.S., Commission of Fish and Fisheries, "The Menhaden Fishery," p. 368.

By 1873 the number of oil works had increased to eight and all were clustered at the eastern end of Long Island. Also at that time two floating factories were employed in oil reduction.<sup>21</sup>

By 1873 there were two oil factories in New Jersey, at Somers Point and Great Egg Harbor. By 1877 the number of factories had increased to five. One oil works was at Port Monmouth, while Somers Point and Tuckerton had two factories each. During the season of 1878 a floating menhaden factory, the Alabama was operated in New Jersey waters.<sup>22</sup>

#### Chesapeake Bay

In 1865 David Floyd, of Greenport, Long Island, started the menhaden fishing industry in the Chesapeake Bay area. Floyd, operating from a sailing vessel equipped with oil works, lacked experience and was unsuccessful in his pioneering venture.<sup>23</sup> Three years later the first factories were constructed in Virginia: one located on Tanners Creek and the other on Back Creek. The following year another oil works was set up at Reedville.<sup>24</sup> By 1880 the menhaden oil industry in Virginia

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<sup>21</sup>U.S., Commission of Fish and Fisheries, "The Natural and Economical History of the American Menhaden," p. 166.

<sup>22</sup>Ibid., p. 168.

<sup>23</sup>U.S., Commission of Fish and Fisheries, "The Menhaden Fishery," pp. 369-370.

<sup>24</sup>U.S. Commission of Fisheries, "The Menhaden Industry of the Atlantic Coast," by Rob Leon Greer, Report of the U.S. Commissioner of Fisheries 1914, Appendix 3 (Washington: Government Printing Office, 1915), p. 5.

had increased to nearly sixty large and small factories, employing over seven hundred fishermen and factory workers.<sup>25</sup>

#### North Carolina

Menhaden, or fat-backs as the fish were known locally throughout North Carolina,<sup>26</sup> have been recorded in the State's waters since colonial times. In 1709 John Lawson listed "Fat-Backs" as one of the salt water fish of North Carolina.<sup>27</sup> In describing the menhaden, Lawson wrote that "Fat-Backs are small Fish, like Mulletts, but the fattest ever known. They put nothing into the Pan, to fry these. They are excellant sweet Food."<sup>28</sup>

The impetus for the establishment of the menhaden industry in North Carolina came during the middle of the nineteenth century. At the time of the Civil War many soldiers of the Union Army, while stationed along the coast of North Carolina, noticed the abundant supply of menhaden which frequented the inshore waters. These northern soldiers gave "glowing accounts of the abundance of fish in the North Carolina sounds."<sup>29</sup> On hearing these encouraging reports northern

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<sup>25</sup>U.S., Commission of Fish and Fisheries, "The Menhaden Fishery," pp. 369-370.

<sup>26</sup>George Brown Goode, "A Study of the Popular Names of the Menhaden," The American Naturalist, Vol. 12 (November 1878), p. 735.

<sup>27</sup>John Lawson, A New Voyage To Carolina (A reproduction of the original 1709 London edition) ed. by Hugh Talmage Lefler. Chapel Hill: University of North Carolina Press, 1967, p. 155.

<sup>28</sup>Ibid., p. 160.

<sup>29</sup>U.S., Commission of Fish and Fisheries, "North Carolina and Its Fisheries," by R. Edward Earll, in The Fish and Fishery Industries of the United States, Sec. 2, Part 12, ed. by George Brown Goode and associates (Washington: Government Printing Office, 1887), p. 495.

capitalists soon traveled to the Tar Heel State in order to validate the soldiers' claims. From personal observations the capitalists substantiated the soldiers' stories and invested in a fishery for menhaden. Experienced fishermen were brought from northern fisheries to help initiate the plans. However, in spite of the large fish supply, the experience of the northern fishermen, and the capital of the promoters the early history of the menhaden fishery in North Carolina was plagued with a number of failures and severe losses. Several different locations were tried, but all attempts were unsuccessful (see Map 2). Many years passed before the menhaden business was successfully operated in the Tar Heel State. In the late 1880's several menhaden factories were in operation at Beaufort, and by the early 1900's the industry was well established at Beaufort and the Cape Fear area, where landings have been made for most years to the present.<sup>30</sup>

#### Harper's Island

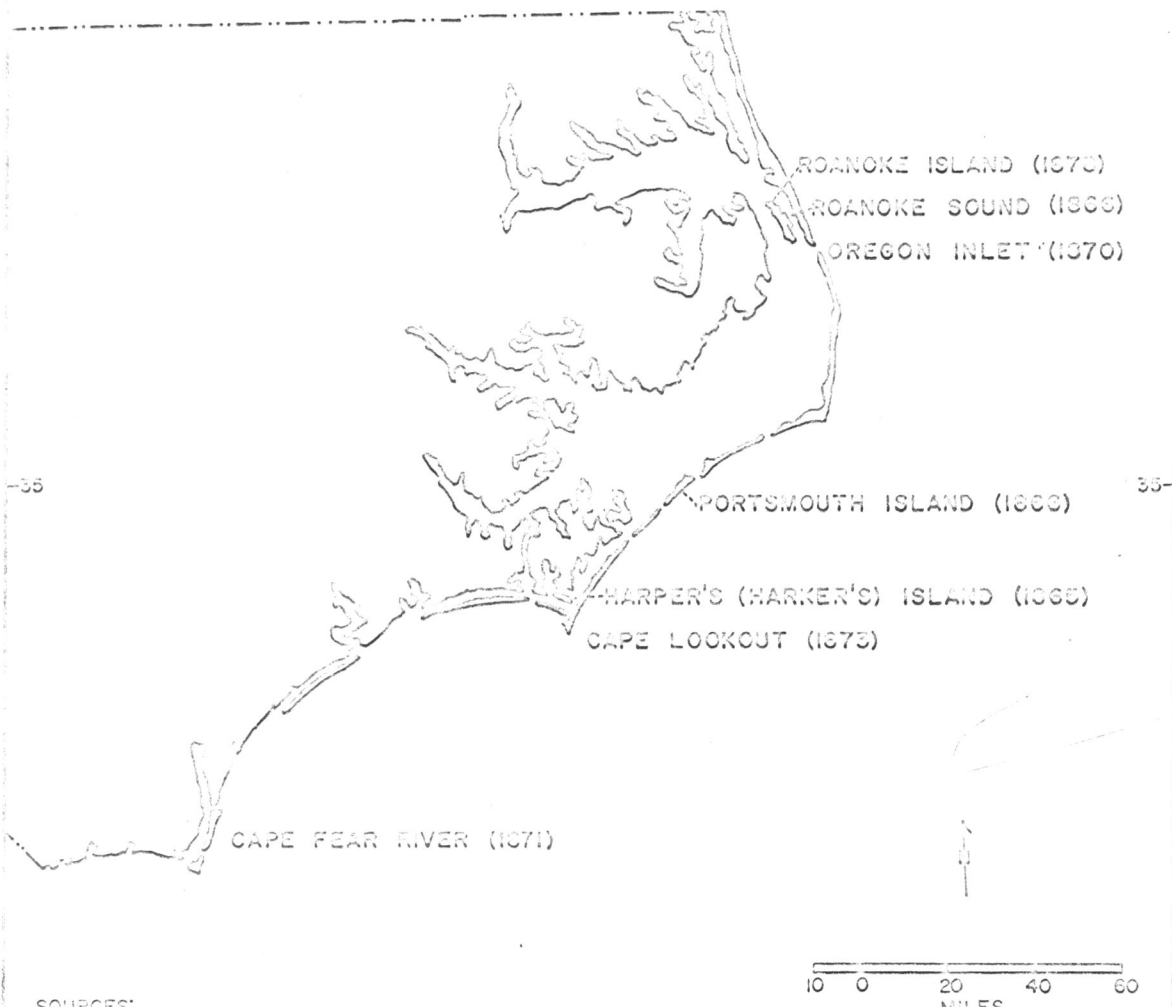
According to Earll's account, Harper's (Harker's) Island, situated just off the mainland in Core Sound, was the scene of the first menhaden processing plant in North Carolina (see Map 2). Built in 1865 this oil and guano factory utilized the menhaden which were captured with gill nets. Kettles and handpresses constituted the factory equipment. Some time later, a steam operated boiler was added to the

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<sup>30</sup>U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Fishery Statistics of the United States, 1965, p. 301.

# MENHADEN FISHERIES IN NORTH CAROLINA.

(DATES AND APPROXIMATE LOCATIONS)



SOURCES:

- EARL, "NORTH CAROLINA AND ITS FISHERIES," 1837
- GOODE, "HISTORY OF THE AMERICAN MENHADEN," 1877

Map 2

operation. The fishery was expanded with the introduction of the purse and haul seining techniques. The factory remained in operation until 1873 when the equipment was dismantled and transferred to what was considered a more favorable location, Cape Lookout. However, the equipment was never assembled at the Cape and the business venture came to a halt. The total loss was approximately \$3,000.<sup>31</sup>

#### Roanoke Sound Vicinity

According to George Brown Goode's classic work on menhaden, menhaden fishing was started in North Carolina in 1866. A prospecting party of the Quinnipiac Fertilizer Company, of New Haven, Connecticut, spent the winter of 1866 in the Roanoke Sound area and "established weirs for the capture of menhaden, which were very abundant."<sup>32</sup> However, this enterprise did not last long due to the fact that the local people were envious of the northern fishermen. The native inhabitants destroyed the weirs and drove the strangers away from the area. The northerners relocated near Cape Charles, Virginia, where the menhaden were extremely plentiful.<sup>33</sup>

#### Portsmouth Island

In 1866 a Rhode Island stock company, called the Excelsior Oil and Guano Company, invested \$50,000 in a venture to set up a menhaden fishery in North Carolina waters. Having investigated the claims

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<sup>31</sup>U.S., Commission of Fish and Fisheries, "North Carolina and Its Fisheries," p. 495.

<sup>32</sup>U.S., Commission of Fish and Fisheries, "The Natural and Economical History of the American Menhaden," p. 117.

<sup>33</sup>Ibid.

of northern soldiers, the promoters established a factory on Portsmouth Island in Pamlico Sound (see Map 2). Northern fishermen, experienced in the use of purse seines, were imported to run the fishery. "Modern" equipment was installed to cook and press the fish. After the third season, the venture had proven futile and the factory was closed with a combined loss of \$75,000. According to the business manager of the company, a number of factors were responsible for the failure. First, the menhaden had not been as abundant as expected. Less than twenty-five barrels of fish made up the average school of menhaden. Second, since the captured fish would begin to decompose in a few hours under the summer heat, the range of fishing could not exceed twenty-five miles from the factory. Third, ocean fishing was not engaged in due to the shoalness of the inlets at low tide and the prevalence of sudden storms. Fourth, the fishery had depended on fish caught in the sounds, but these menhaden were very poor with only two quarts of oil from a barrel of fish on the average. The company's business manager expressed the opinion that "it would be impossible to make the menhaden fisheries profitable along this coast."<sup>34</sup>

#### Oregon Inlet

About 1870 another menhaden factory was constructed, this time, at Oregon Inlet (see Map 2). Financed by the Church Brothers of Rhode Island the factory lasted two seasons. During the first year

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<sup>34</sup>U.S., Commission of Fish and Fisheries, "North Carolina and Its Fisheries," pp. 495-496.

of operation a steamer, the Seven Brothers, was employed in the fishery. In the final year small sailing vessels replaced the steamer. According to a business partner of the Church Brothers, a strong current often prevented the fishing boats from having free passage into and out of the sound, and it was this situation that led to the factory's closing.<sup>35</sup>

#### Cape Fear

In 1871 a tract of land near the mouth of the Cape Fear River became the site of a menhaden factory. The Nevassa Guano Company, of Wilmington, which used fish scrap as an ingredient in their fertilizer, established the factory in an attempt to supply the needed raw material for their business. Two vessels were employed in the purse seine fishery. After only two years the enterprise was abandoned. On closing the total investment loss was estimated to be between \$8,000 and \$10,000. According to the president of the company, the fish were too scarce and the oil yields were too limited to allow profitable business. The catches per week never exceeded five hundred barrels, and the oil yields per barrel averaged only three pints.<sup>36</sup>

#### Roanoke Island

Captain I. Cain, of Roanoke Island, investigated the possibility of establishing a menhaden fishery in 1878. Following a number of

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<sup>35</sup>Ibid., p. 496.

