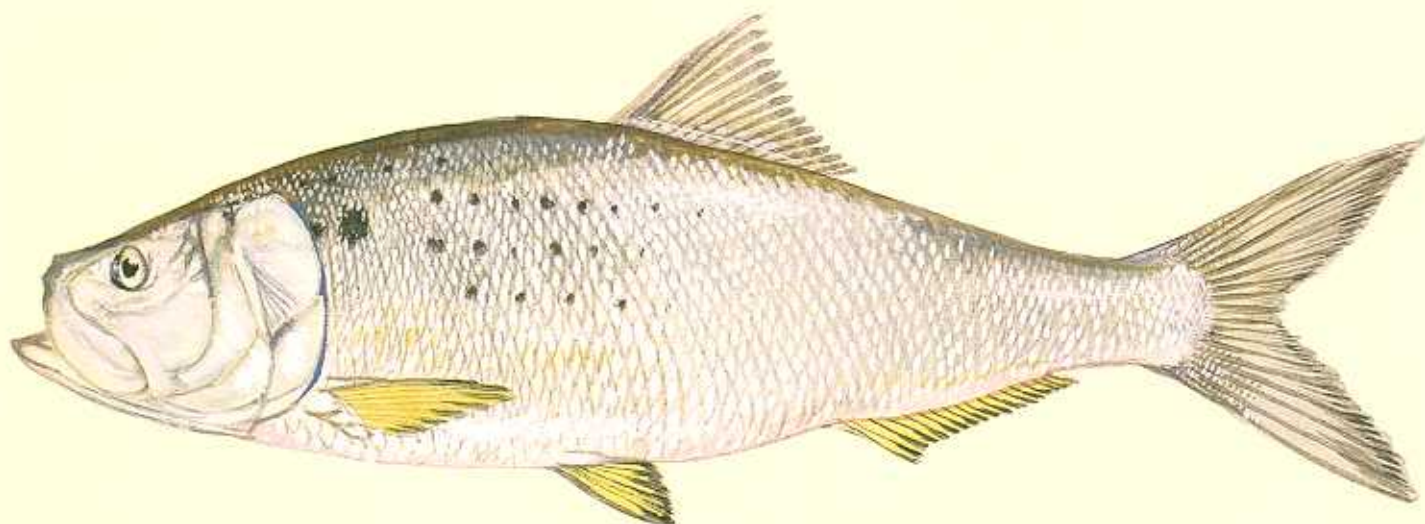


Virginia

MARINE RESOURCE

BULLETIN



Virginia Sea Grant Program, Virginia Institute of Marine Science
College of William and Mary
Spring 1994, Vol. 26, No. 1

Virginia MARINE RESOURCE BULLETIN

DR. DENNIS L. TAYLOR
Dean and Director
School of Marine Science
Virginia Institute of Marine Science
College of William and Mary

DR. WILLIAM RICKARDS
Director
Virginia Sea Grant College Program

DR. WILLIAM D. DUPAUL
Director
Marine Advisory Program

Spring 1994

Vol. 26, No. 1

Contents

Introduction	3
Marine Oils	4
Menhaden Oil Shortening + Eggs + Flour + Sugar + Flavoring =	6
Life History	8
Harvesting, Then and Now	
From the Boat to the Final Product, an Overview of Processing	16
By-Catch and the Menhaden Fishery	
How the Menhaden Fishery is Managed	22
New Publications	

Susan C. Waters, Editor, Writer and Designer

Susan R. Stein, Typography and Mechanicals

On the cover: Menhaden artwork by Duane Raver, Jr. ©

The Marine Resource BULLETIN is a quarterly publication of Marine Advisory Services of the Virginia Sea Grant College Program which is administered by the Virginia Graduate Marine Science Consortium with members at the College of William and Mary, Old Dominion University, University of Virginia and Virginia Polytechnic Institute and State University. Subscriptions are available without charge upon written request.

The BULLETIN is intended as an open forum for ideas. The views expressed do not imply endorsement, nor do they necessarily reflect the official position of Sea Grant or the Virginia Institute of Marine Science.

Sea Grant is a partnership of university, government and industry focusing on marine research, education and advisory service. Nationally, Sea Grant began in 1966 with passage of the Sea Grant Program and College Act.



The Bulletin is printed on recycled paper. ♻️

Menhaden

Brevoortia tyrannus, the Atlantic menhaden, is an anonymous-looking fish; nothing in its appearance would remotely suggest anything out of the ordinary. Yet, if anything beyond popular culture connects the farmer in Des Moines with the New York fashion model and the lumberjack from the Pacific Northwest, it is their use of menhaden* products. Menhaden is probably in the feed the farmer gives to his poultry and swine, and in the fertilizer he applies to his fields; the model may use lipstick which contains *B. tyrannus*; and the lumberjack's saw may have been tempered with the oil extracted from this bony fish.

Menhaden oil has been used to il-

luminate, to promote growth in animals and plants, and to preserve products ranging from linoleum and fabric to cables and surfaces on vessels. Menhaden oil in large quantities is exported to Europe and Canada for use in margarine, shortening, and as a cooking oil.

In part of the 19th century it was utilized as a substitute for whale oil and used for illumination. Menhaden oil was even mixed with mineral oil to light the way for miners.

Some fortunes have been made from this fish, and the fishery itself continues to support many people. It is the largest single-species fishery on the Atlantic, and is the most concentrated fishery in the Chesapeake Bay.

Even so, *B. tyrannus* retains its anonymity, a fish incognito without even trying. The intent of this issue of the *Bulletin* is to take a closer look at this unnoticed yet ubiquitous fish. ❖ ❖

**Menhaden are found worldwide. The Atlantic and Gulf menhaden, Brevoortia tyrannus and B. patronus are the focus of the U.S. commercial fishery.*



Menhaden fishing vessel.



Marine Oils

The “greening”^{**} of the U.S. may lead to an even greater industrial use of marine oils. Food applications for marine oils have predominated in recent years.^{**} However, the current demand for environmentally friendly sources of raw materials has caused a renewed interest in marine oils. Interestingly, some of the proposed applications are not new at all. To wit: as late as the 1940s, marine oils were burned in lighthouse lamps, and in recent years the use of marine oils for fuel revived when petroleum prices rose. Countries such as Japan and Denmark used fish oils to fuel boilers, diesel engines and dryers.

In the marine environment, the use of fish oils for various applications signifies an especially appropriate way to minimize environmental impacts. Historically, ocean-going wooden sailing vessels were waterproofed with fish oil. Today exists a variation on that theme: fish oils are used to rust-proof surfaces on vessels, and to waterproof cotton fishing net cordage. The environmentally sound release agent for a concrete bridge mold is, yes, menhaden oil.

On land, the ways in which menhaden oil is utilized is encyclopedic, and sometimes surprising. One of the most common uses of menhaden meal, solubles and oil is as part of livestock, aquaculture and pet feeds. The addition of menhaden products provides essential amino acids, energy, vitamins, minerals and trace elements which may be missing in the other feed ingredients.

A second common use of menhaden products is as a fertilizer. In the United States, fish fertilizers were used extensively until around the 1940s. Two factors combined to change that: petroleum-derived chemical fertilizers, which were less expensive; and the wartime demand for fish protein to supplement broiler and stock feed. In the past few decades the tables turned again, spurred in part by environmental considerations, and menhaden products found their way back into the fertilizer market.

^{*}The so-called “greening” of the United States is a word used to signify several concepts. In this case it is used in the context of the increased use of environmentally “friendly” products.

^{**}See page 6 for food applications.

