Larval distributions in inner-shelf waters: The roles of wind-driven cross-shelf currents and diel vertical migrations

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ABSTRACT: To determine how physical processes and biological behaviors influence larval dispersal on the inner shelf, time series of larval concentrations were quantified during August 1994, on the Outer Banks of North Carolina, U.S.A. Zooplankton pumps, moored in 21 m of water at 3.2, 8.7, and 12.2 m above bottom, collected larvae every 3 h for 3 weeks. Physical variables and larvae were sampled at similar time and space scales. Larval concentrations were typically 10^2-10^4 m^{-3} for polychaetes, bivalves, and gastropods and 10-10^2 m^{-3} for brachyuran crab zoeae. There were two dominant scales of variability, 3-6 h and 2-10 d. The high-frequency signal is partially explained by diel vertical migrations—nocturnal ascent and daytime descent. This pattern would allow larvae to feed in subthermocline waters while avoiding visual predators. Low-frequency variations tracked with water temperature. Highest concentrations of worm larvae occurred in cool (upwelled) water and of crab zoeae in warm (downwelled) water. At least two larval groups comprised the clam and snail time series, one with fairly high abundances in cool water and the other with peak concentrations in warm water. Wind-driven cross-shelf transport is the most plausible explanation for these low-frequency fluctuations. For example, dense patches of worm larvae overlying parental habitat (offshore muds) would be carried shoreward in cool, upwelling flows. In contrast, brachyuran zoeae in nearsurface waters would descend at the coast during downwelling and, together with larvae aloft nearshore sediments, be transported seaward below the thermocline. Thus advected by strong along-shore and weaker cross-shelf currents, larvae zigzag up and down the coast. Vertically traversing the water column while they feed and grow, larvae ultimately seek a suitable habitat in which to settle.

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