MENHADEN IN THE MULLICA VALLEY

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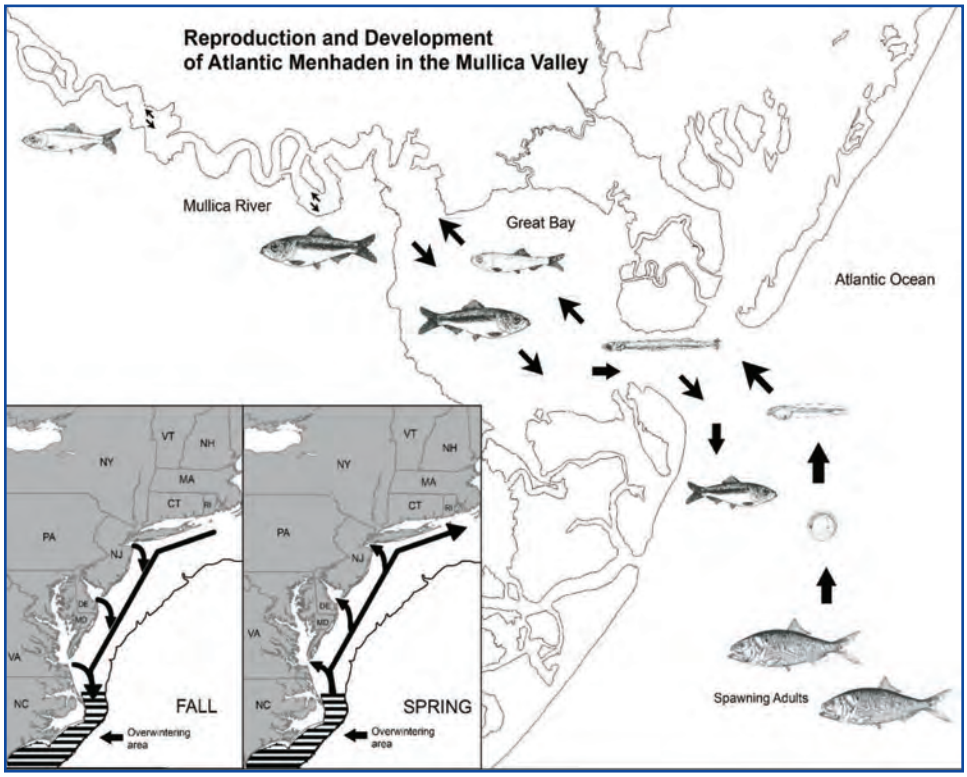

Figure 1. The life history of Atlantic menhaden and their different life history stages and the connection between the ocean and the estuarine waters of the Mullica Valley. The embryos and small larvae develop in the ocean while changes in body shape to miniature adults (juveniles) occur in the estuary. The juveniles migrate out of the estuary in the fall to join the adults in the ocean. The inset depicts the seasonal migration of the juveniles and adults during a typical year.

Rachel Carson, the noted writer and environmentalist, once wrote "….almost every person in the United States has at sometime eaten, used, or worn something made from menhaden." This statement is certainly true as the oily, soft-bodied relative of the herring gets incorporated into multiple uses from bait for stripers to a source of omega 3 in aquaculture and pills for humans. In addition, this fish (also called bunker, pogy, etc) has been referred to as "the most important fish in the sea" because it can feed on small algae and convert it to flesh, but at the same time serves as an important food for many different kinds of marine fishes, birds, and mammals. Despite its economic and ecological importance we do not completely understand the basic natural history of this abundant species. This hampers our ability to manage and conserve this species.

Many of the life history characteristics we have observed for Atlantic menhaden in the Mullica Valley, i.e. including Great Bay and the Mullica River, are true for other estuaries along the east coast. Spawning occurs in the ocean, the eggs and larvae develop there but must make an important movement into less salty estuaries in order to develop as juveniles (Fig. 1). They then move back into the ocean where they mature and become adults to complete their life cycle. This connection between the ocean and estuaries, like the Mullica Valley, are common to many other fish species in the United States, hence the reference to "estuarine dependent" species. At the Rutgers University Marine Field Station (RUMFS) we have been monitoring the entrance of the menhaden into Great Bay for over 27 years. During this time the seasons of their occurrence have changed drastically. In the early years (1989-1992) the larvae were most abundant in the fall and again in the spring. A careful analysis of the dates on which they hatched was possible because microscopic growth in their earbones, or otoliths, are laid down, not unlike the rings in a tree, except they occur daily. Thus a detailed record of their age is possible to calculate, at least when they are larvae. From this recorded history, we know that those larvae that entered through Little Egg Inlet in the fall and early winter were probably spawned and hatched during the fall as the adults make their way south along the coast for the winter. However, those larvae that enter the inlet in the spring are likely the result of spawning from south of Cape Hatteras off North Carolina because the adults do not typically occur off New Jersey at that time of year. They make their way up to Little Egg Inlet in the Gulf Stream and associated streamers. This pattern of occurrence in the Mullica Valley changed markedly during 1998 to 2006, when the peak in larval abundance was during the summer, presumably