<sup>36</sup>Ibid.



experiments, which "satisfied him that the menhaden fishery could be carried on with profit," Cain set up a factory for the processing of menhaden. Plant equipment consisted of the essential kettles and presses. A small boat was outfitted for use in the fishery. However, due to the lack of a sufficient amount of fish in the sound waters, work never began during the season of 1879. In spite of that initial failure, the following year Captain Cain planned to add a steam boiler and some hydraulic presses to his plant.<sup>37</sup> Although it is not certain, the Captain probably carried out his plan with a total investment of approximately \$2,000. According to Goode and Clark's section entitled "The Census Statistics of the Menhaden Industry For 1880," North Carolina was given credit for \$2,000 under "Value of factories and fixtures" and \$2,000 under "Total capital invested." However, according to the same source no menhaden fishing was conducted in North Carolina waters during the season of 1880.<sup>38</sup>

Writing in 1887 Goode and Clark reported the status of the menhaden fishery up to that time, and commented on the possibility of a profitable menhaden fishery in North Carolina waters.

Several efforts have been made to locate factories on the North Carolina coast, and some parties have prosecuted the business with varying success for several years. Thus far, however, no one has succeeded in making it profitable. It is, therefore, an open question whether this fishery can be

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<sup>37</sup>Ibid.

<sup>38</sup>U.S. Commission of Fish and Fisheries, "The Menhaden Fishery," p. 361.

prosecuted in the State. The currents are so strong at the inlets that sail vessels are often unable to enter them when the tide is unfavorable, and they are thus frequently delayed so long that the fish spoil before they reach the factory. Menhaden are quite abundant in the inner sounds, but the water is usually so shoal as to interfere seriously with the use of purse-seines, and the fish are <sup>39</sup> scattered that only a few barrels can be taken at a haul.

### Beaufort

In spite of the early failures experienced in the attempts to establish a menhaden fishery at various locations in North Carolina, the industry was finally set up and operated successfully in the Beaufort area. By 1889 the North Carolina menhaden fishery was definitely concentrated at Beaufort or in the immediate vicinity. Seven different factories were in operation during that year.<sup>40</sup> Although it is not certain, the fishery was probably started in this area as early as 1887, since North Carolina was given credit for 14,756,000 pounds of menhaden in that year.<sup>41</sup> In 1890 the total number of factories had been reduced to six, and the total capital invested in buildings, vessels, and apparatus amounted to \$97,560. One hundred eighty-seven workers were employed in the industry. The fishery landed \$16,171 worth of menhaden that year.<sup>42</sup>

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<sup>39</sup>Ibid., p. 332.

<sup>40</sup>U.S., Fish Commission, "Report on the Fisheries of the South Atlantic States," by Hugh M. Smith, Bulletin, Vol. 11 (Washington: Government Printing Office, 1893), p. 305.

<sup>41</sup>U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Fishery Statistics of the United States, 1965, p. 301.

<sup>42</sup>U.S., Fish Commission, "Report on the Fisheries of the South Atlantic States," p. 305.

By 1902 the menhaden fishery was centered in two separate and distinct localities in North Carolina: 1) Beaufort and vicinity; and 2) the Cape Fear area. During the 1902 season, 18,862,000 pounds of menhaden, valued at \$31,420, were captured by the North Carolina fishery.<sup>43</sup>

Thus, from an unpromising beginning, the menhaden fishing industry became an important activity along the State's seaboard. In 1907, just two decades after Goode and Clark had expressed doubts concerning a successful menhaden fishery in North Carolina, Hugh M. Smith described the status of the then well established fishery:

The menhaden is one of the most valuable of the North Carolina fishes. Here as elsewhere it is caught chiefly for conversion into oil and guano, at factories located in the vicinity of Beaufort and Cape Fear. Fishing is done with purse seines and haul seines in the ocean and sounds, and the industry gives employment to many people. In recent years there have been about 10 such establishments, with upwards of 500 fishermen and shore hands connected therewith.<sup>44</sup>

Slightly over a decade later Samuel Hildebrand recognized and scientifically described what up to that time had been the much misunderstood natural resource which was the basis of that most important North Carolina fishery.<sup>45</sup> According to Hildebrand, the

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<sup>43</sup>North Carolina, Geological and Economical Survey, The Fishes of North Carolina, by Hugh M. Smith, North Carolina Geological and Economical Survey, Vol. 2 (Raleigh, N.C.: E.M. Uzzell and Company, 1907), p. 132.

<sup>44</sup>Ibid.

<sup>45</sup>Hildebrand identified Brevoortia smithi as Brevoortia aureus, U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Annotated Bibliography on Biology of American Menhaden, by John W. Reintjes, James Y. Christmas, Jr., and Richard A. Collins, Fishery Bulletin No. 170 (Washington: Government Printing Office, 1960), p. 308.

Atlantic menhaden, known locally as fatback, was the "most abundant fish in the vicinity of Beaufort,"<sup>46</sup> and was captured in large amounts to be converted into oil and scrap. This species, Brevoortia tyrannus, was described as migratory, and it was determined that the fish congregated in schools. Inside the harbor small schools were noted to be common, with large schools occurring only infrequently. In the Beaufort area fatback appeared throughout the "warmer part of the year."<sup>47</sup> During this early investigation, Hildebrand described the migrations of Brevoortia tyrannus:

There is usually a period late in the spring, one in midsummer, and another late in the fall when large schools pass by. It is during these "runs," generally known as the spring, summer, and fall runs, that the fish are taken in large quantities. The fall run is, however, by far the most important one, as at this time the fish are not only much more abundant than during the other runs, but they are also usually bigger and fatter, therefore yielding more oil.<sup>48</sup>

The yellowfin menhaden was described as "much less abundant than the fatback," and was "not known to school."<sup>49</sup> In the summer months yellowfin menhaden were captured inside the harbor, but not in any great amount at a particular time. This species usually occupied the deeper waters.<sup>50</sup>

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<sup>46</sup>U.S., Commission of Fisheries, "Two Species of Menhaden Occurring on the Coast of North Carolina," by Samuel F. Hildebrand, Report of the United States Commissioner of Fisheries 1918 (Washington: Government Printing Office, 1919), p. 4.

<sup>47</sup>Ibid.

<sup>48</sup>Ibid.

<sup>49</sup>Ibid., p. 7.

<sup>50</sup>Ibid.

### Summary

Menhaden were being captured and used as fertilizer by the coastal Indians of the northeast Atlantic seaboard when northern Europeans arrived on the North American continent. The colonists adapted the same method of fertilization, but no one knows when the practice was discontinued. Commercial exploitation of the menhaden began around the turn of the nineteenth century when farmers again demanded the fish for use on their fields. Fertilizer remained the chief product of the early industry which was characterized by an inshore fishery and crude production methods. For the first half century the young industry was limited to scattered beach sites in New York State and Connecticut. However, about the middle of the nineteenth century, with the introduction of several new production techniques in conjunction with certain natural developments, the menhaden fishing industry began to prosper. The emphasis was shifted from fertilizer to oil extraction, the production process was mechanized and moved into small factories, and the fishery changed from a crude inshore operation to an efficient deep-sea activity. As the demand for oil increased, the industry expanded to the states of Rhode Island, Massachusetts, Maine, New Jersey, and Virginia. By the late 1870's several attempts to establish the menhaden industry in North Carolina had failed.

Although menhaden had been known to frequent North Carolina waters since the colonial period, the impetus for commercial exploitation of the vast resource did not come until after the Civil War. When the accounts telling of immense schools of fish reached northern

capitalists via Union soldiers, several companies sent experienced fishermen south with plans to work the teeming Tar Heel waters. For over a decade different sites were tried, including the sound locations of Roanoke and Harper's Islands; the Outer Banks' areas near Roanoke Sound, Oregon Inlet, and Portsmouth Island; and a mainland site near the mouth of the Cape Fear River. All attempts were unsuccessful due to a combination of several natural and human factors. It was not until the late 1880's that the menhaden industry was finally carried out on a profitable basis in North Carolina. Although the industry was probably in operation as early as 1887, full scale business was definitely in progress at Beaufort during the season of 1889. By the turn of the century the industry had expanded to an area near Cape Fear in Brunswick County. Since that time the menhaden fishing industry of North Carolina has been concentrated in the same two areas, Beaufort and the Cape Fear vicinity, and has remained active with landings recorded for most seasons.

## CHAPTER III

### THE RESOURCE

Menhaden, Genus Brevoortia, and other clupeid fishes similar to menhaden, namely of the genera Ethmalosa and Ethmidium, occur in three geographically separate areas of the world. Six species of menhaden are distributed in certain parts of the western Atlantic Ocean, including the Gulf of Mexico, from Nova Scotia to Argentina. Two species of Ethmidium are found in the eastern Pacific Ocean from Mexico to Peru. Ethmalosa occurs in the coastal waters of the eastern Atlantic Ocean from Senegal to Angola. A general world survey of the distribution of menhaden and menhaden-like fishes is provided in Table 1. It is important to note the two non-menhaden fishes because: 1) a large industrial fishery is conducted for Ethmalosa, and there is potential for an industrial fishery in connection with Ethmidium;<sup>1</sup> and 2) the misconception that menhaden occur in Peruvian and west African waters needs to be corrected.

#### Atlantic and Gulf Coasts

##### Geographical distribution and migrations

Four species of menhaden are recognized in North American waters. Along the Atlantic coast Brevoortia tyrannus, the Atlantic

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<sup>1</sup>U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Annotated Bibliography on Biology of Menhadens and Menhadenlike Fishes of the World, by John W. Reintjes, Fishery Bulletin, Vol. 63, No. 3 (Washington: Government Printing Office, 1964), p. 532.

TABLE 1  
 MENHADEN AND MENHADENLIKE FISHES  
 BY GEOGRAPHICAL AREAS

Scientific name	Common name	Area
<u>Brevoortia tyrannus</u>	Atlantic menhaden	Atlantic Coast of North America from Nova Scotia to Florida.
<u>Brevoortia smithi</u>	Yellowfin menhaden	Atlantic Coast of the United States and Gulf of Mexico from North Carolina to Louisiana.
<u>Brevoortia patronus</u>	Gulf menhaden	Gulf of Mexico from Florida to Mexico.
<u>Brevoortia gunteri</u>	Finescale menhaden	Gulf of Mexico from Alabama to Mexico.
<u>Brevoortia pectinata</u>	Lacha or savelha	Atlantic Coast of South America from Brazil to Argentina..
<u>Brevoortia aurea</u>	Lacha or savelha	Atlantic Coast of South America from Brazil to Argentina.
<u>Ethmidium chilcae</u>	Machete, machuela, or trite.	Pacific Coast of South America from Peru and Chile.
<u>Ethmidium maculatum</u>	Machete, machuela, or trite.	Pacific Coast of Central and South America from Mexico to Peru.
<u>Ethmalosa fimbriata</u>	West African shad or bonga.	Atlantic Coast of West Africa from Senegal to Angola.