If the use of menhaden in feed supplements and fertilizer seems commonplace, some of the industrial applications may be surprising. Menhaden oil is used extensively in protective coatings such as paints, varnishes, stains, and printing inks. Menhaden may be found as part of rubber products, metallic greases, textile chemicals, polishes, carbon paper and crayons. The anti-corrosive properties of menhaden oil make it suitable for use in industrial lubricants and greases, and in oil-field chemicals.

Without repeating the applications in the list below, suffice it to say that probably, without exception, you use menhaden products quite frequently. In fact, you may well be *surrounded* by com-

modities which utilize the oil. It may be in the presswood fiber boards of your home, in the oil cloth on your kitchen table, in the ink used by your favorite maga-

"...almost every person in the United States has at sometime eaten, used, or worn something made from menhaden."

—Rachel Carson

zine, and in the caulking of your window sills. If you had citrus from the West Coast at breakfast, you didn't know it but the farmers who grew the fruit may have used menhaden to distract yellow jackets so they could work without being stung. When you

worked on the crossword puzzle in the paper this morning, occasionally erasing an answer, the eraser may have contained. .
.Brevoortia tyrannus! What about that T.V. documentary last night about the bear population of a federal park? You weren't aware of this but the biologists may have utilized a menhaden product to attract the large mammals. The leather jacket you don for work may have been treated with menhaden oil, and the crank-case of your car could have been lubricated with a synthetic product which uses fatty acids from fish oil.

As for the rest of your day? Your encounters with *Brevoortia tyrannus* are bound to be endless.



Some Industrial Uses for Menhaden

Attractant and Lures

Automotive Gaskets

Caulking Compounds

Ceramic Deflocculants

Core Oils

Cutting Oils

Fatty Acids

Fatty Chemicals

Fermentation Substrates

Fire Retardants

Fuel Oils

Glazing Compounds

Illuminating and Fuel Oils

Insecticidal Compounds

Leather Tanning

Linoleum

Lubricants and Greases

Mold-Release Agents

Mushroom Culture

Oil-Field Chemicals

Oiled Fabrics

Ore Flotation

Plasticizers

Polyurethane Lures

Presswood Fiber

Boards

Printing Inks

Protective Coatings

Refractory Compounds

Rustproofing

Soaps

Specialty Chemicals

Tin-Plating Oils



Historically, menhaden oil was used for illumination.

Menhaden Oil Shortening + Eggs

Improbable as a meeting of the twain might seem—chocolate and fish oil shortening—they do and have so for about 70 years in this country, when sardine oil was initially used in U.S. margarine and shortening.

Yet, the use of fish oil as an edible oil has had an erratic history stateside. The California sardine fishery collapsed in the 1950s, just when new legislation governing margarine was enacted. Animal fat and vegetable oil were the ingredients found in margarine when the legislation passed. Fish oil was therefore considered a “new” food ingredient, and long-term, expensive studies of any “new” product needed to be completed before any federal stamp of approval. As a consequence, menhaden oil has not been used as an edible oil in the U.S. until recently. Meanwhile, menhaden oils have been exported to Europe and Canada for 25 years where they are used in both margarine and shortening.

The following article, adapted from an essay by Anthony Bimbo—Director of Research at Zapata Protein (USA), Inc., in Reedville, Virginia—gives a short history of table fats, and especially of margarine, a product which we perceive as commonplace, but which was a new idea in the middle of last century.

Margarine was invented in 1869 to fill a growing consumer need for table fat due to expanding populations during the Industrial Revolution. The production of butter was lagging far behind the requirements of the population, especially in western Europe, and something was needed to fill the expanding gap.

Margarine as first produced by a Frenchman, Mege Mouries, was made from rendered beef fat which had been chilled, crystallized and pressed to separate an oil which was the raw material. The oil was then mixed with milk and salt, churned, chilled, pressed into a semi-solid mass and pounded into barrels for sale as bulk margarine.

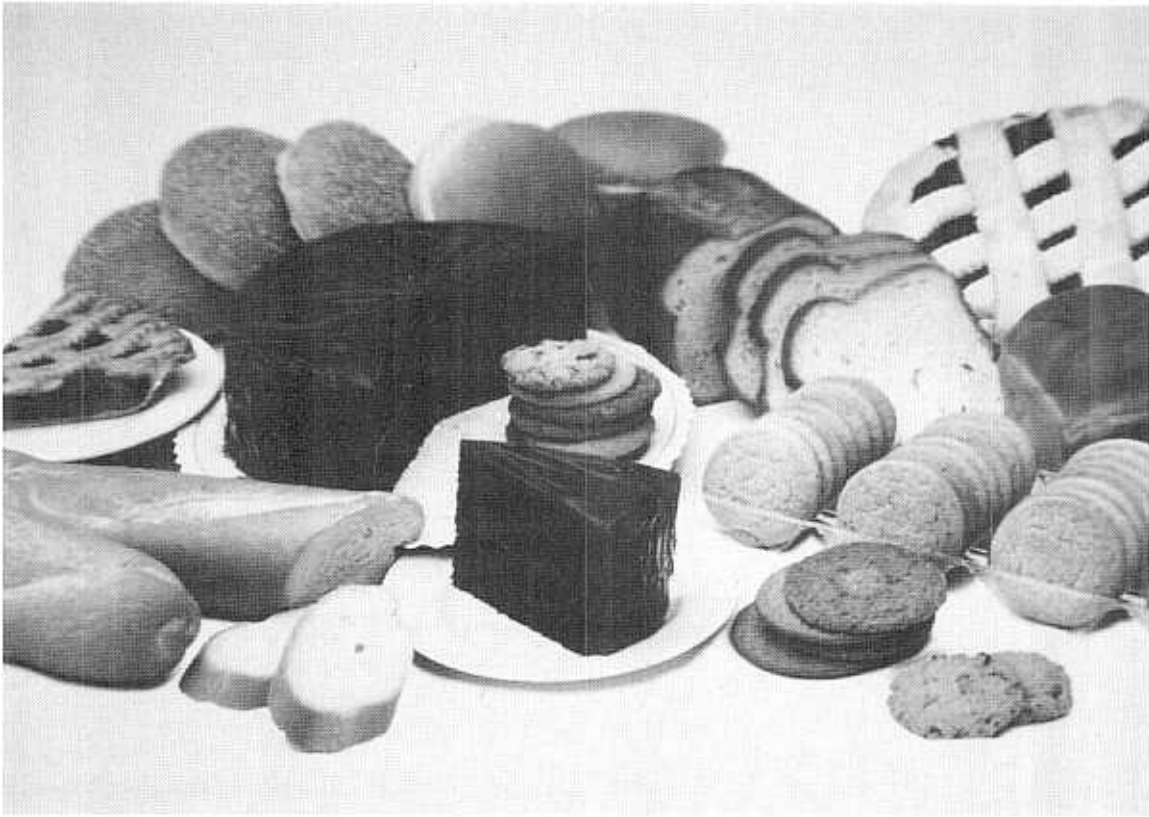
Despite the availability of beef tallow in the United States, the continued growth of the

world population in the early 1900s made the supply of margarine insufficient to meet demand. About this time, the chemistry of preparing hardened fats from liquid oils was perfected and various oils including fish oils were being produced in greater quantities. This development enabled margarine manufacturers to utilize a wide range of liquid oils to produce a product that was acceptable to the consumer. Unfortunately, the consumer sometimes was sold butter adulterated with the cheaper margarine and these fraudulent practices led to a wide range of legislation governing the production and distribution of margarine. In 1886 a federal law was enacted that imposed a tax of two cents per pound on margarine in addition to restrictive license requirements. In 1902 this was replaced by a tax of 1/4 cent per

pound on uncolored margarine and ten cents per pound on colored margarines. This was a compromise since the original legislation introduced by representatives from the dairy states called for coloring margarine green. In addition, many individual states imposed extra taxes and passed laws restricting the sale of margarine, and some states actually prohibited its sale.

