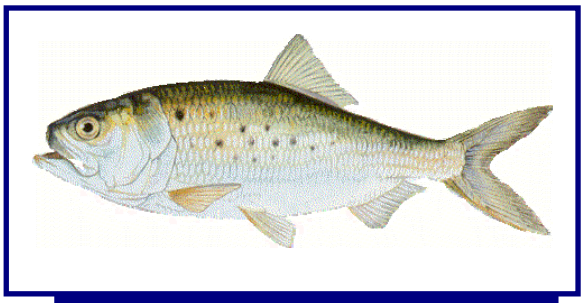
The production of fishmeal and fish oil from gulf menhaden



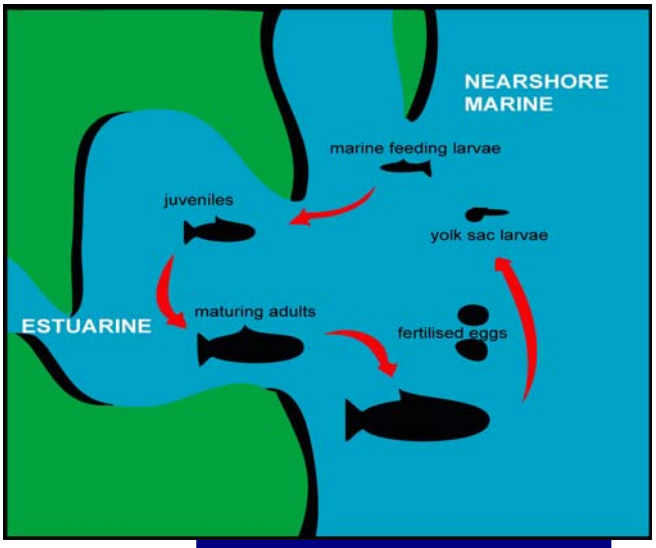
gulf menhaden

geographical distribution

STOCK DESCRIPTION

Latin name – *Brevoortia patronus*

Species description – marine, pelagic, schooling, inshore in summer, but at least some moving out into deeper waters from October in the Mississippi delta area, although adults have been recorded near shore in winter along the Gulf Coast of Florida. Feeds in dense schools, filtering phytoplankton. Breeds in winter. High fecundity; minimum population doubling time less than 15 months (Food and Agriculture Organization of the United Nations).



life cycle of gulf menhaden

Species distribution – throughout the Gulf of Mexico from the Yucatan Peninsula to Tampa Bay, Florida; however, they are most abundant in the north central Gulf of Mexico. The primary fishing ground for gulf menhaden is the north central Gulf of Mexico; which includes the coastal regions of Alabama, Mississippi, Louisiana, and Texas (Gulf States Marine Fisheries Commission, 2002).

Stock size/health – has generally been measured in relation to maximum sustainable yield (MSY)*. Estimates of long-term MSY from production models generally lie between 717,200 and 752,700 metric tons. Recent landings (421,400 to 694,224 metric tons) are comparable to, and mainly below, the MSY.

**The National Marine Fisheries Service (NMFS) has expressed intentions to begin using a 'Forward Projecting Virtual Population Analysis' system, replacing the MSY as the main benchmark for measuring stock size.*

Studies suggest that recent fishing mortality is low and biomass is high. Over the period 2000 to 2004, Gulf annual landings have averaged 575,311 metric tons; approximately 80% of the lower end of the MSY quoted above.

The NMFS – recently renamed the National Oceanic and Atmospheric Administration (NOAA) Fisheries Service – and its predecessor have been assessing menhaden stocks since 1964. The latest NOAA assessment states that "comparisons of recent estimates of fishing mortality to biological reference points do not suggest overfishing" and "given the variability in the data and model estimates, recent landings below long-term MSY suggest that the stock appears reasonably stable" (United States Department of Commerce, 2000). According to NMFS statistics, less than 6% of gulf menhaden biomass has been landed per year since 1990.

Species behaviour – menhaden occur in dense schools, generally by species of fairly uniform size (Gulf States Marine Fisheries Commission, 2002).

FISHING EFFORT

The menhaden fishery in the Gulf of Mexico is primarily a single-species reduction fishery (i.e., feed or industrial fishery). Landings comprise about 11% of all U.S. landings, making this the second largest commercial fishery in the United States (NMFS, 2005).

Gear – the purse seine is the predominant net type used in the menhaden fishery. Purse seines are usually about 1,200 feet long and ten or more fathoms deep.