Source: U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Annotated Bibliography on Biology of Menhadens and Menhadenlike Fishes of the World, by John W. Reintjes, Fishery Bulletin, Vol. 63, No. 3 (1964), p. 532.



menhaden, ranges the more temperate waters from Nova Scotia to the east central coast of Florida.<sup>2</sup> Brevoortia smithi, the yellowfin menhaden, occurs in the warmer waters from North Carolina to Louisiana, although they are common only in the coastal waters of Florida.<sup>3</sup> In the Gulf of Mexico, the large-scaled Gulf menhaden, Brevoortia patronus, occurs in the more temperate waters from Tampa Bay, Florida to Brazos Santiago, Texas.<sup>4</sup> In the warmer waters the fine-scaled menhaden, Brevoortia gunteri, "ranges from Mississippi to the Gulf of Campeche, Mexico."<sup>5</sup> Thus, there is an overlapping of the distribution of the three species occurring in the Gulf of Mexico, with all three menhaden present in the waters around Chandeleur Sound, Louisiana.<sup>6</sup>

Atlantic menhaden, Brevoortia tyrannus, constitute the great resource of the menhaden fishery of the Atlantic coast. These fish follow a most interesting migration pattern, which has been described by June and Reintjes:

Atlantic menhaden undertake extensive migrations. There is a northward movement in spring, following which the smaller and younger fish are found in the southern part of the range and progressively larger and older fish occur in each more northerly latitude. Furthermore, there is a tendency for fish of similar

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<sup>2</sup> John W. Reintjes, "Continuous Distribution of Menhaden Along the South Atlantic and Gulf Coasts of the United States," Proceedings of the Gulf and Caribbean Fisheries Institute, November 1959, p. 31.

<sup>3</sup> Dahlberg, p. 2.

<sup>4</sup> J. Y. Christmas and Gordon Gunter, "Distribution of Menhaden, Genus Brevoortia, in the Gulf of Mexico," Transactions of the American Fisheries Society, Vol. 89, No. 4 (1960), p. 338.

<sup>5</sup> Dahlberg, p. 2.

<sup>6</sup> Christmas and Gunter, p. 341.

size and age to occur together in a given locality, but remain separated from those of overlapping sizes and ages in adjacent localities. Thus, a north-south gradient in size and age becomes established, with the larger and older fish found farther northward.

A southward movement of the fish takes place in the autumn. Prior to their withdrawal from the summer grounds, the fish congregate in large schools comprised of many millions of individuals. Such large schools appear along the coast of North Carolina in November. These schools disappear in the vicinity of Cape Fear, N.C. in December.<sup>7</sup>

Gulf menhaden, Brevoortia patronus, do not have a migration pattern similar to the Atlantic menhaden. In the warm summer months these fish, which make up by far the greatest amount of the Gulf menhaden fishery's catch, appear congregated in immense schools along the shallow Gulf coast. The greatest concentration is usually located in the waters about the Mississippi River delta. In the autumn the fish leave the coastal waters. Knowledge of where the menhaden go during the winter is lacking.<sup>8</sup>

#### Fishing areas and seasons

The fishing areas and seasons for menhaden are highly correlated with the seasonal migrations and availability of the fish.<sup>9</sup> Along the Atlantic coast the earliest fishing season begins in the South

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<sup>7</sup>Fred C. June and John W. Reintjes, "A Status Report on the Atlantic Menhaden (Brevoortia tyrannus)," Atlantic States Marine Fisheries Commission, Species Report, September, 1962, p. 2.

<sup>8</sup>U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, The Menhaden Fishery of the United States, p. 8.

<sup>9</sup>John W. Reintjes, "Continuous Distribution of Menhaden Along the South Atlantic and Gulf Coasts of the United States," p. 31.

Atlantic area during late March and continues until December or January. The fishing region of the South Atlantic fisheries ranges over the waters of the continental shelf from Cape Kennedy to the North Carolina-Virginia line (see Map 3). Two distinct seasons are apparent in the South Atlantic. The summer fishery is conducted from late March or early April to the middle of October.<sup>10</sup> The fall fishery is conducted only along the coast of North Carolina, and lasts from the middle of October through December.<sup>11</sup>

The Chesapeake Bay fishing region consists of "Chesapeake Bay proper and coastal waters outside the Bay lying between False Cape and Great Machipongo, Va." (see Map 3).<sup>12</sup> Beginning in April menhaden are captured by the pound net technique in the Chesapeake Bay. Although the pound nets are set up primarily to entrap other fish, menhaden often constitute the greatest percentage of the catch.<sup>13</sup>

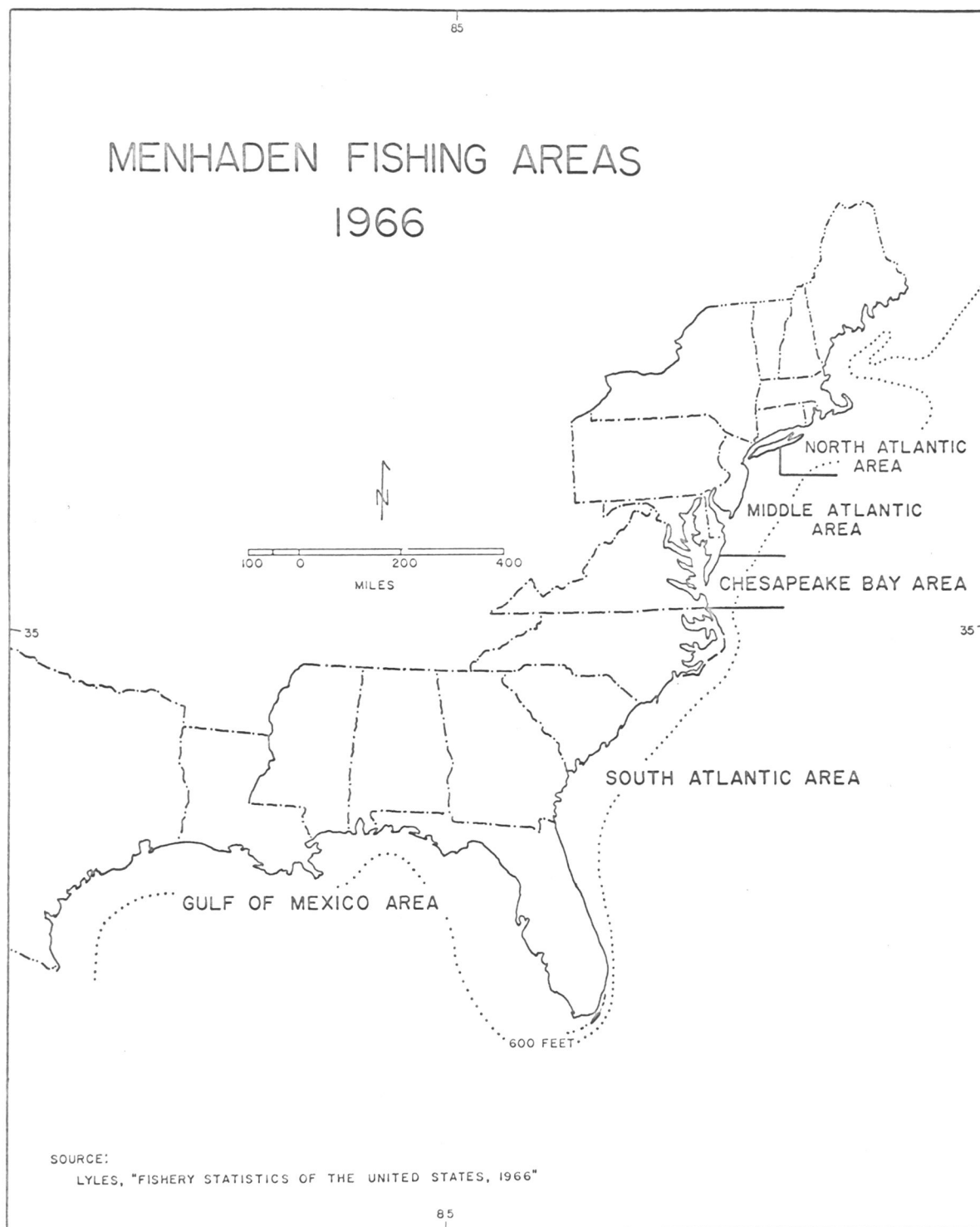
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<sup>10</sup>U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Age and Size Composition of the Menhaden Catch Along the Atlantic Coast of the United States, 1958, With a Brief Review of the Commercial Fishery, by Fred C. June and William R. Nicholson, Special Scientific Report No. 446 (Washington: Government Printing Office, 1964), pp. 3-4.

<sup>11</sup>U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Distribution of Fishing by Purse Seine Vessels for Atlantic Menhaden, 1955-59, by Charles M. Roithmayr, Special Scientific Report No. 434 (Washington: Government Printing Office, 1963), p. 4.

<sup>12</sup>Ibid.

<sup>13</sup>J.L. McHugh, "The Pound-Net Fishery in Virginia; Part 2-- Species Composition of Landings Reported as Menhaden," Separate-- Commercial Fisheries Review, Vol. 22, No. 2 (February, 1960), p. 5.



Map 3

From late May until the end of October menhaden are taken in immense quantities by the purse seine fishery.<sup>14</sup>

The coastal waters lying between Great Machipongo Inlet, Virginia, and Moriches Inlet, Long Island, are designated as the Middle Atlantic region (see Map 3).<sup>15</sup> In this area menhaden are taken by a pound net fishery beginning in April. A purse seine fishery is conducted for Atlantic menhaden from May until the middle of October.<sup>16</sup>

The North Atlantic area consists of "waters along the southern coast of Long Island, east of a line due south of Moriches Inlet, Long Island Sound, and waters northward" (see Map 3).<sup>17</sup> A purse

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<sup>14</sup>U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Age and Size Composition of the 1960 Menhaden Catch Along the U.S. Atlantic Coast, With a Brief Review of the Commercial Fishery, by William R. Nicholson and Joseph R. Higham, Jr., Special Scientific Report No. 479 (Washington: Government Printing Office, 1964), p. 3.

<sup>15</sup>U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Distribution of Fishing by Purse Seine Vessels for Atlantic Menhaden, 1955-59 (Washington: Government Printing Office, 1963), p. 4.

<sup>16</sup>U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Age and Size Composition of the Menhaden Catch Along the Atlantic Coast of the United States, 1961, With a Brief Review of the Commercial Fishery, by William R. Nicholson and Joseph R. Higham, Jr., Special Scientific Report No. 495 (Washington: Government Printing Office, 1965), p. 4.

<sup>17</sup>U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Distribution of Fishing by Purse Seine Vessels for Atlantic Menhaden, 1955-59, (Washington: Government Printing Office, 1963), p. 4.

seine fishery is conducted in the coastal waters of this northern area from the end of May through October.<sup>18</sup>

In the Gulf of Mexico, menhaden are captured by a purse seine fishery from May until October, with July and August being the period of concentrated fishing. The fishing grounds consist of the inshore waters ranging "along a relatively short stretch of the northern Gulf Coast from Sabine Pass on the Texas and Louisiana border eastward to Alabama" (see Map 3).<sup>19</sup>

#### Factors affecting distribution

Concerning the factors affecting the distribution of menhaden, June has stated:

Although the effect of oceanographic factors on the availability of menhaden has not yet been clearly demonstrated, fishery scientists believe that the varying seasonal and geographical distribution of the schools depends upon prevailing hydrographic conditions.<sup>20</sup>

Although there is no complete answer for the distribution of menhaden, several explanations have been presented in recent years. Dahlberg has stated that the Atlantic and Gulf menhaden (Brevoortia tyrannus, and Brevoortia patronus) "were probably a single continuous population

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<sup>18</sup>U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Age and Size Composition of the Menhaden Catch Along the Atlantic Coast of the United States, 1962, With a Brief Review of the Commercial Fishery, by William R. Nicholson and Joseph R. Higham, Jr., Special Scientific Report No. 527 (Washington: Government Printing Office, 1966), p. 4.

<sup>19</sup>June, "The Menhaden Fishery," p. 149.