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from spawning off New Jersey at that time of the year instead of in the fall. Subsequently, and extending to 2015, most larvae were collected in the fall. Over the years of these collections, the overall abundance of larvae has increased. In the early years, catches were low, but increased slightly in the late 1990s (Fig. 2). In 2002, they were very abundant and subsequently had generally more larvae after that during the early 2000s. In the last 3 years for which we have data, the catches of larvae have been much higher than the long-term average (Fig. 2). Unfortunately we do not understand the factors responsible for these changes. They may be due to changing environmental factors such as warming water temperatures, effects of the fishery, or changing distribution of the spawning adults. Or it could be all of these and others we have not yet considered. These vagaries are what make understanding the natural history of Atlantic menhaden so difficult and conservation and management even more difficult.

Once the larvae are in Great Bay and all the way up the Mullica River to Lower Bank, the larvae undergo a metamorphosis into the juvenile stage when they resemble small adults (Fig. 1). While in the estuary their growth and survival may be dependent on the available food. The smallest individuals (less than 1 – 1.5 inches) feed on small crustaceans such as copepods. At larger sizes their diet shifts to detritus (broken down plant material) and microscopic algae. When feeding on these types of food they swim around with their mouths open and sieve the small food particles out of the water on the gill rakers and small spines in front of their gills. Once the food is swallowed, a gizzard-like stomach helps them to break down the food for further digestion. Thus they can represent a direct link between salt marsh and algae production and the fishery for them. During the first summer in the estuary they begin to school together at about the same size as when they begin filter feeding. It is these tightly packed schools of "peanut" menhaden that can frequently be seen, constantly swimming while opening and closing their mouths.

The largest of these reach approximately 3 – 4 inches by September or October. They typically leave the estuary in the fall and they are seldom present during the winter. An exception is in the heated water from the power plant in Barnegat Bay. However if they are deprived of this heated water, as when the plant shuts down for repairs, they quickly die. We know from trawl surveys that the juveniles and adults migrate south for the winter in shallow water along the East Coast (Fig. 1 inset) in apparent response to lowering water temperatures. They spend the winter in the ocean south of Cape Hatteras and some spawn there. In spring, they again migrate back north, spawning frequently, along the coast to start their seasonal cycle of migration all over again. The menhaden response to warmer temperatures was also evident during the very mild winter of 2015 – 2016 when adult menhaden were found far up the Mullica River based on visual records and our gill net collections in March.

While in the estuary the juvenile and adult menhaden are frequently preyed upon by a variety of fishes, birds and mammals. One of the most visible is the osprey which can frequently be seen flying over with a large juvenile or adult in its talons during the summer and fall. Frequently they will sit on a post along the RUMFS causeway and slowly devour the entire body or they will deliver it to their nest for the chicks. Eagles feed on them as well and discard the bony head and the large gill covers, which can be found under their nests in the Mullica Valley during the spring through summer. Small menhaden also end up on the menu of terns and skimmers when feeding their chicks in the nests around Great Bay. A variety of resident and migrant fishes also rely on the juveniles and adults for a major part of their diet, including bluefish, weakfish, and striped bass. Together, all life history stages of the menhaden provide important ecological links throughout the Mullica Valley.

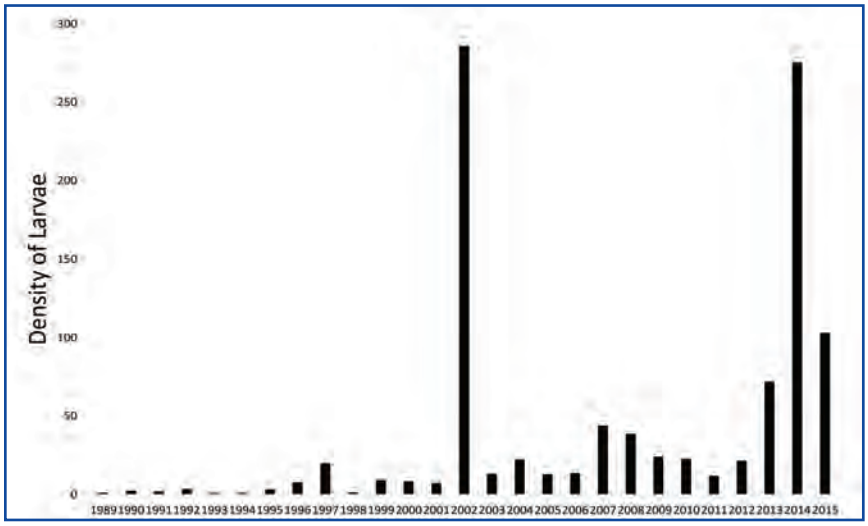

Figure 2. Variation in the abundance of menhaden larvae based on weekly collections over 27 years behind Little Egg Inlet in the Mullica Valley.