Vessels – purse boats and carrier (steamer) vessels are used in the capture of gulf menhaden. The smaller purse boats are used to set the net on schools of menhaden. The larger menhaden carrier vessels transport the catch from the fishing grounds to the reduction plants. The number of fishing 'sets' made by a vessel per day depends on the availability and size of the schools. Schools may contain from 3 to 100 metric tons of menhaden each; however, an average set contains 17 to 22 metric tons of menhaden (Gulf States Marine Fisheries Commission, 2002).

Scale of fishing effort – since the mid-nineties the fleet size has decreased from about 50-52 vessels to 41 boats in 2006/7.

By-catch – the NMFS reports a numerical by-catch incidence (fish that are unintentionally caught) of less than 0.1% for the menhaden fishing industry. Numerous other studies have shown that there is little or no by-catch (about 0.04%) in the menhaden purse seine fishery.

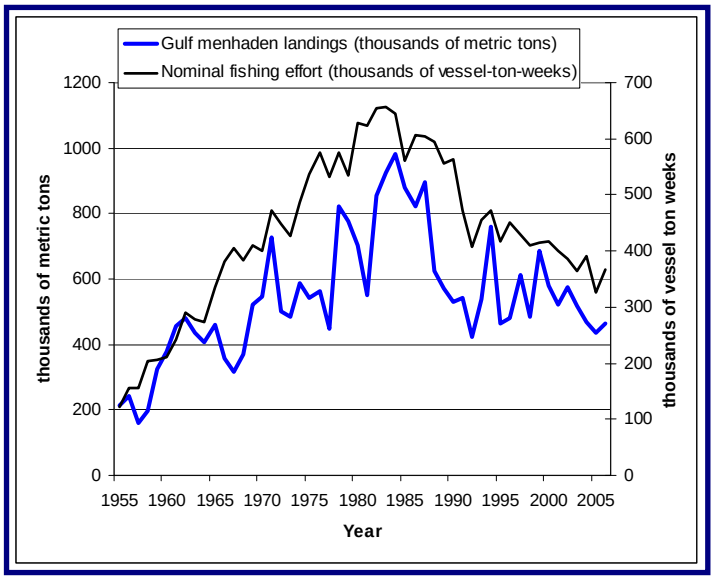
Although by-catch reduction devices have been used by the industry since the 1950s, the natural characteristics of menhaden behaviour decrease the likelihood of the collateral capture of non-targeted fish. The tight, species-specific schooling behaviour permits precise targeting.

Ecosystem impact – there are no studies showing a significant biological collateral effect on any other species. Purse seines do not drag on the seabed and leave benthic flora and fauna undisturbed. Predator fish do not generally swim inside the menhaden school and, in the rare event that this occurs, the speed and developed eyesight of the species who normally feed on menhaden allow them to escape via the large bottom opening. As a Category II fishery, any encounters with marine mammals are reported, but these are extremely rare. The same is true for turtles, which are at little risk as the nets are immersed for only 30 to 40 minutes.

Landings

Source: NMFS

Landings have decreased from the peak of the 1980's (blue line). However, overlaying the nominal fishing effort figures (black line) onto the same graph shows that the lower catches are the result of reduced effort, as opposed to over fishing.



MANAGEMENT MEASURES

Gulf menhaden are distributed throughout most of the Gulf of Mexico and as a result fall under the jurisdiction and authority of several federal and state agencies.

Legal jurisdiction – while the US's exclusive economic zone (EEZ) extends 200 nautical miles into the Gulf of Mexico, authority over the area from shore to three miles out is ceded to individual states. As menhaden are predominantly found in these state territorial waters, the five Gulf States (Louisiana, Mississippi, Alabama, Florida* and Texas) exercise direct management authority over the stock.

Additionally since the 1970s, oversight of the gulf menhaden fishery has been coordinated by the Gulf States Marine Fisheries Commission's (GSMFC) Menhaden Fisheries Management Plan. The GSMFC's stated goal is "to manage these fisheries in a manner that is biologically, economically, socially and ecologically sound, while protecting the resource and those who benefit from it" (Gulf States Marine Fisheries Commission, 2002).

**The use of industrial sized purse seines is not permitted in Florida State waters.*

MANAGEMENT REGIME

Statutory seasons/closures – the fishing season for gulf menhaden is from the third Monday in April until 1st November each year, approximately 140 days per year.

Summary list of statutory management controls for gulf menhaden – closed areas; seasonal bans; by-catch limits; vessel registration.

Mesh size regulations are in place (7/8" bar, 1.75" stretch mesh, knitted and knotted twine), which are designed to minimise the harvest of juvenile age-0 menhaden.

