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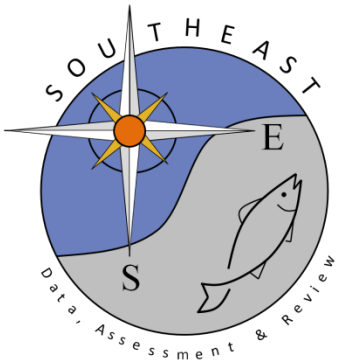

A Possible Mechanism for Recruitment of Postlarval Brown Shrimp

By
J. David Whitaker

The brown shrimp, *Penaeus aztecus,* is an important constituent of the South Carolina shrimp fishery comprising an average of 30-40 percent of the annual landings. Although the life history of the species from entering the estuaries as postlarvae to emigrating as "marketable size" shrimp is well known, little is known about location of spawning stocks, time of spawning, or migration of larval or postlarval shrimp to the coastal nursery grounds. We know that postlarvae enter the estuaries with warming water temperatures in late winter and early spring and appear to come in large pulses unlike its close relative the white shrimp, *Penaeus setiferus,* which immigrates into the estuaries over a relatively long recruitment period (usually early May through August with peaks in late May and early June).

The pulse of postlarval brown shrimp, usually in late February or early March, has suggested to biologists that the postlarvae are coming from a common spawning ground. This ground was thought to be offshore, perhaps off South Carolina or further south. The pulses were explained by the inshore movement of shrimp-laden, circulating surface water masses. If this is true, why is the timing of immigration of postlarvae so closely related to water temperature? I propose that postlarval brown shrimp are not coming from a common spawning ground but are coming from a common overwintering ground.

Laboratory tests by Zein-Eldin and Aldrich (1965) indicated that *P. aztecus* postlarvae cannot tolerate water temperatures below 11°C at salinities of 21 to 40 ppt. They also found that tolerances to low salinities were decreased at temperatures below 15°C. These data agree with our field observations which indicate that postlarval brown shrimp do not enter the estuaries until temperatures exceed 12-15°C. Further laboratory work has shown that postlarvae bury into a silty-clay substrate as temperature fell below 17°C and emerged as temperature rose to 18-22°C (Aldrich et al., 1967). Aldrich's study suggests that postlarvae may "hibernate" in the substrate during a portion of the winter when water temperatures are low.

Taking into account the above, I have constructed the following scenario for brown shrimp. Spawning occurs offshore during fall, perhaps in relatively deep water (probably less than 60 ft). Larvae become planktonic and move toward the surface where they are swept along by the warmer surface currents. The

larvae develop into postlarvae and grow slightly as they remain planktonic. In mid-December or January, the postlarvae come to nearshore waters where they encounter vertically unstratified and relatively cold (13 to 15°C) water. At this time the postlarvae seek bottom, bury, and "overwinter" until temperature rises in late February or March. The postlarvae then become active, move into the water column and are carried into the estuaries on tidal currents.

This hypothesis accounts for the large influx of postlarvae into the estuaries with increasing water temperature and also explains why no large aggregations of "roe" brown shrimp have been located off South Carolina. It appears there is a continual inshore movement of postlarvae through fall and winter from sparse spawning stocks offshore. The result is a gradual buildup of postlarvae along some isotherm (probably 12-17°C) near the coast. Some indirect evidence for this hypothesis comes from data collected in 1977. During that year, the peak of postlarval recruitment as indicated by sampling at Breach Inlet bridge, was only about half the size of the previous three-year mean. The 1976-1977 winter was extremely severe with MARMAP records indicating that nearshore water temperature was very low and the 10°C isotherm was much further seaward than normal. Postlarvae may have been force to remain further offshore than normal and thereby reduced their chances of entering the estuary immediately following the increase in coastal water temperatures. Although shrimp did not enter in large pulses, the recruitment period may have been lengthened which would account for the lengthened commercial brown shrimp season in 1977 which lasted more than a month beyond normal.

There are several suggestions of overwintering brown shrimp postlarvae in recent literature. Temple (1968) reported the occurrence of postlarvae off the Texas coast from September 1966 - April 1967. These postlarvae had a modal length of 11 mm in September and grew to 13 mm by January when cold temperatures arrested growth. The shrimp remained at 13 mm through the winter and entered the coastal inlets at that size. Hoese (1973), working off Georgia concluded, "...there is little evidence of overwintering (in the estuary) and the spring influx of young probably come either from overwintering larvae from a fall spawn or from areas far from Sapelo Island." Temple and Fischer (1967) examined Texas postlarvae and determined two seasonal peaks in abundance — one during fall and one during late winter or early spring when postlarvae entered Galveston Bay. They stated that the peaks were separated by a period of cold water temperatures and hypothesized that the shrimp were burying in the offshore bottom during this period.

The hypothesis presented here has no real bearing on shrimp management strategies. However, should brown shrimp postlarvae really overwinter in some zone near the coast, then careful consideration is needed with respect to ocean dumping of dredged materials.

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