<sup>20</sup>Ibid., p. 148.

before they were isolated by the emergence (probably more than once) of the Florida peninsula."<sup>21</sup>

The continental shelf appears to be an important factor in the areal pattern assumed by menhaden, particularly during the summer months. Roithmayr has stated that "during the warmer months, the fish congregate in schools which are found in greater concentrations in waters of less than 20 fathoms overlying the inner third of the Continental Shelf."<sup>22</sup>

Presently it is believed that estuaries are a major factor in the distribution of menhaden. After hatching in the Atlantic Ocean or the Gulf of Mexico the menhaden larvae go into estuaries and remain there for over half of their first year.<sup>23</sup> Larvae generally enter the estuaries during the late winter and spring months. "Between Cape Canaveral and Cape Cod there are approximately thirty-eight estuarine systems which are known to provide an environmental link in the life history and biology of the Atlantic menhaden (Brevoortia tyrannus)."<sup>24</sup>

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<sup>21</sup>Dahlberg, p. 68.

<sup>22</sup>U.S., Department of the Interior, Fish and Wildlife Service Bureau of Commercial Fisheries, Distribution of Fishing by Purse Seine Vessels for Atlantic Menhaden, 1955-59 (Washington: Government Printing Office, 1963), p. 2.

<sup>23</sup>John W. Reintjes and Anthony L. Pacheco, "The Relation of Menhaden to Estuaries," American Fisheries Society, Special Publication No. 3, 1966, p. 50.

<sup>24</sup>Fred C. June and J. Lockwood Chamberlin, "The Role of the Estuary in the Life History and Biology of Atlantic Menhaden," Proceedings of the Gulf and Caribbean Fisheries Institute, 11th Annual Session, 1958, p.41.

According to Pacheco and Grant, menhaden "larvae and juveniles have been reported in nearly every river system along the Atlantic coast of the United States from Maine to Florida."<sup>25</sup> In connection with estuaries, another factor important in the distribution of menhaden is the availability of food. "During the warm months, the fish are caught in greater numbers in the vicinity of major estuarine systems where the microscopic plants and animals upon which they feed are in rich supply."<sup>26</sup>

Surface temperature of coastal waters seems to be a major factor in the migration pattern of menhaden. Concerning this factor, Gunter and Christmas have stated:

It has been generally agreed that temperature governs the north and south migrations of menhaden and that menhaden do not enter waters of temperatures less than 50° F. . . . Goode (1879) collected temperature records along the coast and compared them with the time of appearance of the menhaden. This information led him to state that menhaden appeared after the water temperatures rose to 50° to 51° F. and preferred temperatures between 60° and 70°.<sup>27</sup>

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<sup>25</sup>U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Studies of the Early Life History of Atlantic Menhaden in Estuarine Nurseries; Part 1--Seasonal Occurrence of Juvenile Menhaden and Other Small Fishes in a Tributary Creek of Indian River, Delaware, 1957-58, by Anthony L. Pacheco and George C. Grant, Special Scientific Report No. 504 (Washington: Government Printing Office, 1965), p. 1.

<sup>26</sup>June and Reintjes, "A Status Report on the Atlantic Menhaden (Brevoortia tyrannus)," p. 4.

<sup>27</sup>U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, A Review of Literature on Menhaden With Special Reference to the Gulf of Mexico Menhaden, Brevoortia Patronus Goode, by Gordon Gunter and J.Y. Christmas, Special Scientific Report No. 363 (Washington: Government Printing Office, 1960), p. 11.



Undoubtably many other factors, such as water salinity, have an affect on menhaden. However, there is a general lack of information concerning the factors behind the distribution and migrations of menhaden. June and Reintjes have stated:

Relatively little is known of the relation between environmental factors and the distribution, behavior, and survival of the fish. Seasonal differences in the schooling of the fish occur, but causes of year to year variations in the distribution and movements of the schools remain obscure.<sup>28</sup>

#### North Carolina

Menhaden have been known to frequent the waters of North Carolina since early colonial times<sup>29</sup> and have been shown to have supported a fishery since the late 1880's.<sup>30</sup> By the early part of this century menhaden were considered to be "one of the most valuable of the North Carolina fishes,"<sup>31</sup> and in recent years have been considered to be "by far the most important species of finfish produced in North Carolina both in quantity and value."<sup>32</sup> In 1966 (the latest year for

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<sup>28</sup>June and Reintjes, "A Status Report on the Atlantic Menhaden (Brevoortia tyrannus)," p. 4.

<sup>29</sup>John Lawson, p. 160.

<sup>30</sup>U.S., Fish Commission, "Report on the Fisheries of the South Atlantic States," by Hugh M. Smith, p. 305.

<sup>31</sup>Joseph H. Pratt, "The Fisheries of North Carolina," Journal of the Elisha Mitchell Scientific Society, Vol. 32, No. 4(April, 1917), p.159

<sup>32</sup>George M. Woodward, Commercial Fisheries of North Carolina: An Economic Analysis (Chapel Hill: University of North Carolina Press, 1956), p. 45.

which complete statistics are available) menhaden maintained the highest position in both quantity and value, with over 180 million pounds (approximately 72 per cent of all fish caught in North Carolina) valued at over two and one half million dollars (approximately 26 per cent of the total value of all Tar Heel fish).<sup>33</sup> This vast menhaden resource consists of two different species: the Atlantic menhaden, Brevoortia tyrannus, and the yellowfin menhaden, Brevoortia smithi.<sup>34</sup> However, of the two species of menhaden which are found in North Carolina waters, it is the Atlantic menhaden which makes up almost entirely the large annual catches of the Tar Heel fishery.<sup>35</sup> In fact, yellowfin menhaden are seldom encountered in Tar Heel waters. While it is a scientific truism that the yellowfin species inhabits the coastal waters from North Carolina to Florida, only a few scattered specimens have been taken in the State in recent years.<sup>36</sup>

#### Distribution

In recent years William Ellison has described the distribution and migrations of Atlantic menhaden, Brevoortia tyrannus, in the coastal

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<sup>33</sup>U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Fishery Statistics of the United States, 1966, by Charles H. Lyles, Statistical Digest No. 60 (Washington: Government Printing Office, 1968), pp. 248-249.

<sup>34</sup>U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Annotated Bibliography of Menhaden and Menhadenlike Fishes of the World, p. 532.

<sup>35</sup>U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, The Menhaden Fishery of the United States, pp. 1-2.

<sup>36</sup>John W. Reintjes, private interview held at the Bureau of Commercial Fisheries Biological Laboratory, Pivers Island, Beaufort, North Carolina, August 29, 1969.

waters of North Carolina. Menhaden are abundant in Tar Heel waters for ten months, April through January, and there is some evidence that menhaden are abundant in February and March, although the data are not conclusive.<sup>37</sup>

Atlantic menhaden, Brevoortia tyrannus, migrate along the North Carolina coast in a pattern similar to and in conjunction with the north-south movement of menhaden along the Atlantic coast. Early in spring a run of menhaden generally strikes the coast of South Carolina near Georgetown, and proceeds northward paralleling the coast. These "Georgetown-flats fish," as they are known in North Carolina, consist of specimens ranging from six to eight inches in length. Beginning in May, or sometimes as early as April, the first wave of menhaden strikes the coast of North Carolina. These fish, believed to have originated off the Florida coast, move into Tar Heel waters from the south, and remain there until August.

A "fall run" of menhaden, Brevoortia tyrannus, made up of two different groups strikes the coast of North Carolina about the middle of October. One group of fish moves in from the north, and a second group moves out from the near-by sounds and estuaries. These fish, known in North Carolina as "Chesapeake Bay" fish, "holy jumpers," or "forerunners," range ten to twelve inches in length. This first wave lasts about a month. About the middle of November a second wave of menhaden, Brevoortia tyrannus, known as the "Delaware" fish, comes into

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<sup>37</sup>Ellison, pp. 94-95.

local waters. These fish, ranging from thirteen to sixteen inches in length, remain in local waters for two or three weeks. About Thanksgiving or the end of November, a third wave of menhaden, Brevoortia tyrannus, known as the "Boston Bay" or "Amagansett" fish, strikes the coast. These fish are the largest of the fall run, ranging from sixteen to twenty inches. However, after this run of large fish, a fourth wave of menhaden comes into Tar Heel waters. Appearing in December, this final group is made up of the smallest size fish, with individuals ranging from two to ten inches. No information is available on the source or destination of these fish.<sup>38</sup>

A Beaufort fish meal and oil manufacturer, William H. Potter, has described the seasonal migration pattern of menhaden as is currently observed in North Carolina waters. A spring advance of fish usually begins in May or sometimes in April, and consists of two main groups, one menhaden and the second thread herring. The first group, made up of menhaden, migrates northward from Florida into Bogue, Core and Pamlico sounds (see Map 4). These "Florida run" fish remain in the sounds until early September. With the coming of the first days of autumn weather, known locally as a "mullet shift," the Florida run fish leave the sounds and migrate south. At this same time, a second group of fish, composed of thread herring or "hairy backs" as they are known locally, comes into North Carolina waters from the north. Remaining in the coastal waters until October, these fish are exploited by the local menhaden fishery.

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<sup>38</sup>Ellison, p. 94.

The fall advance of menhaden begins about the middle of October when the surface waters north of Cape Hatteras and in the Chesapeake Bay drop below 50° F. The first fish of the season, called "forerunners," come in from the north. In November the second group of fish, made up of individuals called "Mammy shad" by the native people, comes in from the north and ranges throughout the coastal waters from the North Carolina-Virginia state line to the North Carolina-South Carolina line. The fall migration lasts until the end of December. A final short migration lasts for about two weeks in January. During this time the small fish which are late leaving the coastal waters begin disappearing and are usually gone by the middle of January.<sup>39</sup>

#### Fishing seasons and areas

The fishing seasons for menhaden are highly correlated with the migrations and availability of the fish. The exact times of the year when the menhaden migrate into and emigrate out of North Carolina waters vary each season. Sometimes the first fish come as early as April and the last leave as late as the middle of January. As has been shown the reasons behind the fluctuations are not completely understood. In the North Carolina fishery there are actually two separate and distinct fishing seasons, dependent on the two main migrations of menhaden, known locally as the "spring" and "fall" runs.<sup>40</sup>

The spring fishery begins in May, or sometimes in April, and lasts until August. This fishing period corresponds to the arrival

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<sup>39</sup>William H. Potter, private interview held at Beaufort Fisheries, Incorporated, Beaufort, North Carolina, November 20, 1967.