The development of products from hardened fats grew rapidly in Europe during the period of 1910-1920, but lagged in the United States because of this legislation. A shortage of fats and oils in the United States during World War I led to further research and development work on oils and fats in general and marine oils in particular, primarily the California sardine. By 1925, 50 tons of sardine oil had been processed into margarine. By

+ Flour + Sugar + Flavoring =



Menhaden oil was in the shortening used to make these baked goods.

1928, the annual usage of sardine oil had risen to about 8,000 tons in margarine and in 1936 it peaked at 20,000 tons. Fish oil was also being used in shortening during this period. The shortening use peaked during 1930-1940 at 50,000 tons per year. The total United States consumption of fish oil for all edible purposes during this period was approximately 75,000 tons per year. In 1951, because of the declining availability of fish oil due to the disappearance of the California sardine, the large processing plants in California ceased opera-

tions. Shortly after this, the Food and Drug Administration (FDA) set Standards Of Identity for margarine. Since, by then, no fish oil was being used in margarine production in this country, fish oil was not included in the list of acceptable ingredients for its manufacture. As a consequence, fish oil was considered a new food ingredient, and to obtain federal permission for use in margarine required full-scale, long-term studies which were both involved and expensive. The studies were conducted and, in short, menhaden recently re-

ceived the FDA's GRAS (Generally Recognized As Safe) designation, a classification which allowed the hydrogenated oil to be used, in this case, in shortening. The FDA has also been petitioned to amend the margarine Standards Of Identity to include menhaden oil, and publication of the final ruling is pending. The second part of the petition deals with the use of non-hydrogenated oil in food products. Approval for this form of the oil should be forthcoming. ❖ . ❖

Life History

The straightforwardness of a life history description belies the amount of science and observation it took to portray the biology and the movements of a species. A life history is a compilation of information by numerous individuals, many times over a significant span of time. Tracking a wide-ranging species in the marine environment can be a formidable task in itself without this complication: the natural world is dynamic, and populations both expand and contract for at least a dozen reasons.

In terms of menhaden research, scientists at the Beaufort, North Carolina, Laboratory of the National Marine Fisheries Service (NMFS) have contributed substantially to our understanding of this economically important species. The following article is adapted from work by NMFS researcher Dean Ahrenholz, work that appeared in the Marine Fisheries Review, published by NMFS.

The Atlantic menhaden, *Brevoortia tyrannus*, is part of the worldwide family Clupeidae, a family which includes shads, herrings, sardines, and pilchards. *B. tyrannus* is a filter feeder, obtaining its food by swimming through the water, its mouth agape. Because menhaden are filter feeders they cannot be caught by hook and line.

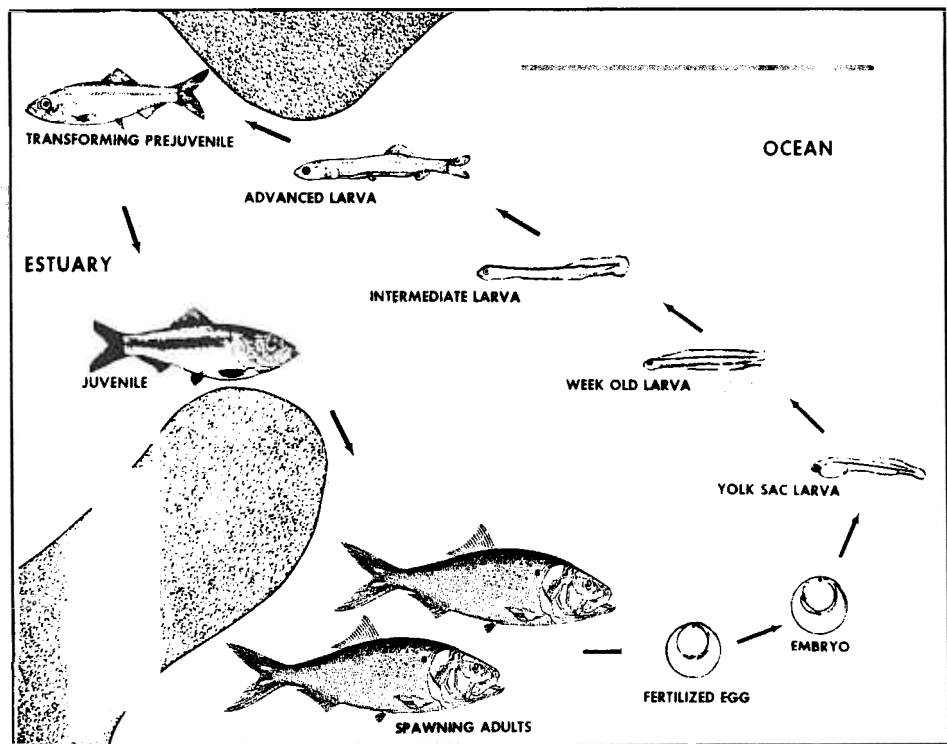
Menhaden schooling patterns seem to have been designed for the commercial fisherman: they form large, densely packed schools which are located near the surface in estuaries and nearshore coastal waters. The general distribution of the Atlantic menhaden is from Florida to Maine.

For the Atlantic menhaden, spawning is believed to be oceanic, on the continental shelf, and from Long Island northward, in bays and sounds. From the spawning

grounds, larvae are transported shoreward, entering estuarine bays, sounds, and streams where they metamorphose into juveniles. The amount of time spent in the nurseries varies. Larvae which enter estuaries in early spring will most likely emigrate between August and November.

It is possible that late-entering larvae may spend a winter as juveniles within the estuary and may stay in the nursery the following summer as well.

The adult population stratifies by age and size; the older, larger fish are located in the northern segment of the range,



Life Cycle of the Atlantic Menhaden.

and, conversely, the younger, smaller fish are in the southern half.

Like many species, Atlantic menhaden migrate up and down the Atlantic coast. Localized movements take place during the summer, but it is in early fall, in September, when the major movement takes place. The northerly portion of the adult population moves south until the part of the population which was north of the Chesapeake Bay during the summer is now off the North Carolina coast. Ensuing

are young-of-the-year emigrating juveniles from the northern nursery areas. The schools disassemble, disappear by late January, only to reassemble in March or April. The migration north starts, and by June the population is again redistributed from Florida to Maine.

