

Penaeid Shrimp Guild

Northern White Shrimp

Litopenaeus setiferus (top)

Brown Shrimp *Farfantepenaeus aztecus*
(middle)

Northern Pink Shrimp *Farfantepenaeus duorarum* (bottom)



Contributor (2013): Larry DeLancey (SCDNR)

DESCRIPTION

Taxonomy and Basic Description

These are probably the most well known shrimp because of their importance in fisheries along the Southeastern US coast, including the Gulf of Mexico. They are members of the shrimp family, Penaeidae, a large group that also contains a few smaller species common in this geographic area.

Penaeid shrimp possess a prominent rostrum (horn) with small teeth on both upper and lower margins, and lack postorbital spines. The first three pairs of walking legs are chelate (pincer like). White shrimp can be distinguished from brown and pink shrimp by their lack of a groove along the dorsal midline of the carapace (shell) and last section of the tail (telson). The groove on brown shrimp is wider than on pink shrimp (it is difficult to insert a fingernail in the pink shrimp telson groove). Despite the common names, color is often not a distinguishing characteristic for these shrimp, depending on freshness and time of year. Pink shrimp usually possess a dark spot on their abdomen, hence the common name “spotted shrimp”. These species can grow to relatively large size, 19 cm (8 in.) total length or greater, and are generally harvested at about 10 cm total length and above. Female penaeid shrimp possess a specialized structure composed of plates on the ventral surface near the last pair of walking legs (thelycum) that receives the spermatophore from male shrimp during mating, prior to releasing fertilized eggs. The male uses specialized appendages located on the first pair of swimming legs (petasma) to place spermatophores on the female (Williams 1984).

Spawning season varies somewhat by species, but occurs from spring through fall in oceanic waters. White shrimp and pink shrimp have a protracted spawning season from late March to early September, whereas brown shrimp have spawning peaks in spring and fall (Lindner and Anderson 1956; Williams 1955; Joyce 1965). Fertilized eggs fall to the bottom where they hatch into a swimming nauplius stage in about 24 hours. The nauplius then passes through several protozoa and mysis stages before molting into the most shrimplike stage, a postlarva (Pearson 1939). This process takes several weeks, depending on water temperature and time of year (Lindner and Cook 1970). Postlarvae move into estuarine areas through inlets, utilizing coastal winds and tidal currents (Bearden 1961; Wenner et al. 2005).

Penaeid shrimp grow rapidly in shallow estuarine nursery areas in the warm months of the year, predominately in tidal creeks adjacent to salt and brackish water marshes (Williams 1955; Zein-Elden and Renaud 1986), then eventually move down to areas close to and into the ocean, where they are harvested by both recreational and commercial fishermen. Figure 1 diagrams this cycle.

Penaeid shrimp are omnivorous, feeding on living and dead animal and plant material, including small benthic invertebrates (Hunter and Feller 1987; McTigue and Zimmerman 1991). They in turn, are consumed by numerous species, especially finfish, providing an important link between primary and secondary producers and larger predators (Minello and Zimmerman 1983).



Fig. 1: Penaeid shrimp stages of development.

Status

Penaeid shrimp have been intensively fished since the early part of the 20th Century; therefore the commercial fishery, and to some extent the recreational fishery, are managed and regulated at the state and Federal level in the US. In South Carolina, the Department of Natural Resources (SCDNR) sets openings for the shrimp seasons, and the closing of the commercial trawl season in state waters. In the Exclusive Economic Zone (EEZ), NOAA and the South Atlantic Fisheries Management Council (SAFMC) promulgate regulations through a management plan (<http://safmc.net/resource-library/shrimp>). The stocks of penaeid shrimp represent some of the most abundant nekton along the coast, and so they are not believed to be threatened at this time, and are viewed as a sustainable resource.

POPULATION SIZE AND DISTRIBUTION

Penaeid shrimp range from at least the mid-Atlantic coast down along the Atlantic and through the Gulf of Mexico (Williams 1984). Although no population estimates of overall numbers exist off the Atlantic Coast, numbers of all three species are thought to exist in the billions in the Gulf of Mexico, where commercial landings exceed Atlantic landings by an order of magnitude (<http://www.st.nmfs.noaa.gov/commercial-fisheries/index>; Hart 2011a, b, c). In South Carolina, the commercial harvest ranges from approximately 1.5 million pounds (tails) to over 4 million pounds, under optimal conditions. In South Carolina, the commercial trawl fishery averaged over 400 licensees in the most recent decade, and is the most valuable commercial fishery in the state in most years. Recreationally, penaeid shrimp are caught in the thousands by fishermen in South Carolina for consumption and bait for fishing (over 18,000 participants estimated for baiting fishery in 2012, SCDNR Fisheries Statistics Section).