<sup>40</sup>Ellison, pp. 93-95.

and departure of the "Georgetown-flats" fish, which are the principal types captured during this period.<sup>41</sup> Although the fishing areas vary from season to season, the spring fishery is carried on in both inshore and outside waters along the Tar Heel coast. Core Sound is the most frequented inshore area, with landings recorded from May through the middle of August (see Map 4). Bogue Sound is also a popular inshore fishing area. Outside fishing is conducted in the ocean between Cape Hatteras and Ocracoke. In addition to this important area, outside fishing is also conducted in the vicinity of Cape Lookout and the Cape Fear River.<sup>42</sup>

The fall fishery corresponds with the arrival and departure of the "fall run" fish. Fishing usually begins about the middle of October and lasts until the end of December, sometimes finishing in January. This is the only fall fishery for menhaden.<sup>43</sup> The primary fishing area ranges between Cape Hatteras and Cape Lookout, with the waters around Drum and Ocracoke Inlets being areas of specific importance (see Map 4). Fishing is also concentrated between Beaufort and Cape Fear Inlets, with the waters off Beaufort and Cape Fear being areas of intense activity.<sup>44</sup>

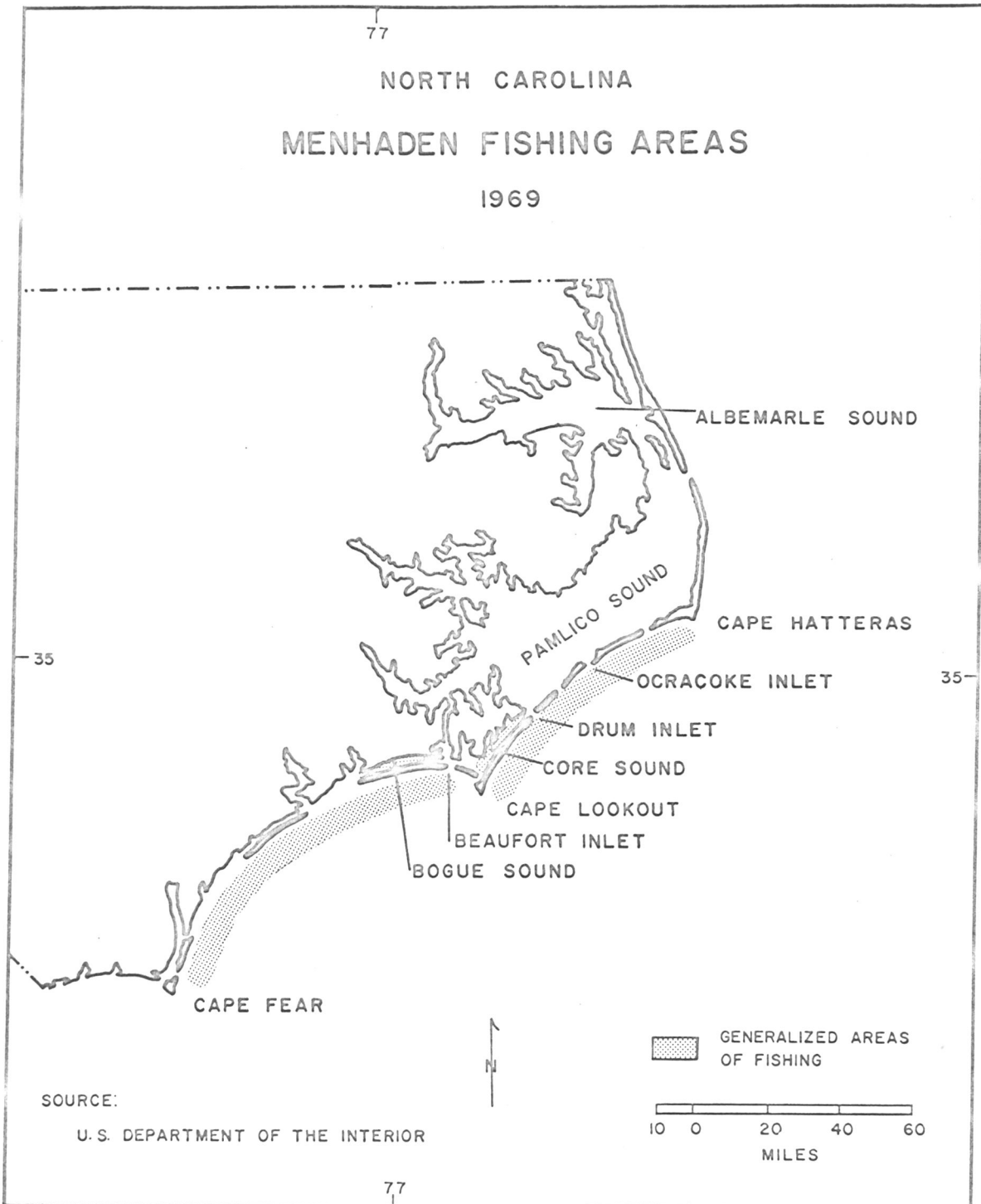
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<sup>41</sup>U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Age and Size Composition of the Menhaden Catch Along the Atlantic Coast of the United States, 1961, p. 3.

<sup>42</sup>U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Age and Size Composition of the 1960 Menhaden Catch Along the U.S. Atlantic Coast, pp. 3-4.

<sup>43</sup>Ellison, pp. 94-95.

<sup>44</sup>U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Age and Size Composition of the Menhaden Catch Along the Atlantic Coast of the United States, 1961, p.4.



Map 4

### Factors influencing distribution and migrations

It is generally believed by fishery scientists that menhaden appear in coastal areas when the water temperature reaches 50° F. on the surface. An average monthly temperature of 50° F. or more is experienced in North Carolina coastal waters throughout the year. According to Ellison, "menhaden are year-round inhabitants"<sup>45</sup> off the North Carolina coast.

Another factor that might influence the distribution of menhaden along the Tar Heel coast is the presence of a large number of estuaries. Certainly, the vast estuaries of the Pamlico, Neuse, and Cape Fear rivers provide excellent nursing areas for the young menhaden. In addition to these large estuaries, the Tar Heel coast has numerous smaller estuaries, such as those associated with the Roanoke, Chowan, Newport, and New rivers. Not only do these areas provide nurseries for the young menhaden, the estuaries provide food, another major factor, for the migratory fish.<sup>46</sup>

Certainly, other factors are involved in the distribution and migration of menhaden along the coast of North Carolina. However, more research needs to be completed before any definite conclusions can be made.

### Summary

Six species of menhaden, Genus Brevoortia, range from Nova Scotia to Argentina in the western Atlantic Ocean. Of the four

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<sup>45</sup>Ellison, p. 95.

<sup>46</sup>Nelson Marshall, "Hydrography of North Carolina Marine Waters," in Survey of Marine Fisheries of North Carolina ed. by Harden F. Taylor (Chapel Hill: University of North Carolina Press, 1951), pp. 64-65.



North American varieties, the two most abundant species, Brevoortia tyrannus in the more temperate Atlantic waters and Brevoortia patronus in the cooler Gulf of Mexico waters, constitute the major resource of the vast United States menhaden industry. These two most important migratory species appear in the shallow waters over the Continental Shelf as the surface water warms with the coming of summer weather. Along the Atlantic coast the earliest fishing begins in the South Atlantic area, with each more northerly area starting a little later in the year. This progression corresponds to the arrival of the menhaden in their northward migration each spring. In the fall the progression is reversed, correlating with the withdrawal of the fish from the cooler northern areas. The fishing seasons end first in the higher latitudes, with each more southerly area having a later closing date. The Atlantic coast fishery ends each year with the exploitation of the North Carolina fall run of Brevoortia tyrannus.

Menhaden have been known to enter North Carolina waters since colonial times. Although two species are listed as inhabitants of Tar Heel waters, only Brevoortia tyrannus is common to the area. This migratory fish comes in immense schools into the area during two separate and distinct periods. Each spring the first run lasts from May until September, and each fall the second run lasts from about the middle of October to January. Brevoortia tyrannus constitutes virtually the entire catch of menhaden in North Carolina. Corresponding to the migration pattern of that species, the State's menhaden industry is composed of two separate fisheries, one utilizing

the southern fish during spring and the other exploiting the northern fish in the fall. While the spring fishery is principally an inshore operation, the fall fishery is predominantly an ocean activity. Thus, North Carolina is the only area that experiences two different menhaden seasons, one in the spring and another in the fall, with the latter being the only fall menhaden operation anywhere.

## CHAPTER IV

### THE FISHERY

#### Atlantic and Gulf Coasts

The capturing of menhaden (Brevoortia tyrannus) for commercial purposes has been described as "the greatest pelagic fishery of the Americas."<sup>1</sup> Although a number of different fishing methods are employed in this fishery, two basic factors must be met in virtually every method used. Concerning these factors, Morgan has stated:

the habits of most pelagic species are such that at certain times they are normally near the surface. Catching them therefore involves, firstly, finding the area in which they are in sufficient quantity, and, secondly, using a device operating on or near the surface to catch them.<sup>2</sup>

Complying with these conditions, the two main fishing methods used in commercial menhaden fishing are: 1) the purse seine method, and 2) the pound net method. Of the two methods, the purse seine is by far the most important method. Several minor techniques are also used in this fishery.<sup>3</sup>

#### The purse seine method

"Since the inception of the large-scale menhaden reduction industry in about 1850, purse seines have been the principal means of supplying the huge quantities of fish required by the plants."<sup>4</sup>

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<sup>1</sup>Morgan, p. 226.

<sup>2</sup>Ibid., p. 105.

<sup>3</sup>June, "The Menhaden Fishery," p. 148.

<sup>4</sup>Ibid.

Morgan described the purse seine as:

another "curtain" type net, hung between surface floats and weights along its foot. It possesses a purse line, which is a stout rope threaded through eyes along the foot of the net. When the school is surrounded, this purse line is hauled on by a winch, thus closing or "pursing" the bottom of the net at the same time as it draws it in to a small area beside the vessel. The fish are thus trapped completely.<sup>5</sup>

(See Diagram 1 for a schematic representation of a purse seine.) These purse seines are made of 1 3/4-inch webbing, with nylon being used in place of cotton or linen in recent years. Although there are several sizes, seines on the average run about 200 feet in length and 60 feet in depth.<sup>6</sup> Over 98 per cent of the annual catch is landed with purse seines.<sup>7</sup> A detailed description of purse seine fishing will be given in the North Carolina section of this chapter.

In 1966 approximately 1.3 billion pounds of menhaden were captured with purse seines. Fishing by this method was conducted in waters along the Atlantic and Gulf coasts, namely in the states of New York, New Jersey, Delaware, Maryland, Virginia, North Carolina, Florida, Mississippi, Louisiana, and Texas.<sup>8</sup>

#### The pound net method

Although the number of menhaden taken in pound nets is extremely small in relation to the numbers taken in purse seines, pound nets account

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<sup>5</sup>Morgan, p. 115.

<sup>6</sup>June, "The Menhaden Fishery," p. 150.

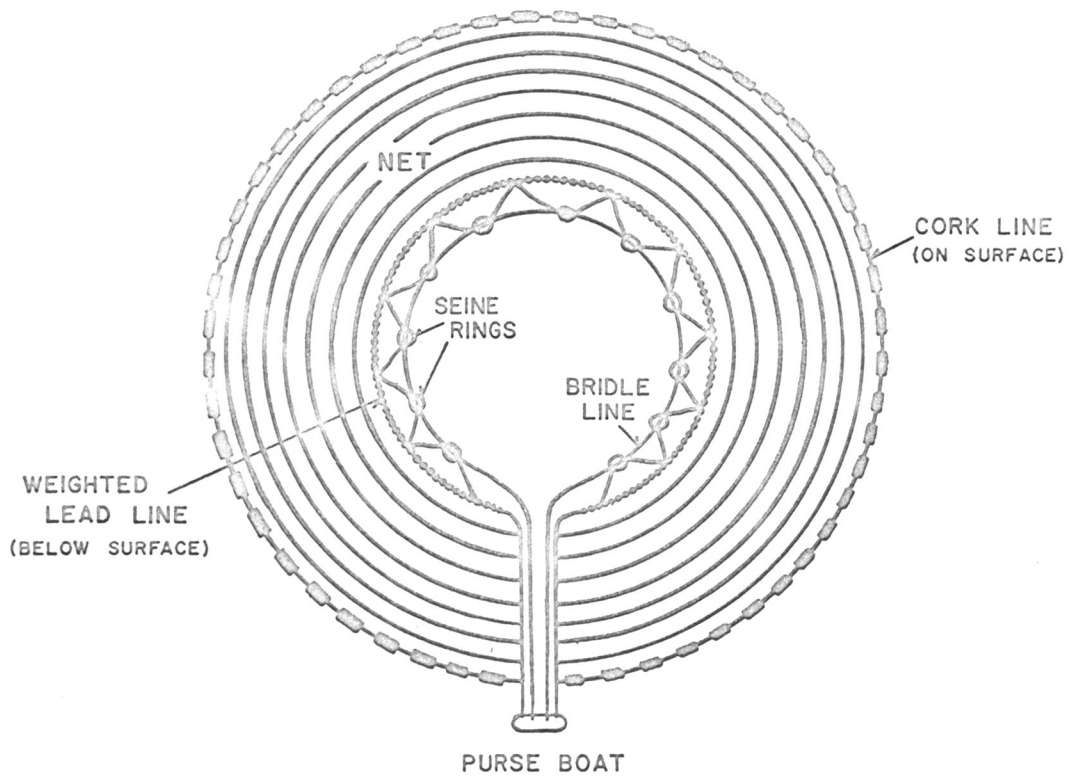
<sup>7</sup>Ibid.