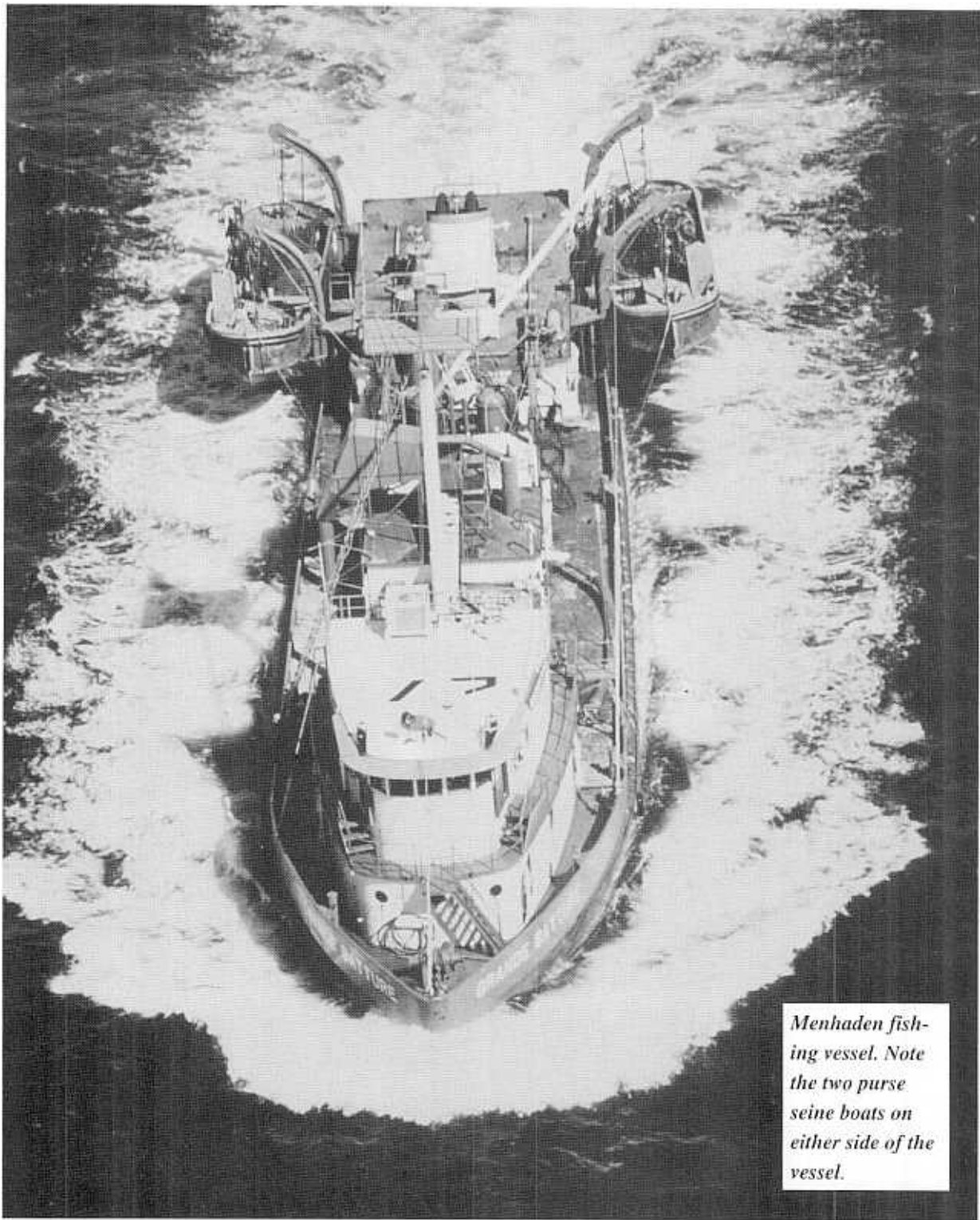
With a fish like menhaden, researchers were confronted with a special challenge: if scientists were to employ a tagging program—one traditional way of determining the movements of a species—how would they re-

cover the all-important tags when the fish are destined for quick, by the million reduction to fish meal and oil? The answer might seem simple: magnetic tags which are recovered at the factory. Yet, refining the mark-recovery operation—from the initial tagging to the magnets used at the factory—plus interpreting the resulting data represent a significant amount of work by many researchers at the NMFS lab in Beaufort, North Carolina. ❖ ❖

Photo by William Hettler, National Marine Fisheries Service

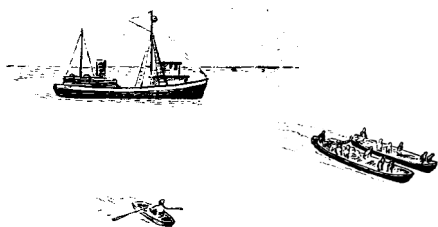


Names: Brevoortia tyrannus, Atlantic menhaden, mossbunker, bunker, pogy, and fat back. The Indians called menhaden Munnawhateaug.



Menhaden fishing vessel. Note the two purse seine boats on either side of the vessel.

These historical illustrations reflect the menhaden fishing technology around the 1940s



Mother ship, purse boats and, in the bottom left, striker boat.



Purse boats begin to circle the menhaden school.

Menhaden Harvesting, Then and



The historical photos on these pages depict the last stages of harvest. Above photo: "hardening" the catch; to the right, brailing the catch; on the far right, another view of brailing.



... Now

It was not until shortly after World War II that the harvesting technology for the menhaden fishery changed in a dramatic fashion. Spotter planes were introduced, a step which greatly improved the harvesting efficiency, as did hydraulic power blocks, which eliminated the back-breaking task of retrieving the nets by hand. Other mid-century refinements included the material used for purse vessels—lighter, faster and more maneuverable aluminum purse boats; more durable nylon seines which replaced natural fiber nets; and large fish pumps, which eliminated the difficult work of “brailing,” transferring the catch from the net to the hold.

Previously, schools of menhaden were sighted from the crow'snest. Now the pilots direct vessels to the location of

menhaden schools. Two purse boats disembark from the “mother ship,” each carrying one-half of the purse seine net, fishing gear which hangs vertically in the water by floats at the top and weights at the lower edge. The two purse boats encircle the school, fully extending the net. In times past, a “striker” positioned himself opposite the converging purse boats. The striker ensured that the corkline was above water and also used to strike the water with an oar to drive the fish away from him and toward the middle of the net.

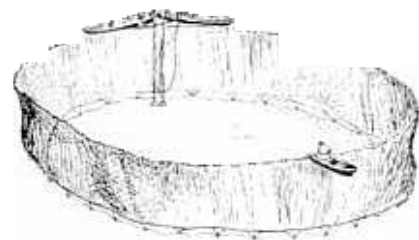
When the menhaden school is fully surrounded, the fishing operation then concentrates on drawing the purse, that is closing the bottom part of the net. The net is subsequently drawn together at the top, a maneuver which is

called “hardening” the catch. The last step is brailing. Formerly, brailing was done with a net; now the fish are transferred from the net to the mother ship via powerful pumps.

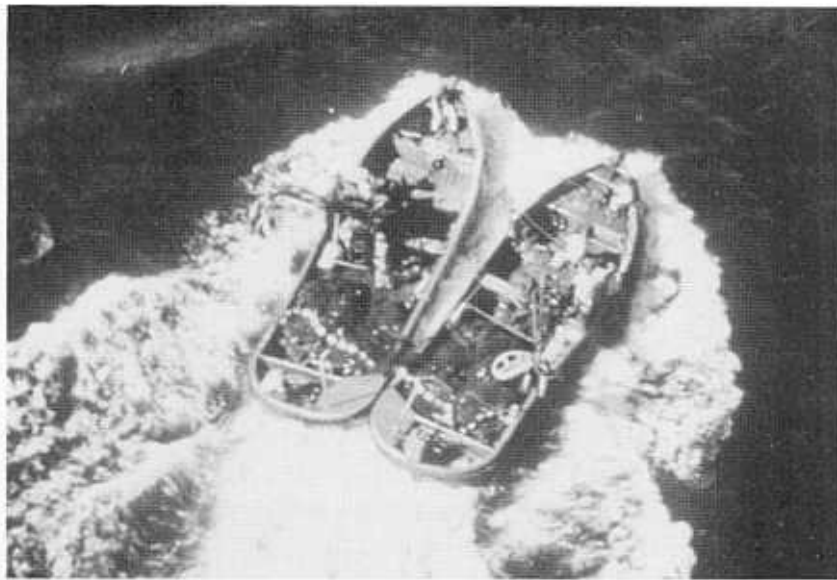
The photos and historical illustrations on these pages nicely depict some of the fundamentals of menhaden fishing, but they cannot hint at the amount of work which was involved in the past. Early in this century, preparing the boat might have meant hauling a ton of coal onto the vessel for the next day's fuel. The amount of men required to pull in the net was greater—about 15-20 men to a purse boat. The purse boatmen rowed out to the menhaden school and if a set was large enough, they might even need to call upon a crew from another vessel to help with the catch. ❖



