Many planktonic larvae use tidal currents to migrate or maintain their position

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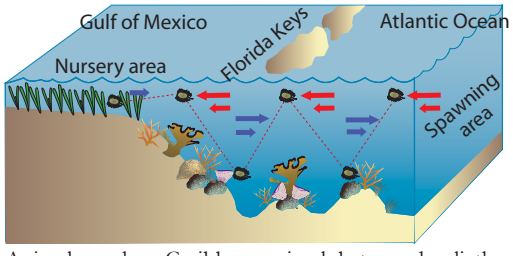
Many planktonic forms have limited mobility and are at the mercy of currents to control their distribution. However, other planktonic forms have the ability to migrate vertically and horizontally in the sea in response to environmental cues.

Vertical migration

Zooplankton, including adult and larval forms of crustaceans, salps, jellyfish, fish, squid, and other animals that live in the open ocean (blue water) perform daily vertical migrations by adjusting their buoyancy in response to light cues. They spend daylight hours at depths with little or no light penetration (aphotic zone) and migrate to the surface to feed during dark hours. This activity concentrates food sources at night and makes the surface waters an "eat or be eaten" environment. Also, excretion of nitrogenous wastes by the nightly migrants at the surface stimulates new primary production by phytoplankton during daylight hours.

Horizontal migration

Many organisms, including lobster, goliath grouper, and shrimp, spawn in the open ocean and settle out of the water column as juveniles in hardbottom, seagrass, and mangrove habitats on the Gulf of Mexico side of the Florida Keys. How do they get there? Larvae and postlarval forms are passively moved toward the Gulf by riding daily tidal currents and during times of periodic, wind-driven current reversals. But, how do they hold their position during unfavorable current conditions? The larvae are not as passive as once believed. They are able to adjust their buoyancy in response to current cues and seek refuge from unfavorable currents by migrating to protected benthic shelters, such as sponges and reefs. When currents become favorable again, they rise toward the surface to continue their migration to nursery habitats. This same mechanism allows larvae spawned in shallow waters to stay in the home range of their parents during daily tidal reversals.



Animals, such as Caribbean spiny lobster and goliath grouper, spawn in the Atlantic Ocean near the bank reef. Larvae are planktonic (i.e., float with the currents) but are capable of raising and lowering their position in the water column to "ride" tidal currents flowing toward the Gulf of Mexico. They find shelter near the bottom, out of the current, during periods of unfavorable flow direction and rise in the water column when the flow direction again becomes favorable. In this stepwise progression, they are capable of moving against the long-term flow and toward their nursery areas in seagrass, sponge, and mangrove communities on the Gulf side of Florida Keys and Florida Bay. Red arrows represent flooding tides toward the Gulf; blue arrows ebbing tides flowing to the Atlantic.

Implications for planning Marine Protected Areas

The movement of larvae into and out of no-take marine reserves plays an integral role in determining whether reserves can sustain themselves, exchange larvae with other protected sites, or supplement surrounding fished areas. A thorough scientific understanding of the larval dispersal methods of species protected in reserves is required in the effective design and placement of protected areas. Are larvae coming from long distances? Do they require protected habitats en route? Or are larvae "self-seeding" from local sources? For species capable of horizontal migration, it does not make sense to protect spawning habitat but not protect nursery habitat when both are required for the conservation of the species.