<sup>8</sup>U.S. Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Fishery Statistics of the United States, 1966, p. 488.

FIGURE 2.

# PURSE SEINE

(TOP VIEW)



SOURCE: MORGAN, WORLD SEA FISHERIES, 1956

for fairly large numbers of menhaden, particularly in the Chesapeake Bay.<sup>9</sup> During early spring menhaden are also taken in a pound net fishery along the coast of Long Island. Reduction plants receive most of the pound net catches, but "large quantities are sold for bait."<sup>10</sup> Concerning the pound net, Reid has stated:

Throughout the years since the introduction of the pound net into Virginia, the basic pattern or design has remained rather constant. The fundamental principle is that of a large bag or netting for impounding, and a series of nets hung from poles to divert the fish into the pound . . . The basic components of a pound net . . . consist of a rectangular or squared bowl, or "head," which is the actual impounding structure, heart-shaped "bays" which concentrate and direct the fish toward the head, and finally, a leader, or "hedging," which turns the fish toward the bays and head.<sup>11</sup>

(See Diagram 2 for a schematic representation of a pound net).

In the Chesapeake Bay pound nets are used to capture menhaden, although many other species are caught in conjunction with the menhaden. Nevertheless, the catches are dominated by young menhaden, and are "used principally as bait for crab pots."<sup>12</sup>

In 1966 pound nets were used to capture over 23 million pounds of menhaden. This technique was used in the Atlantic Coast states of Massachusetts, New York, New Jersey, Maryland, Virginia, and

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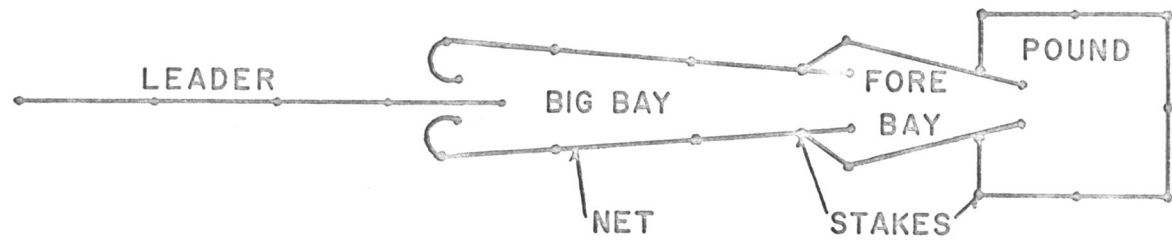
<sup>9</sup>Ibid., p. 236.

<sup>10</sup>June and Reintjes, "A Status Report on the Atlantic Menhaden (Brevoortia tyrannus)," p. 5.

<sup>11</sup>George Reid, "The Pound-Net Fishery in Virginia; Part 1-- History, Gear Description, and Catch," Commercial Fisheries Review-- Separate, Vol. 17, No. 5 (May, 1955), p. 7.

<sup>12</sup>U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, The Menhaden Fishery of the United States, p. 5.

# POUND NET (TOP VIEW)



SOURCE: DUNBAR, HISTORICAL GEOGRAPHY  
OF THE NORTH CAROLINA OUTER BANKS, 1955

10 0 10 20 30  
FEET

FIGURE 3.

North Carolina. Virginia accounted for by far the greatest poundage with over seventeen million.<sup>13</sup>

#### Minor techniques

Menhaden are taken in relatively very small quantities by a number of methods. Including the menhaden caught in pound nets, several minor techniques, namely those associated with haul seines, fyke and hoop nets, gill and trammel nets, floating traps, and otter trawls, accounted for only two per cent of the total catch of menhaden in 1966.<sup>14</sup> One or more of these methods was used in each of the following states: Rhode Island, Connecticut, New York, New Jersey, Maryland, Virginia, North Carolina, South Carolina, and Florida (east and west coast).<sup>15</sup>

#### Geographical distribution of reduction plants

"The fishing grounds and the location of plants for processing the catch are determined by the seasonal occurrence and abundance of the fish."<sup>16</sup> According to the Fishery Statistics of the United States, 1963, for example, the geographical distribution of menhaden landed along the Atlantic and Gulf coasts was as follows:

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<sup>13</sup>U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Fishery Statistics of the United States, 1966, p. 489.

<sup>14</sup>Ibid., p. 486.

<sup>15</sup>Ibid., pp. 488-489.

<sup>16</sup>Reintjes, "Continuous Distribution of Menhaden Along the South Atlantic and Gulf Coasts of the United States," p. 31.



Of the total, 53 per cent was landed in the Gulf of Mexico; 21, in the Middle Atlantic States; 14, in the Chesapeake States; and 12 per cent in the South Atlantic States. Less than  $\frac{1}{2}$  of one per cent was taken in the New England States.<sup>17</sup>

The reduction plant, where the raw fish are converted to meal and oil, constitutes the primary market for landed menhaden. The raw fish are taken directly to the reduction plants or factories for processing, usually, within several hours of capture.<sup>18</sup> In 1963 the total menhaden catch was processed at thirty plants located in nine states. The distribution of menhaden plants, by city and state, was as follows: Amagansett, Long Island, New York; Port Monmouth, Tuckerton, and Wildwood, New Jersey; Lewes, Delaware (2); Reedville (4) and Whitestone, Virginia; Beaufort (4), Morehead City (2), and Southport (2), North Carolina; Fernandina Beach, Florida; Moss Point, Mississippi (3); Empire (2), Morgan City, Dulac, and Cameron (2), Louisiana; and Sabine Pass, Texas.<sup>19</sup>

#### North Carolina

In North Carolina the menhaden fishery is conducted almost exclusively with purse seines. For the five year period from 1962 through 1966 purse seines accounted for over 99 per cent of the

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<sup>17</sup>U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Fishery Statistics of the United States, 1963, p. 421.

<sup>18</sup>U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, U.S. Fish-Reduction Industry, p. 5.

<sup>19</sup>U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Firms Manufacturing Marine Animal Scrap, Meal, Oil, Solubles and Homogenized Condensed Fish, 1963, Scientific Leaflet--151 Revised (Washington: Government Printing Office, 1965).

menhaden catch each year.<sup>20</sup> Thus, since the purse seine fishery constitutes the most important part of the State's menhaden fishery, this report will be concerned primarily with that phase of the industry. Nevertheless, other phases of the State's menhaden fishery will not be neglected.

### The vessels

The menhaden vessels provide a link between the fishing grounds and the reduction plants. June has given an accurate description of the modern vessel:

The design of the carrier vessels has remained essentially unchanged since the early days of the industry. Basically, these vessels are laid out with a high bow, a low stern, a large fish hold amidships, and two houses, one forward and one aft of the fish hold. The forward housing includes a galley on the main deck and pilot house and officers' quarters above. Crew's quarters are below deck, beneath the forward house. The after housing encloses the main engine and auxiliary power equipment. A mast, with its conspicuous crow's nest and boom, is located just aft of the forward housing.<sup>21</sup>

Alverson has stated that the menhaden vessel is "the only American fishing vessel with this particular superstructure arrangement."<sup>22</sup>

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<sup>20</sup>U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Fishery Statistics of the United States, 1962, by E.A. Power and C.H. Lyles, Statistical Digest No. 56 (Washington: Government Printing Office, 1964), p. 189; Fishery Statistics of the United States, 1963, p. 201; Fishery Statistics of the United States, 1964, pp. 202-203; Fishery Statistics of the United States, 1965, pp. 281-282; Fishery Statistics of the United States, 1966, pp. 257-259.

<sup>21</sup>June, "The Menhaden Fishery," p. 149.

<sup>22</sup>Dayton L. Alverson, "Fishing Gear and Methods," in Industrial Fishery Technology, ed. by Maurice E. Stansby (New York: Reinhold Publishing Corporation, 1967), p. 58.

(See Figs. 2 and 3). Vessels operating in North Carolina waters range from about 50 to 600 gross tons in weight, and are highly specialized for this particular fishing activity.<sup>23</sup> During the fall fishing season, there is a migration of men and vessels into North Carolina. Most of these vessels and their crews come from the Chesapeake Bay area. However, vessels have been brought in for the fall season from as far north as New York and as far south as Mississippi.<sup>24</sup> (See Fig. 4).

#### The labor

Generally, a menhaden vessel will carry 17 fishermen made up of a captain, pilot, chief engineer, second engineer, cook, and 12 crew members. In the Beaufort-Morehead City fishery the locally owned vessels are crewed by fishermen from Carteret and Craven counties. However, during the fall fishery most of the labor force comes from around the Reedville and Kilmarnock areas of Virginia.<sup>25</sup>

#### The fishing method

Purse seines are used to catch the menhaden schools as they swim along the near-surface waters. The seine, small boats, crew, and other essential elements of the fishing operation are carried to the grounds in the large menhaden vessel. The actual fishing operation, however,

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<sup>23</sup>U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Fishery Statistics of the United States, 1966, p. 487.

<sup>24</sup>Survey conducted in November, 1967.

<sup>25</sup>William H. Potter, private interview held in Beaufort, North Carolina, November 20, 1967.

is not conducted from the mother vessel. The main purpose of the "steamer," as the mother vessel is known in the business, is three-fold: 1) transportation of the equipment and men to the grounds; 2) life support base for the crew; and 3) transportation of the men, equipment, and catch to the reduction plant. Two small aluminum boats, called purse boats, are used to carry the seine from the mother vessel to the menhaden school. It is from these purse boats that the actual fishing activity is accomplished.

On sighting a school of menhaden, the captain boards a purse boat and directs them to the fish. The purse seine is held and carried in two equal parts by the purse boats, which are secured together side by side (see Fig. 5). On reaching the school, the men begin laying the seine, while the purse boats move in a half circular direction opposite to each other until the school is entirely surrounded by the net (see Fig. 6). When the fish are encircled, a heavy lead weight called a "tom" is attached to the seine's bridle line and dropped overboard. Connected to a power winch, the bridle line is reeled in, causing the bottom of the seine to close like a "purse." The weight of the "tom" keeps the seine from being pulled up to the surface during winching. The seine is then attached to power-blocks, one to a purse boat, and is hauled in, compressing the school into an area which grows smaller and smaller until the entire body of fish is held in a very small space (see Fig. 7). The mother vessel then comes along side the net and the fish are pumped into the large central hold of the vessel by means of a large rubber hose (see Fig. 8). When the vessel is filled, or night falls, the day's fishing is completed

and the vessel returns to the reduction plant to unload the catch.<sup>26</sup>

One of the most important innovations in the purse seine fishery has been the use of airplanes to "spot" fish. On this matter June wrote:

Since about 1946, airplanes routinely have been used to locate the fish, and in recent years the practice of directing the laying of the seine around a school of menhaden from the air by radio communication between the airplane pilot and the fishing captain has been universally adopted.<sup>27</sup>

In North Carolina airplanes are used to spot the menhaden schools. During the 1967 season about twenty-five planes were used, one plane for every three vessels. Although no fishing is practiced on Sundays, airplanes are used to report the location of migrating schools.<sup>28</sup>

#### Marketing

Reduction plants, or menhaden factories, constitute the primary markets for the daily catch of menhaden. June has explained the marketing of menhaden:

Because of the large quantities in which the fish are caught and the rapidity with which they decompose, vessels generally return with the catch to the processing plant at the end of the day. Accordingly, the fish are usually landed at the plant within 10 to 15 hours after being taken from the water. Vessels equipped with refrigerated holds may remain at sea for several days, particularly when catches are running light, and still deliver the fish in satisfactory condition.<sup>29</sup>

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<sup>26</sup>U.S. Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, The Menhaden Fishery of the United States, p. 3.