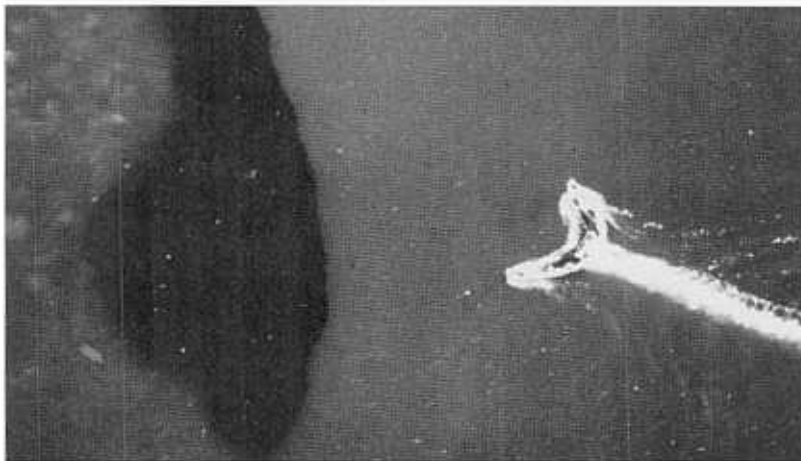
The striker helps secure the net as the purse boats make the final set.



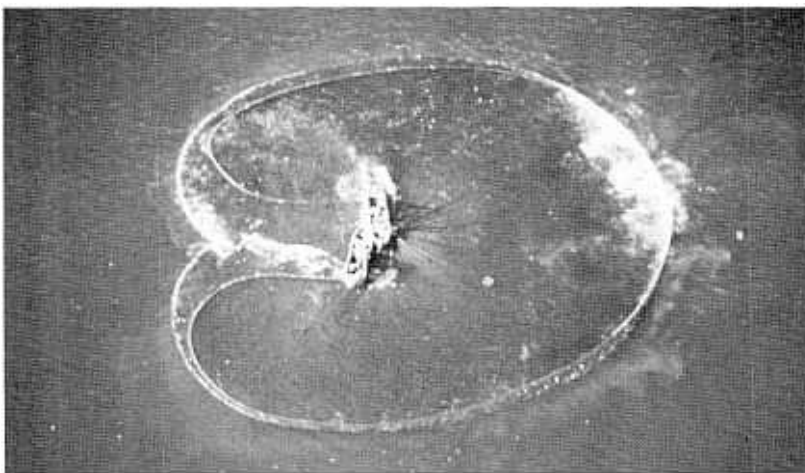
The purse boats drop the tows, anchoring the bottom of the net.



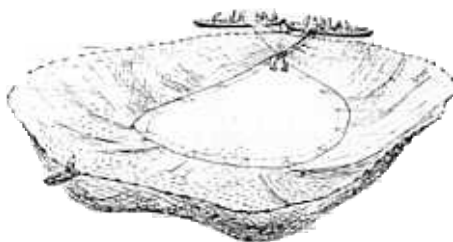
Purse boats, each carrying half the net.



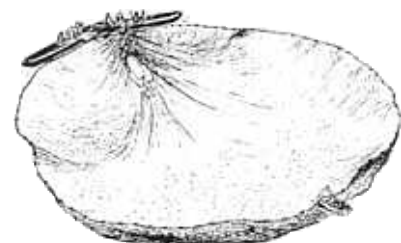
The large dark area is the menhaden school. The purse boats are starting to encircle the school.



Menhaden school fully encircled.



Fishermen begin to draw the purse.



The net is almost entirely pursed.

Menhaden Chanteys

The advent of

tradition became widespread after interaction with African-American culture, and the songs were normally affiliated with hard labor.

Folk artforms, like the chantey songs, can sometimes be temporal; once the need for a certain folk expression dissipates, the songs or stories can be lost. Plus, the artistic value of folk art has been traditionally underrated in this country; it wasn't until the 1920s that the work song genre was generally considered *music* worth recording for future generations.

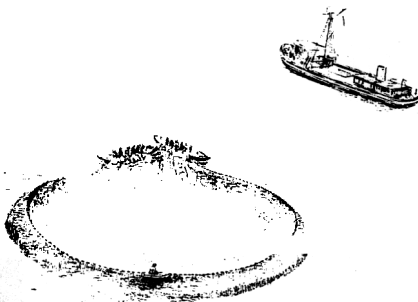
In the case of mid-Atlantic chanteys, some recordings were collected and reside in the Library of Congress. That might have been one of the last records of the chanteys if several folklorists had not recently tracked down the men who used to sing as they brought in the catch. In short, not only have songs been recorded, but two groups have been formed,

one in Virginia and another one in North Carolina.

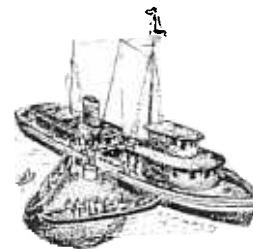
The chanteys on this page are from an excellent history of the fishery, *The Men All Singing*, by John Frye. These songs are from Frye's book, recorded by Captain John Lowry of Reedville aboard his own fishing vessel, the *John O*. ❖ ❖ ❖

<i>Chanteyman:</i>	All the weight's on the mate's boat!
<i>Fishermen:</i>	Hey, hey, honey!
<i>Chanteyman:</i>	We gonna save them if we can!
<i>Fishermen:</i>	Hey, hey, honey!
<i>Chanteyman:</i>	She's long and she's tall!
<i>Fishermen:</i>	Hey, hey, honey! Long and tall!
<i>Chanteyman:</i>	Want to see her!
<i>Fishermen:</i>	Hey, hey, honey!
<i>Chanteyman:</i>	I have a girl in Baltimore! Hey, hey, honey!
<i>Fishermen:</i>	Streetcar runs right by her door!

<i>Chanteyman:</i>	I left my baby standin' in the back door cryin', Honey, don't go!
<i>Fishermen:</i>	Lawd, Lawd, don't go!
<i>Chanteyman:</i>	I'd go home but ain't got no money!
<i>Fishermen:</i>	Lawd, Lawd, ain't got no money!
<i>Chanteyman:</i>	To pay my way!
<i>Fishermen:</i>	Lawd, Lawd, to pa-ay my wa-ay!
<i>Chanteyman:</i>	Yes, I'm gonna row here few days longer, Then I'm goin' back home!



Fishermen begin to "harden the catch," to concentrate the fish in the middle of the net. The "mother" ship moves in closer so the fish can be transferred to the hold.



"Brailing" the catch, transferring the fish from the net to the vessel hold.



From the Boat to the Final Product

An Overview of Processing, Past and Present

*From a speech by
Anthony Bimbo,
Director, Applied Research
Zapata Protein (USA), Inc.*

The history of menhaden use dates back to pre-colonial America where the Indians used menhaden for fertilizer by burying one fish under each hill of corn. The colonists followed the farming practices of the Indians and the use of raw, whole fish fertilizer continued into the 19th century—until methods of removing the oil were developed in Rhode Island (1812), and in Maine (1850). The oil proved to be a good substitute for whale and linseed oil, and was often mixed with mineral oil for use in miners' lamps. The residue from the production of oil became known as menhaden scrap, and its lack of oil made it even more desirable as a fertilizer than the whole fish.