HABITAT AND NATURAL COMMUNITY REQUIREMENTS

The three important penaeid species in the Carolinian region inhabit estuarine and oceanic areas as adults, with some apparent differences among species. White shrimp occur primarily in shallow waters less than 30 m in depth (Williams 1984). This is a reflection of their more primitive adaptations when compared to brown and pink shrimp (McMillen-Jackson and Burt 2003). As year-round residents of shallow water, white shrimp are prone to periodic cold kills from winter cold fronts that generally do not severely impact brown shrimp, which reside in deeper waters in the winter (Williams 1984), or pink shrimp which burrow into the sediment (Williams, 1955). Larval stages of the penaeids are planktonic in oceanic waters and are therefore influenced by factors such as currents, planktonic food supply, and abundance of various predators such as medusae and fish (Temple and Fisher 1967; Wong et al. 1989; Mills 1995; Lindquist and Hay 1996). When penaeid shrimp enter estuaries as post-larvae, they are carried by tidal currents into suitable nursery habitats using cues such as optimal salinity regimes to settle out onto preferred bottom types (Zein-Elden and Renaud 1986; Wenner and Beatty 1993). All three species are found over soft bottoms (mud, sand, and clay) with varying levels of detritus, but juvenile pink shrimp are most abundant in seagrass beds that exist in North Carolina and the Florida Keys (Williams 1955; Murphey and Fonseca 1995).

All three species can tolerate a wide range of physical factors, but generally water temperature that falls below 8°C is lethal for white shrimp, which are more tolerant of very low salinity waters (Zein-Eldin and Renaud 1986; Lam et al. 1989).

CHALLENGES

The factors that drive trends in penaeid shrimp wild populations are primarily climatic in nature, whereas the shrimp fisheries have been strongly influenced by both climatic and economic factors. In the second decade of the 21st century, the stocks and the fishery are in decline in South Carolina and in the neighboring states. The shrimp populations are probably sustainable at some reduced level from the previous half century, and will continue to be important as consumers and prey in the estuarine and coastal ecosystem, but will production be sufficient to support fisheries at a significant level? Recent prolonged drought conditions have negatively impacted white shrimp stocks (<http://www.dnr.sc.gov/marine/species/whiteshrimp.html>) and may approximate effects of future freshwater usage demands by a growing coastal human population (DeLancey et al. 2008). Rising sea level, establishment of exotic species such as the Asian tiger shrimp, *Penaeus monodon*, and the recent emergence of black gill disease (an unidentified protistan, M. Frischer, Univ. Georgia, pers. comm. 2013) are all factors that could be detrimental to penaeid shrimp stocks presently and in the future.

A general trend observed over the last four decades of an apparent increase in the frequency of warmer-than-normal winters appears to be resulting in increased survival of white shrimp spawners, resulting in more stable populations. However, mild winters appear to be interfering with brown shrimp recruitment mechanisms, thus resulting in smaller populations of that species. Also, reduced annual rainfall and increasing salinities in the estuaries appear to be having negative impacts on both white and brown shrimp populations. [Whitaker 2012, SCDNR Climate Change Workshop presentation.]

CONSERVATION ACCOMPLISHMENTS

Coastal Zone protection laws and regulations have been the most important factors in ensuring adequate and productive estuarine habitats for penaeid shrimp, with destructive activities such as dredging and filling marshland a thing of the past for the most part in South Carolina. More subtle impacts of increased human population growth in the Coastal Plain include increased freshwater usage and non-point source runoff that can degrade water quality. These factors can impact the ability of the estuaries to produce sustainable shrimp crops (Holland et al. 1996). Efforts to educate the public about resource protection and less impactful development practices have been fruitful, and will hopefully continue to inform planning and management decisions affecting shrimp and all coastal resources in the years to come.

CONSERVATION RECOMMENDATIONS

- Continue support for long-term monitoring programs for penaeid shrimp stocks.
- Encourage research on environmental impacts on species life history and production.
- Develop population models and innovative disease diagnostic tools.
- Improve our understanding of the spatial and temporal patterns of disease development in state waters, particularly in regards to black gill disease.
- Ensure that coastal habitat protection efforts continue.
- Collectively pursue alternative energy strategies to lessen dependence on fossil fuels.
- Continue to support conservation easements for land in estuarine watersheds.

Additional information on penaeid shrimp can be found on the SCDNR Website:

<http://www.dnr.sc.gov/marine/pub/seascience/shrimp.html>.

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