Regulatory oversight – the gulf menhaden fishery is closely monitored and controlled at both the Federal and State level.

The NMFS and its predecessor have monitored the gulf menhaden fishery since 1964, collecting information on:

- Daily landings
- Nominal fishing effort
- Size and age compositions of the catch

Tagging (mark and recapture) is also used to monitor stock health.

A Government sampling programme is in place at all landing sites as input to its assessment modelling. Additionally, the NMFS conducts an annual review of the stock and fishery status to ensure a consistent approach to the evaluation of existing menhaden management measures.

At the State level all fisheries agencies take regular trawl samples to assist with population assessments of menhaden.

The menhaden industry itself has kept records of every set made since 1979, and provides this data directly to the NMFS.

Stock rebuilding programs – in the event that the gulf menhaden stocks become overfished or depleted, the State/Federal Fisheries Gulf Menhaden Advisory Committee of the Gulf States Marine Fisheries Commission will recommend measures to rebuild the stock in a time frame not to exceed 10 years.

Voluntary codes – fishing takes place only during daylight hours from Monday to Friday throughout the statutory fishing season.

PROCESSING/MANUFACTURE

Factories – currently there are four fishmeal/fish oil processing plants for gulf menhaden, all located along the mid-northern coast of the Gulf of Mexico at Moss Point, Mississippi; and Empire, Abbeville, and Cameron, Louisiana.

Methods – the process of wet reduction begins with the offloading by pumps of chilled whole menhaden from the refrigerated holds of the carrier vessel. The fish are then steamed and the resulting mass of solids and liquids conveyed to the press. Oil and water containing dissolved and suspended solids is then squeezed from the mass leaving a damp intermediate known as press cake. The cake is then mixed with condensed solubles from the liquid phase and gently dried. The resulting product is then milled into meal and treated with an antioxidant to help the meal maintain its protein and residual oil qualities during storage and shipment.

The oil and water released during the pressing stage is pumped through screens and decanters to remove any suspended solids. This semi-clarified liquor is then separated by centrifuge. The oil is filtered and stabilised with antioxidants before going to storage tanks. The water fraction is returned to be dried with the meal to retain the protein rich dissolved and suspended solids (Gulf States Marine Fisheries Commission, 2002).

Output statistics

Estimated gulf menhaden meal & oil production

	Fishmeal (metric tons)	Fish oil (metric tons)
2000	132,000	57,803
2001	117,000	94,895
2002	132,000	72,941
2003	117,000	53,405
2004	134,000	55,557
2005	111,000	60,491
2006	118,000	46,528

Source: Daybrook Fisheries, Inc.; Omega Protein, Inc.

Food safety/traceability – the NMFS provides a seafood inspection program which includes the examination of economic integrity, quality and wholesomeness conditions, and HACCP seafood safety provisions (Brown, 2005).

HACCP traceability regulations require the establishment and maintenance of procedures for identifying products during all stages of receipt, production and distribution (National Marine Fisheries Service, 2000).

PRODUCTS AND MARKETS

Products – the main products of the menhaden fishmeal and fish oil industry are:

Low temperature fishmeal

Protein	62 - 66%
Fat	8 – 12%
Ash	16 – 21%
Moisture	6 – 10%
Salt/Sand	1 – 4%
Histamine	50 – 300 ppm

Fish oil

Free Fatty Acid	<4%
Unsaponifiable Matter	<2%
Moisture & Impurities	< 0.8%
Iodine Value	160 -180
Totox	20-35%
EPA Ω-3	12.8 – 15.4%
DHA Ω-3	6.0 – 9.1%

Amino acid profile

Aspartic Acid	5.8%
Threonine	2.7%
Serine	2.5%
Glutamic Acid	8.6%
Proline	3.3%
Glycine	4.8%
Alanine	4.2%
Cystine	0.6%
Valine	3.2%
Methionine	2.2%
Iso-Leucine	2.7%
Leucine	4.6%
Tyrosine	2.1%
Phenylalanine	2.5%
Histidine	1.8%
Lysine	5.0%
Arginine	4.0%
Tryptophane	0.5%
Taurine	0.5%
Hydroxyproline	1.4%

Main markets – the primary markets for menhaden fishmeal are the manufacturers of feeds for aquaculture and for young pigs, followed by the pet food industry.

Menhaden fish oil is sold in the USA, Europe, Chile, Canada and Japan. The primary market for the oil is in aquaculture feeds, although its richness in EPA and DHA Ω-3 fatty acids makes it attractive for direct human consumption as a supplement or in functional foods.

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