Rapid changes occurred within the menhaden industry during the period of 1865-1874. Twenty factories were built in Maine and others in Rhode Island around Narragansett Bay. These factories, the predecessors of the modern day plants, were of

crude design and were operated entirely by hand.

The fish were unloaded from the boats with pitch forks into tanks or directly into small wooden tram cars holding about 20 barrels each. These cars were hauled to the upper floor of the plant where the fish were dumped into large reservoirs. From here, the fish flowed as desired into cooking tanks. These were constructed of wood staves, sometimes with a false bottom, and had perforated pipes in the bottom for the introduction of steam. The tanks held from 50 to 75 barrels of fish and were filled to a depth of six inches to a foot with sea water, which was sometimes preheated before the addition of the fish. Cooking time was usually a half hour to an hour, though in one plant the fish were simmered for five hours. After cooking, the hot water and oil were drawn off, and the mass of fish allowed to drain and cool. A man then climbed into the tank and pitch forked the fish into "curbs" which confined the fish during the pressing operation. These were built of heavy wooden slats, iron bound or of iron with eighth inch holes, and held from three to ten barrels of

fish each. The curbs were usually mounted on small trucks running on tracks leading to the press. The first presses received their pressure by weighting with rocks or from using a lever to squeeze the oil from the fish. The mechanical screw press was developed in the late 1850s.

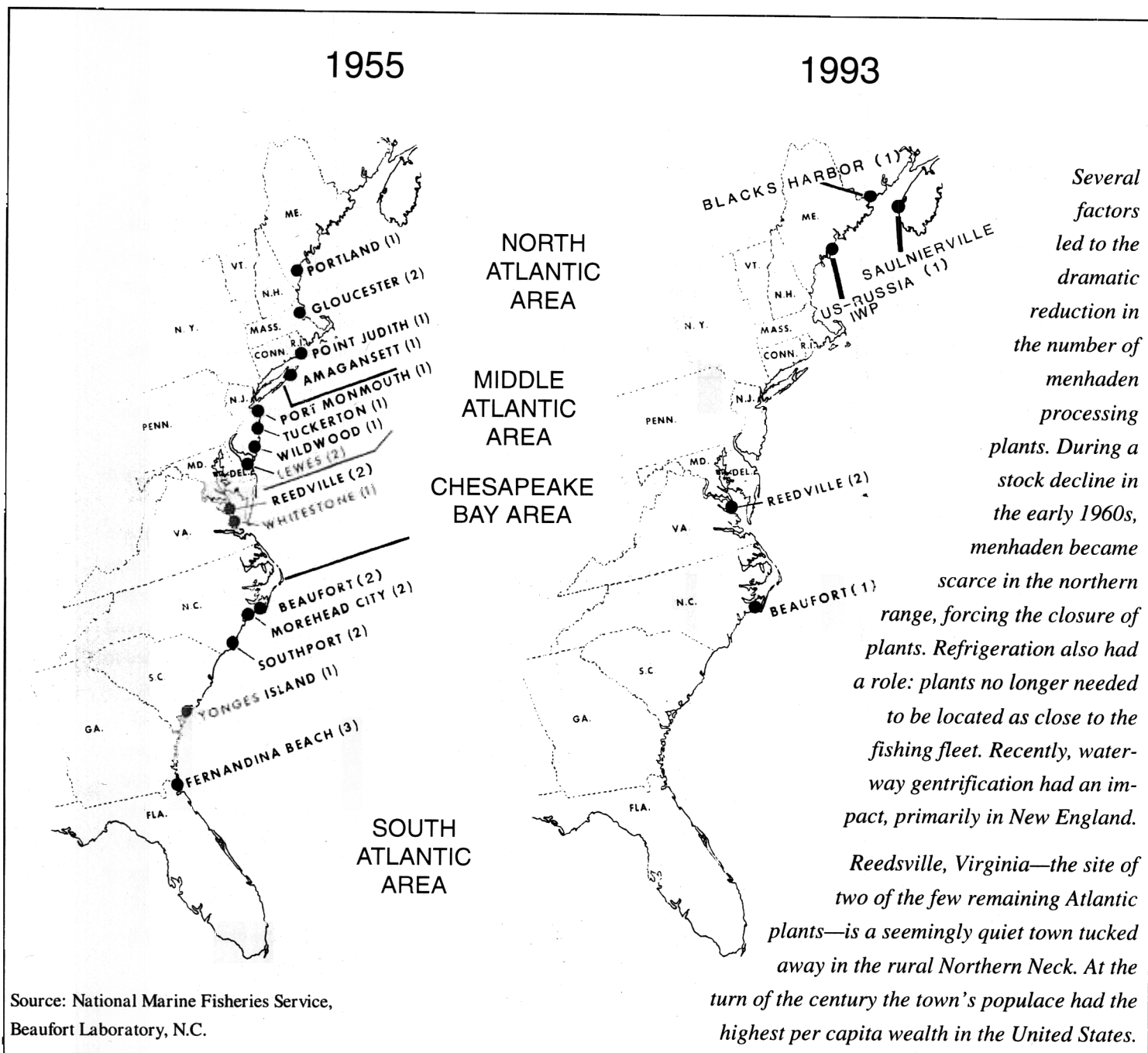
Oil and water draining from the cooking tanks and presses ran to a series of settling tanks. The operators were aware of the fact that the oil contained finely divided fleshy material which settled out more slowly than the press water, and that for the best grade of oil, this should be removed before putrefaction started. However, settling and skimming were the only means available to effect this separation. The top oil was skimmed off and held in open tanks for one to two weeks to sun bleach for the best grade of "white oil." The lower levels of oil were run off into other tanks and yielded progressively poorer grades of oil. Some plants used the sludge at the bottom by adding back to the cooking tank and separating a "gurry oil."

The remaining solids (press cake or guano) in the curbs was dumped through a trap door in

the floor to a room or open space beneath the plant. In some plants it was allowed to accumulate until fall or winter, and then sold as fertilizer. During the period 1873-1877, 500 million fish representing 1.7 billion pounds were processed to yield 2.5-3.0 million gallons of oil and 50,000 tons of

fertilizer. The menhaden scrap continued to sell as fertilizer until the late 1920s when it was found that the scrap contained many of the essential nutrients necessary for normal growth. With the discovery of vitamin B12 as a source of the animal protein factor in 1949, the use of menhaden

scrap in animal feeds was re-emphasized. About the same time, the water from the pressing operation was also found to be rich in vitamin B12 and this became a new by-product (after concentration to 50 percent solids)—condensed fish solubles.



In contrast to the early reduction operations, the modern wet reduction plant is mechanized from unloading the fish through the shipping operation. Whole fish are mechanically pumped from the hold of the vessel by huge pumps employing water for conveying the fish and maintaining the vacuum. The fish and water pass over revolving screens which separate the water from the fish, and the water is recycled back to the vessel via a water tank. The fish then pass through a measuring device which gives the weight of the catch. From the fish measure, the menhaden are conveyed to holding bins, raw boxes or tanks where they are stored, and used

to feed the system. Fish are conveyed from the raw box to horizontal, direct steam-heated cookers where the steam breaks down the fat cells and coagulates the protein. The cooked fish pulp is then conveyed through a bank of hydraulic screw presses and the oil-water emulsion (press liquor) is expressed from the cooked fish. The residual solids, called the presscake, are transported through a hammer mill to dryers, where the moisture content of the presscake is quickly reduced from 50 to eight percent. The resulting dried fish scrap is cooled, further ground, and then shipped to the customer.