<sup>27</sup>Ibid.

<sup>28</sup>William H. Potter, private interview held in Beaufort, North Carolina, November 20, 1967.

<sup>29</sup>June, "The Menhaden Fishery," pp. 151-152.

Roger Harrison has commented on the location of menhaden factories:

The factories are located as near the fishing grounds as practical. The buildings are generally built on banks of some creek, river, cove, or behind some natural windbreak, so that smooth water is assured the vessels at the unloading dock. It is essential that the unloading equipment be located on water deep enough to permit the vessels to come in at all times. As a result, parts of many factories and even entire factories have been put up on piling over the water; this also facilitates the dumping of waste water. Where the factory has not been so constructed, the unloading or elevator house has been placed on deep water and the fish are conveyed back to the reducing equipment.<sup>30</sup>

(Note Fig. 9 for example of unloading facilities).

In North Carolina five large menhaden factories are located in the Beaufort-Morehead City area, and one large factory is located at Southport.<sup>31</sup> In the Morehead City area, two factories are located adjacent to each other along the shore of Bogue Sound. In Beaufort two factories are located on Taylor's Creek, and one factory is located on the Beaufort Channel of the Newport River (see Fig. 10). A small, cat food manufacturing plant, which utilizes menhaden captured from one vessel, is also located on the Channel (see Map 5).<sup>32</sup>

#### Minor fisheries

Menhaden have been recorded by several minor fisheries along the North Carolina coast. For example, during the 1966 season menhaden

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<sup>30</sup>U.S., Department of Commerce, Bureau of Fisheries, The Menhaden Industry, p. 16.

<sup>31</sup>U.S., Department of Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Firms Manufacturing Menhaden Products, p. 3.

<sup>32</sup>Field observation by the author.

were taken in haul seines, pound nets and gill nets. The total catch of 166,000 pounds was valued at less than \$2,500.<sup>33</sup>

#### Geographical distribution of catch

Over a ten-year period from 1957 through 1966 menhaden landings were recorded in nine North Carolina counties. Landings were concentrated in the two counties of Carteret and Brunswick. For the ten-year period Carteret County accounted for the vast majority of the total catch, approximately 77 per cent. For the same period of time Brunswick recorded about 22 per cent. The remaining 1 per cent was recorded in seven counties: from north to south; Chowan, Washington, Tyrell, Dare, Pamlico, Onslow, and New Hanover (see Map 6). During this ten-year period Carteret County recorded an average yearly catch of over 150 million pounds. For the same period, Brunswick recorded a yearly average of nearly 44 million pounds.

Total menhaden landings for the State came to nearly 2 billion pounds over the ten-year period. The largest single year catch amounted to over 235 million pounds, recorded in 1958; while the smallest annual catch was recorded at just over 122 million pounds during 1962. From 1957 through 1966 menhaden landings were recorded each year in both Carteret and Brunswick Counties.<sup>34</sup>

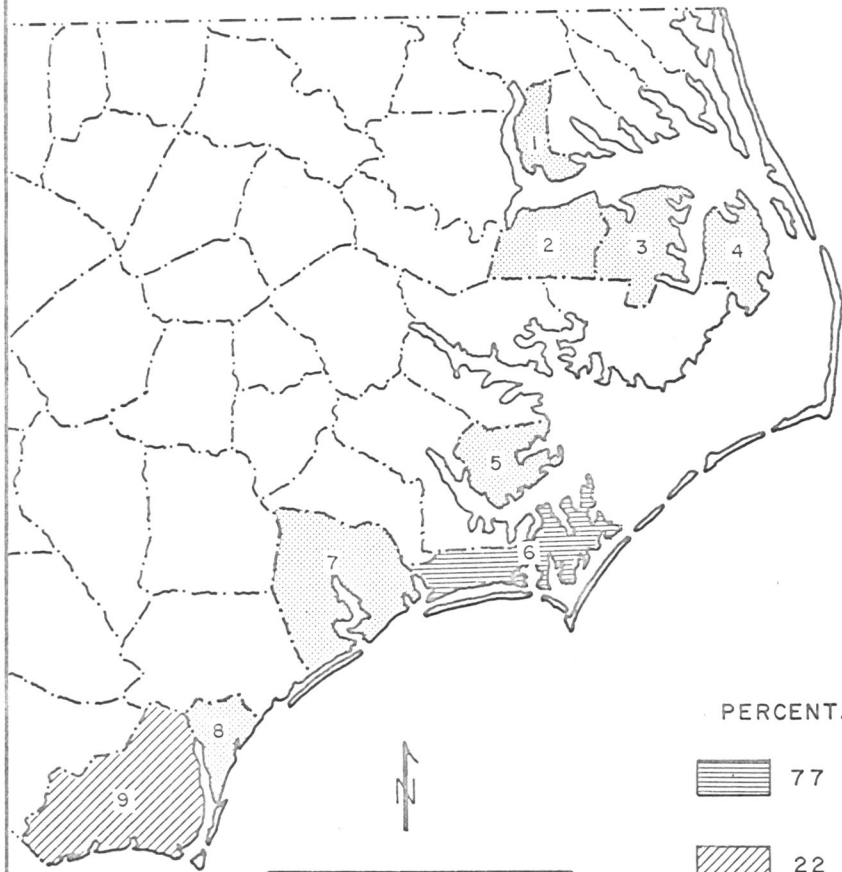
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<sup>33</sup>U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Fishery Statistics of the United States, 1966, pp. 488-489.

<sup>34</sup>U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, North Carolina Landings, 1957-1966 (Washington: Government Printing Office, 1957-66).

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# NORTH CAROLINA MENHADEN CATCH 1957-66



35

### PERCENTAGE BY COUNTIES

 77

 22

 1

- (1) CHOWAN
- (2) WASHINGTON
- (3) TYRRELL
- (4) DARE
- (5) PAMLICO
- (6) CARTERET
- (7) ONSLOW
- (8) NEW HANOVER
- (9) BRUNSWICK



SOURCE:

NORTH CAROLINA COMMERCIAL FISHING, 1957-66

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Map 6



### Summary

Since menhaden are schooling fish which swim in the near-surface waters, the most efficient method of fishing employs a type of net, known as a purse seine, which because of its design allows the bottom to be "pursed," thus completely entrapping the fish. This purse seine method has been used since the middle of the nineteenth century, and presently accounts for over 98 per cent of the annual catch. Although the purse seine fishery is by far the largest operation, menhaden are caught in a pound net fishery in Virginia and by several minor methods. Most menhaden are marketed directly at plants where the raw fish are then reduced to meal, oil and condensed solubles. These reduction plants are located in eight states along both the Atlantic and Gulf coasts.

North Carolina constitutes the major area for purse seine activities along the south Atlantic coast. The State has six large reduction plants; three at Beaufort, two at Morehead City and one at Southport. Carteret and Brunswick Counties account for approximately 99 per cent of the total landings. During the summer season menhaden are captured by local fishermen, but in the fall a large influx of men and vessels primarily from Virginia constitutes the last major purse seine fishery for menhaden each year. A single purse seine operation involves basically a large carrier vessel specifically designed for menhaden fishing, two aluminum purse boats and a small skiff from which the actual fishing activity takes place, and about seventeen fishermen. These elements are typical not only of the North Carolina fishery, but of all purse seine operations on the Atlantic and Gulf coasts.

## CHAPTER V

### PROBLEMS AND PROSPECTS

#### Atlantic and Gulf Coasts

Like any modern, complex industry the menhaden fishing industry has been experiencing a number of problems. These problems while interconnected may be classified into three main sections concerning: 1) the resource; 2) the fishery; and 3) foreign imports.

#### The resource

When the California sardine or pilchard suddenly disappeared in the late 1940's and that fishery all but collapsed, the menhaden fishery was just beginning its long period of domination in the fish meal industry, and was quick to take the lead in supplying the much-sought-after meal. "The result was that 8 out of 10 years in the flourishing fifties saw a new record set for the catch of menhaden."<sup>1</sup> During this period the menhaden resource was generally considered to be inexhaustible. One investigator, who "wondered if menhaden too would not decline in numbers as did the Pacific pilchard,"<sup>2</sup> received this reply from a menhaden fisherman: "I've been fishing for menhaden nearly 22 years, and instead of the fish decreasing in numbers they seem

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<sup>1</sup>Charles F. Lee, "Industrial Products Trends . . . Developments," Fishing Gazette, Reprint of 1961 Annual Review, p. 1.

<sup>2</sup>Roy, p. 823.

to be more abundant each season."<sup>3</sup> In 1953 Lee commented on the menhaden resource:

In spite of extreme local fluctuations in abundance, so far as is known, at no time in its existence has the menhaden fishery as a whole failed to the same extent that the pilchard fishery did just a few years back, or as has the herring and sardine fishery at intervals and in some areas throughout the world.

From the vantage point of 75 years of generally successful fishing, the dire predictions made in the 1870's of ruin to the industry from overfishing or by predatory species may seem amusing.<sup>4</sup>

However, the menhaden have declined in numbers. After the season of 1956, a weakening trend was observed in the Atlantic fishery, but a rise in Gulf of Mexico landings offset the drop in Atlantic catches. In 1966 the Gulf landings dropped sharply, and the total catch was less than 40 per cent of the peak year of 1962. According to Graham:

The decline in the menhaden fishery, like that of the California sardines, has occurred in the face of a good demand for the fish. The market for menhaden in the United States is firm but the fish cannot be found.<sup>5</sup>

According to Lyles, fishery scientists "attribute the diminishing catch to overfishing along the Atlantic coast and recommend a curtailment of fishing to permit replenishment of the resource."<sup>6</sup>

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<sup>3</sup> Ibid.

<sup>4</sup> U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Menhaden Industry--Past and Present, p. 16.

<sup>5</sup> Herbert W. Graham, "Trends in the Marine Fisheries of the Continental Shelf of the Eastern United States," Transactions of the American Fisheries Society, Vol. 97, No. 1 (January, 1968), p. 79.

<sup>6</sup> U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Fishery Statistics of the United States, 1966, p. 6.

Still other factors may play an important role in reducing the menhaden resource. Lewis has commented on the destruction of the young menhaden's nursery grounds:

Water-development projects and pollution are becoming more prevalent as the human population grows. For example, dams that will effect large masses of water in estuaries on the Atlantic and Gulf coasts of the United States are under consideration. These structures will probably reduce the nursery areas accessible to menhaden larvae and may reduce the numbers of menhaden.<sup>7</sup>

Natural causes also effect the abundance of menhaden. Bigelow and Schroeder have commented on the great numbers of fish and marine animals which prey on menhaden:

No wonder the fat oily menhaden, swimming in schools of closely ranked individuals, helpless to protect itself, is the prey of every predaceous animal. Whales and porpoises devour them in large numbers; sharks are often seen following the pogy schools; pollock, cod, silver hake, and swordfish all take their toll . . . Tuna also kill great numbers. But the worst enemy of all is the bluefish . . . Not only do these pirates devour millions of menhaden every summer, but they kill far more than they eat. Besides the toll taken by these natural enemies, menhaden often strand in myriads in shoal water, either in their attempt to escape their enemies or for other reasons, to perish and pollute the air for weeks with the stench of their decaying carcasses.<sup>8</sup>

### The fishery

Highly correlated with the diminishing resource is the decline in production of captured menhaden. Peeling has written:

The catch by menhaden seiners along the Atlantic coast last year (1967) was 430 million pounds, the smallest since 1942. States bordering the Gulf of Mexico produced 697 million pounds,

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<sup>7</sup>Robert M. Lewis, "Effects of Salinity and Temperature on Survival and Development of Larval Atlantic Menhaden, Brevoortia tyrannus," Transactions of the American Fisheries Society, Vol. 95, No. 4 (October, 1966), p. 423.