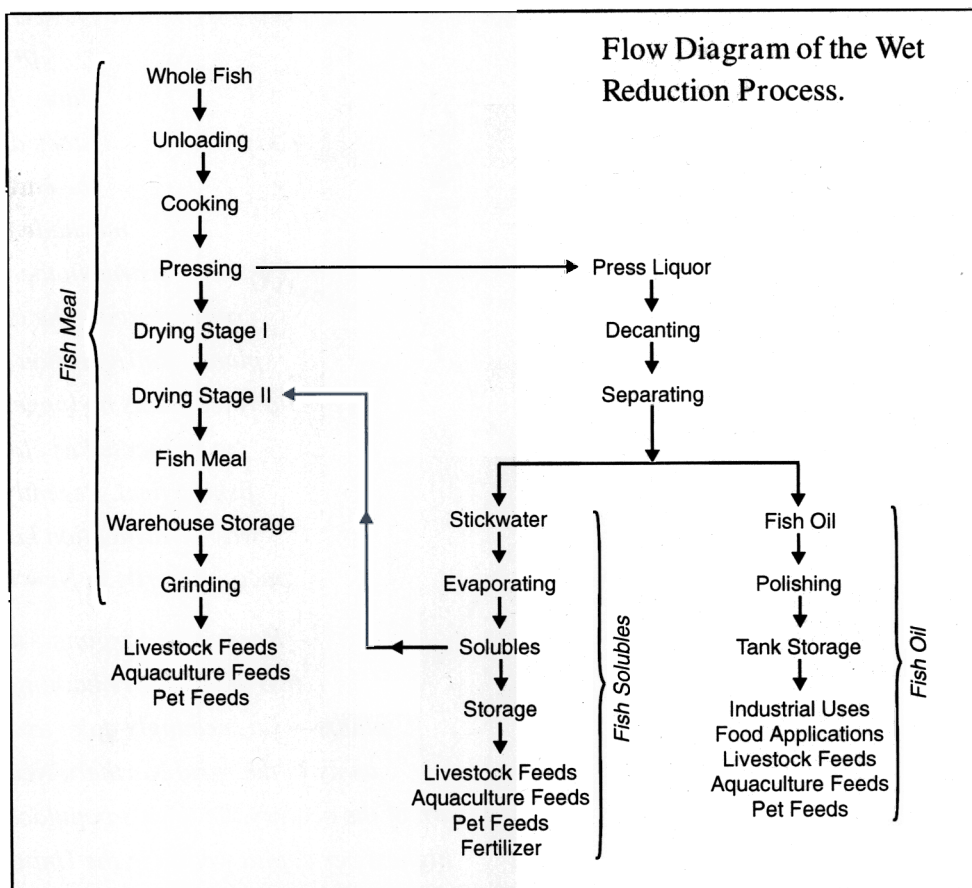
The press liquor passes over a series of vibrating screens or, in

some plants, centrifugal decanters to remove suspended fines. The press liquor is pumped into a holding tank where steam brings the temperature to 180°F. The heated press liquor passes through a bank of centrifugal separators which separate the oil and water portions. The oil is then fed to a series of polisher centrifuges where, with the addition of hot fresh water, the remaining fines and moisture are removed. This oil goes to storage. The stickwater, as the de-oiled press liquor is called, is pumped into large holding tanks, treated, and then fed to an evaporator where the solids are concentrated to 50 percent. The condensed fish solubles, as this

paste product is called, are treated and stored in large tanks equipped with circulating pumps.

Menhaden oil can be sold either as crude oil, or it can undergo one or more of several treatments designed to remove all the last traces of objectionable color, moisture, solids, impurities or saturated fatty acids. From this operation, ten different grades of commercially available menhaden fish oil are produced.

❖ ❖ ❖





*Menhaden
Fishermen*

By-Catch And The Menhaden Fishery

Incidental by-catch has become a contentious issue in a number of states. Attention first focused on the by-catch issue when Gulf of Mexico shrimpers were required to use Turtle Excluder Devices (TEDs) to minimize or eliminate the number of sea turtles which were unintentionally drowned in the fishing gear. Two distinct factions were in opposition: the one seeking preservation of endangered sea turtles, and the fishermen who perceived themselves as endangered because they anticipated that the use of TEDs would mean substantial financial losses.

The by-catch issue spread to other states but it was not always as contentious, nor did it necessarily revolve around an endangered species and a specific fishery. The by-catch issue is really a symptom of a underlying, world-wide problem: increased fishing pressure and natural fluctuations in stocks have resulted in the decrease, and in some cases, the near collapse of fisher-

ies; when a natural resource is significantly diminished, attention converges on any entity which is suspected of exacerbating the problem.

In the mid-Atlantic, concern recently centered on the Atlantic menhaden (*Brevoortia tyrannus*) fishery. The menhaden fishery drew attention for three reasons: the fishery is the largest, single-species fishery on the Atlantic; menhaden are an important prey species for striped bass, bluefish, Spanish mackerel—and therefore might be found in close association with these sought-after sports fish; and because menhaden constitute the most concentrated fishery in the Chesapeake Bay. The sheer tonnage of menhaden harvested would seem to warrant a closer look at the by-catch type and the quantity.

Toward this end, Virginia Institute of Marine Science researchers Herb Austin, James Kirkley and Jon Lucy conducted a study* which examined both at-sea and dockside by-catch in the Chesapeake Bay and coastal wa-

ters. The rationale behind inspections at both locations was to arrive at a more realistic picture of the actual by-catch. For most Northwest Atlantic fisheries, inspection is conducted dockside; this is where state and federal inspectors make their determination of by-catch. Inspections at-sea would better define the magnitude of release or potential mortality of other by-catch species *before* landing dockside.

Using a combination of video recorders, visual inspections, and sampling, by-catch was categorized by species and assessed. Tapes from the video recorders were viewed by several researchers to assess by-catch and species composition and to determine whether or not video technology offered a valid means for assessing by-catch.

At-sea inspections were usually conducted with a research team of two individuals. Once a vessel captain was aware of a school of menhaden, purse boats and crew were launched. Researchers accompanied the captain and crew in the purse boats and stayed until the menhaden were ready for pumping aboard the large mother vessel. During the entire operation, researchers visually observed and filmed the

*The detailed results of this study were published under the title of *By-catch and the Fishery for Atlantic Menhaden* (*Brevoortia tyrannus*) *in the Mid-Atlantic Bight*, and published by the Virginia Sea Grant Program at the Virginia Institute of Marine Science. The project was funded under the Saltonstall-Kennedy Fishery Development Program. A copy of the report can be obtained by sending a \$3 check (payable to VIMS) to Virginia Sea Grant, Marine Advisory Services, Virginia Institute of Marine Science, Gloucester Point, Virginia 23062.

Table 1. By-catch composition during survey^a

Species / common name	Number of individuals		Number of menhaden per unit by-catch
	Total	Per 10,000 menhaden ^b	
Bluefish	1,206	0.747	13,387
Croaker	747	0.463	21,613
Spot	137	0.085	117,847
Spanish mackerel	1,182	0.732	13,659
Weakfish	329	0.204	49,073
Striped bass	97	0.060	166,493
False albacore	30	0.019	538,167
Flounder	260	0.161	62,096
All other species excluding menhaden	2,629	1.630	6,141
Total fish	6,617	4.101	2,439

^aBy-catch composition assessed using estimated by-catch.

^bAll numbers relative to menhaden are in terms of number of standard menhaden.

fish in the net. Once pumping was initiated, researchers returned to the large vessel and sampled the catch by placing 1.5 bushel baskets (a standard fish basket holds approximately 100 pounds of fish or 250 large menhaden) on the grate or just above the fish hold. When the basket samples were finished and the vessel stopped pumping menhaden, random sampling of the hold was conducted to further assess the by-catch.

For the dockside inspections, researchers went unannounced to the plants and observed off-loadings. Menha-

den are pumped from the vessel's hold to a large cylindrical, rotating dewatering tank; menhaden are then dumped into a hopper or box which holds approximately 1,000 standard menhaden (670 pounds). The box is weight activated to turn and dump menhaden onto a conveyer which carries them into the plant for processing into meal and fish oil. By-catch was determined by documenting and counting all the fish or shellfish other than menhaden that came through the dewatering container during off-loading.

The off-loading of menhaden was also monitored by video cameras. Later, researchers viewed the video films to assess by-catch. Often, species other than menhaden were severely mutilated and could not be readily identified. In these cases, researchers collectively reviewed the video films, and by consensus, estimated the species of severely mutilated fish.

During a limited number of off-loadings, researchers also sampled the catch using large steel-handled nets. Each net was capable of holding approximately 100 fish. The net was



How the Menhaden Fishery is Managed

held under the dewatering container, just above the collection hopper, until it was full of fish. The contents of the net were then dumped into 1.5 bushel baskets, and the number of menhaden and other fish and shellfish were counted.

A total of 88 inspections were conducted between June and November of 1992; 45 were dockside and 43 were at-sea. The harvest accounted for 16,146,413 fish. By-catch found in samples were estimated at 6,617 fish or shellfish. Relative to the total harvest, by-catch accounted for 0.041 percent. Specifically, the by-catch of major recreational species were, in descending order of number, bluefish, Spanish mackerel, Atlantic croaker, weakfish, flounder, spot, striped bass and false albacore. The most by-catch occurred during the month of August.

No marine mammals, sea turtles, or other protected species were killed, captured, entangled, or observed during inspections. ❖

More Atlantic menhaden are landed annually along the Atlantic coast than any other fish species. Landings have remained fairly consistent, averaging about 341,000 metric tons during the years 1982-1991. That figure does not include the amount of Atlantic menhaden harvested for bait—a sizeable 30,000 metric tons in recent years.*

Even if the Atlantic menhaden fishery appears healthy today, current conditions do not ensure the future of this or any other fishery. For this reason, the management strategies for the fishery have been consistently reviewed and refined. The actual condition of the fishery is evaluated annually.

The primary management responsibility resides with individual states. However, another entity is involved in regulating the Atlantic menhaden fishery, the Atlantic States Marine Fisheries Commission (ASMFC).** The ASMFC was formed in the 1940s as a means for discussion and resolution of common marine resources issues, and as a vehicle for developing cooperative multistate fisheries programs. The National Marine Fisheries Service (NMFS) serves as the primary research agency dealing with menhaden for the commission. A long-term database on Atlantic menhaden is maintained at the NMFS Beaufort Laboratory in North Carolina. Principal data elements include harvest, fishing area, nominal effort, and size and age of individual fish. These data form the basis for periodic stock assessments and annual monitoring of the stock and fishery.



*Catches from the purse-seine bait fishery are used in blue crab, lobster, crayfish, and eel fishing. Menhaden are also used by sport fishermen as chum and cut or live bait for sport fishes such as striped bass, bluefish, king mackerel, sharks, and tunas.

**The other major U.S. menhaden fishery is in the Gulf of Mexico. The fishery targets *Brevoortia patronus*, a species which is found along the Gulf Coast in nearshore waters. Management of the fishery is through the individual states, and the counterpart to ASMFC, the Gulf States Marine Fisheries Commission.

New Publications

The following Sea Grant publications can be obtained by writing Virginia Sea Grant, Marine Advisory Services, Virginia Institute of Marine Science, Gloucester Point, Virginia 23062. The cost of each publication is \$3 (please make checks payable to the Virginia Institute of Marine Science).

***By-Catch and the Fishery for
Atlantic Menhaden
(Brevoortia tyrannus) In the
Mid-Atlantic Bight***

Date: March 1994

Authors: Herb Austin, James
Kirkley, Jon Lucy

Incidental harvesting or by-catch can have important ramifications for ecosystems and for managing populations of commercial and recreational fish. Because of the growing interest in the harvesting of by-catch or non-targeted species, the National Marine Fisheries Service funded a study to measure the extent of by-catch in the mid-Atlantic menhaden fishery.

By-catch and the Fishery for Atlantic Menhaden In the Mid-Atlantic Bight reports the results of an investigation in 1992 to assess the extent of by-catch harvesting in the mid-Atlantic menhaden fishery. Over a six month period, researchers measured by-catch both dockside and at-sea. Using a combination of video recorders, visual inspections, and sampling, by-catch was categorized by species and assessed. A total of 88 samples were conducted; 45 were dockside and 43 were at-sea. A total of 16,146,413 fish were sampled. Relative to the total harvest, by-catch accounted for 0.041 percent. ❖ ❖ ❖

***The Warmwater Crab Fishery In Asia: Implications for the
Chesapeake Bay Blue Crab Industry***

Date: May 1994

Authors: Charles Petrocci and Douglas Lipton

The Chesapeake region of the United States is one of the main blue crab producing regions in the world. In 1992, the blue crab (*Callinectes sapidus*) harvest was 52 million pounds with an ex-vessel value of nearly \$24 million. This represents 27 percent of the total U.S. landings and value, though it was the lowest harvest from this region since 1978. In 1991, the Chesapeake region's harvest was 43 percent of U.S. landings.

The production and marketing of crab and crab products have become a significant factor in the world's fisheries market. During the 1980s, total landings of crab have increased by some 40 percent. International trade in crab and value-added crab products has risen significantly in quantity and in value. Exports of fresh, chilled, or frozen crabs alone are worth more than \$870 million annually.

Although the Chesapeake region has figured predominantly in blue crab production, it does face significant competition both in the U.S. and abroad. Production from the mid-Atlantic, the south Atlantic and Gulf of Mexico displays a dramatic increasing trend. In addition to increased competition from domestic producers, Chesapeake producers have also experienced increased competition from abroad. The competition is not only from other blue crab processors, but from countries producing crab products that are close substitutes for blue crab.

A new Sea Grant publication, *The Warmwater Crab Fishery In Asia: Implications for the Chesapeake Bay Blue Crab Industry*, assesses the international activity of the Asian warmwater marine crab industry and its potential impact on the Chesapeake Bay crab industry. The findings are based on a 1992 field survey of several crab producing counties, in particular, Hong Kong, China, Malaysia and Thailand. Site visits were conducted at resource habitats, landing sites, processing plants and wholesale and retail markets. Meetings and interviews were held with fishermen, processors, distributors, buyers and brokers.

The Warmwater Crab Fishery In Asia is a joint effort by the Maryland and Virginia Sea Grant programs. Additional support was provided by the Maryland Rural Development Center, and the Office of Seafood Marketing, and the Maryland Department of Agriculture. ❖ ❖ ❖

*On the cover: Menhaden by
Duane Raver, Jr.*

Sea Grant Communications
Virginia Institute of Marine Science
Gloucester Point, Virginia 23062

Address correction requested

NONPROFIT ORGANIZATION
U.S. POSTAGE PAID
GLOU. PT., VA 23062
PERMIT NUMBER 6