<sup>8</sup>U.S., Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Fishes of the Gulf of Maine, by Henry B. Bigelow and William C. Schroeder, Fishery Bulletin No. 74 (Washington: Government Printing Office, 1953), p. 115.

the Gulf fishery's worst year since 1958. Overall, production was down 11 per cent and value 30 per cent.<sup>9</sup>

Aside from the overall decline in annual catches, tremendous fluctuations in the menhaden catches of a particular area have been and still are serious problems encountered in the fishery. Despite the availability of menhaden year-to-year fluctuations may be caused by: 1) bad weather conditions, which make fishing impractical if not impossible; 2) an oversupply at certain plants which prevents the vessels from unloading their catch; and 3) low wages which discourage the fishing effort.<sup>10</sup>

#### Foreign imports

Accompanying the decline in menhaden catches, imports of foreign fish meal have begun to rise. In 1967 the herring fishery of Norway provided 17 per cent of the United States' imports of fish meal, while the anchovy fishery of Peru provided 68 per cent.<sup>11</sup> Concerning this problem, Peeling has written:

Since imports are available at prices lower than those paid United States producers, the US producers are hit twice: they can't meet domestic needs and they have to drop price to compete . . . Fish meal imports in this country rose 45 per cent in 1967 over 1966. They have increased 82 per cent over the average for the period 1962-66.<sup>12</sup>

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<sup>9</sup>Ruth Peeling, "Poor Catches Threaten Menhaden Industry," Carteret County News--Times (Morehead City, North Carolina), June 17, 1968, p. 6.

<sup>10</sup>William H. Potter, private interview, Beaufort, North Carolina, November 20, 1967.

<sup>11</sup>Peeling, p. 6.

<sup>12</sup>Ibid.

Thus, in combination with other factors, the underselling of domestic fish meal by foreign imports constitutes a major economic problem for the fishing industry.

### Research

The problems of the menhaden industry are undergoing intensive research. The Bureau of Commercial Fisheries, which has conducted menhaden research since 1955, is currently involved in studies concerning the life history, ecology, physiology, and population dynamics of both the Atlantic and Gulf menhaden. Major emphasis is being placed on the "tagging" of menhaden in an attempt to obtain more accurate knowledge of the distribution and migrations of the fish. As of October 1969, over a million menhaden have been tagged and 136,000 of the tags have been recovered from the processed fish.<sup>13</sup>

The menhaden fishing industry itself has conducted some small scale research in the areas of technology and fishing gear. Research has also been conducted by several state governments, and several universities have been planning some research activities concerned with menhaden.

### Prospects for the future

While at the present time, "things look bleak"<sup>14</sup> for the menhaden fishery, continued research may provide solutions to many of the problems associated with the industry. One possible solution to the declining

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<sup>13</sup>Letter from John W. Reintjes, December 12, 1969.

<sup>14</sup>Peeling, p. 6.

resource might be in diversification of the fishing effort. Exploitation of the thread herring might replace dependence on menhaden.

Reintjes and June have commented on this species:

The thread herring, Opisthonema oglinum, occurs generally throughout the Caribbean and along the Gulf coastal states southward to the Gulf of Campeche. This species was found to be available in large quantities throughout the year along the west coast of Florida and appeared to be present in large numbers in the shallow coastal waters of the remaining Gulf states during the summer.<sup>15</sup>

Concerning the menhaden resource, June has stated that exploitation of the two warm water species, Brevoortia smithi and Brevoortia gunteri, would help augment the low catches of Atlantic and Gulf menhaden. June explained his thesis:

Two North American species--the yellowfin and fine-scaled menhaden--exist as virgin stocks and apparently are not being utilized because the distribution and habits of the fish are not well known.<sup>16</sup>

Continued research will surely bring forth methods by which the year-to-year supply of menhaden can be reasonably projected, thus making wiser harvesting practices possible. In this manner, the present stocks of menhaden might be allowed to replenish themselves for future utilization by the industry.

As far as foreign imports are concerned, some type of protective legislation on the national level might help control the importation of lower priced fish meal. A measure of this kind would certainly do much to help the menhaden industry.

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<sup>15</sup>John W. Reintjes and Fred C. June, "A Challenge to the Fish Meal and Oil Industry in the Gulf of Mexico," Proceedings of the Gulf and Caribbean Fisheries Institute, Thirteenth Annual Session, November, 1960 p. 64.

<sup>16</sup>June, The Menhaden Fishery of the United States, p. 12.

### North Carolina

The problems and prospects for future development of the menhaden fishing industry in North Carolina reflect the over-all situation in the United States' fishery.

#### Problems

Depletion of the raw resource constitutes the primary problem in North Carolina. Landings were "well below average"<sup>17</sup> in the Tar Heel fishery during 1967. The fall fishery, by far the larger of the two North Carolina seasons, accounted for approximately 113 million pounds of menhaden, a decline of about 45 million pounds from the previous year.<sup>18</sup>

In addition to the general decline in numbers of menhaden, great fluctuations in the annual catches have been characteristic of the fishery in North Carolina. The annual production of menhaden has been anything but steady over the ten-year period from 1957 through 1966. During this time menhaden landings ranged from a high of over 235 million pounds in 1958 to a low of over 122 million pounds in 1962. Throughout the ten-year period yearly variations ranged from about 38 million to 157 million. The average yearly landings amounted to over 192 million pounds.<sup>19</sup>

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<sup>17</sup>Kenneth A. Henry, "The Gulf and Atlantic Menhaden Fishery," Talk given at Third Annual Meeting of the National Fish Meal and Oil Association, Norfolk, Virginia, February 19, 1968, p. 3.

<sup>18</sup>Henry, p. 3.

<sup>19</sup>U.S., Department of the Interior, Fish and Wildlife Service Bureau of Commercial Fisheries, North Carolina Landings, 1957-66.



Competition from lower priced, imported fish meal constitutes a direct problem in the Beaufort-Morehead City area. A newly established distributing plant at the Morehead City port receives foreign fish meal which is shipped throughout the State.<sup>20</sup>

### Prospects

The future of the menhaden industry in North Carolina appears to be dependent on the development of ways to arrest the decline in the menhaden resource. The Bureau of Commercial Fisheries maintains a laboratory on Piver's Island, Beaufort, where the extensive research programs on both the Atlantic and Gulf menhaden are centered. It is through these programs that solutions to the menhaden problem may be found. One possible solution might be the taking for commercial purposes of other herring-like fish which are found in North Carolina waters. Already this practice is carried out on a limited scale. Some thread herring, known in the Beaufort-Morehead City area as "hairy backs," are now being captured and utilized by the local menhaden fishery during part of the summer season.<sup>21</sup> In conjunction with this development, "research is underway to see if Atlantic herring can be used as a replacement for the declining menhaden stocks."<sup>22</sup>

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<sup>20</sup>"Fishmeal," North Carolina State Ports Magazine, Vol. 14, No. 4 (Winter, 1969), p. 9.

<sup>21</sup>William H. Potter, private interview held at Beaufort Fisheries, Incorporated, Beaufort, North Carolina, November 20, 1967.

<sup>22</sup>Roy Hardee, "Red Fishing Fleet Off Carolina Coast," The News and Observer (Raleigh, North Carolina), April 13, 1969, sec. 4, p. 1.

### Conclusion

Menhaden were captured in North American waters before European settlement of the continent, and were taken in large amounts for commercial purposes by the early 1800's. With its initial development in the New England states, the menhaden fishing industry gradually expanded southward. In North Carolina menhaden have been reported since early colonial times, and, in spite of a number of futile attempts to establish a successful fishery in the state, menhaden have been captured in Tar Heel waters on a continuous, commercial basis since about 1887.

Since 1946 menhaden have been captured along the Atlantic and Gulf coasts in the largest commercial fishery, by volume, in the United States. The vast majority of menhaden are captured in a highly efficient purse seine fishery, which is in operation from April through December. The North Carolina purse seine fishery constitutes the largest fishery in the South Atlantic region, and as such plays an important role in the over-all menhaden fishery in the United States. Menhaden are captured in Tar Heel waters during two distinct periods, namely the summer months from May through August, and the fall months from October through December. The latter season is the only fall fishery for menhaden.

Although the menhaden fishing industry still remains the largest fishery by volume in the United States, there has been a definite weakening trend since 1957 in the Atlantic fishery and since 1966 in the Gulf fishery. A general decline in the menhaden catches reflects the diminishing raw resource. Several factors have been

attributed to the declining menhaden stocks, chief among which are:

1) overfishing of the resource; and 2) pollution of estuaries, the nursing grounds of young menhaden. The general decline of menhaden catches are reflected in the North Carolina fall fishery which dropped from 158 million pounds in 1966 to 113 million pounds in 1967.

In the final analysis the menhaden fishing industry, while having a long and prosperous history as the largest fishery by volume of catch in the United States, appears at this time to be facing serious problems concerning both the natural resource base and uncontrolled foreign competition. The menhaden fishing industry in North Carolina exemplifies to a high degree the general situation in the United States' fishery.

## APPENDIX A

MENHADEN CATCH STATISTICS  
SOUTH ATLANTIC FISHERIES, 1880-1966

(Thousands of Pounds)

Year	North Carolina	South Carolina	Georgia	Florida (East Coast)	TOTAL
	<u>Quantity</u>	<u>Quantity</u>	<u>Quantity</u>	<u>Quantity</u>	<u>Quantity</u>
1880	(1)	(1)	(1)	(1)	(1)
1887	14,756	-	-	(1)	(1)
1888	13,844	-	-	-	13,844
1889	8,753	-	-	-	8,753
1890	12,410	-	-	-	12,410
1897	11,310	-	-	-	11,310
1902	18,862	-	-	-	18,862
1908	57,412	-	-	-	57,412
1918	179,911	-	29,485	48,363	257,759
1923	63,290	-	26,973	57,918	148,181
1927	98,987	-	34,102	24,876	157,965
1928	99,302	-	30,030	21,512	150,844
1929	173,490	-	29,213	31,717	234,420
1930	134,051	-	24,701	34,242	192,994
1931	67,877	-	869	3,710	72,456
1932	54,476	-	11,520	11,180	77,176
1934	106,651	-	18,752	29,404	154,807
1936	150,088	-	14,500	65,482	230,070
1937	61,706	-	9,864	133,538	205,108
1938	146,819	-	7,034	148,916	302,769
1939	181,968	-	2,957	102,318	287,243

1/ Not available.

Source: U.S., Department of the Interior, Fish and Wildlife Service Bureau of Commercial Fisheries, Fishery Statistics of the United States, 1965, by Charles H. Lyles, Statistical Digest 59 (1967), p. 301; and Fishery Statistics of the United States, 1966, by Charles H. Lyles, Statistical Digest 60 (1968), p. 489.

## APPENDIX A-Continued

Year	North Carolina	South Carolina	Georgia	Florida (East Coast)	TOTAL
	<u>Quantity</u>	<u>Quantity</u>	<u>Quantity</u>	<u>Quantity</u>	<u>Quantity</u>
1940	129,592	-	234	95,056	224,882
1945	141,533	-	-	114,746	256,279
1950	124,905	961	-	21,259	147,125
1951	104,013	4,477	-	79,600	188,090
1952	191,341	3,218	-	120,282	314,841
1953	132,105	1,696	-	65,544	199,345
1954	160,301	3,952	-	42,009	206,262
1955	184,919	6,638	-	36,254	227,811
1956	246,648	-	-	67,998	314,646
1957	172,522	7,027	-	16,852	196,401
1958	235,385	861	-	7,871	244,117
1959	279,888	3,991	-	46,637	330,516
1960	190,431	-	-	24,592	215,023
1961	221,555	-	-	32,950	254,505
1962	122,898	-	-	34,271	157,169
1963	190,214	-	-	25,672	215,886
1964	172,992	-	-	17,154	190,146
1965	160,595	10	-	31,670	192,275
1966	182,289	235	-	32,590	215,114

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