Chapter 9 – Tropical and Subtropical Shallows Seas

Chapter Summary

Hard substrate is an important limiting factor in the tropical ocean. Coral reefs, mangrove stands, and seagrass meadows provide homes and attachment sites for countless marine organisms.

Coral reefs are formed by sea anemone-like coral polyps that secrete a hard calcium carbonate skeleton. Most corals are colonial, built of numerous interconnected polyps. The growth rate of each colony is due to many factors, including light intensity, water clarity, day length, water temperature, plankton concentration, predation pressure, and competition. The growth rate of the entire reef is a function of deposition and removal of calcium carbonate by a variety of reef inhabitants and visitors. They usually are located within 30º latitude of the equator, in water that averages at least 20º C, on the eastern side of most continents, and at depths no greater than 50 meters.

Coral reefs are unique ecosystems whose most dominant animals are reef-building corals. Reef-building corals differ from other corals in that they harbor symbiotic, photosynthetic zooxanthellae within their tissues. This symbiotic relationship shapes the form of the trophic levels in coral-reef regions. Because of the transfer of products of photosynthesis, namely sugars and oxygen, coral-reef communities are able to thrive in nutrient-poor tropical waters. Although corals can gain food from zooxanthellae, they also can acquire either phytoplankton or zooplankton via suspension feeding as is common in other anthozoans.

Coral reefs occur in three morphologies, fringing reefs, barrier reefs, and atolls. Charles Darwin was the first to suggest that these reef designs are sequential developmental stages in the life cycle of a single reef.

Reproduction in reef-forming corals is both sexual and asexual. Asexual reproduction functions to increase the size of a particular coral colony by increasing the number of polyps (thus enabling more effective feeding), and to initial neighboring colonies that are clones of the original (via fragmentation, budding, and polyp bail-out). Sexual reproduction functions to increase genetic diversity. Most corals are broadcast spawners in that they release massive amounts of eggs and sperm into the water column above the reef. Subsequent fertilization takes place and results in a planktonic planula larva. These planula larvae remain in the plankton until appropriate and largely unknown cues influence them to settle to form new coral colonies.

Wave force, water depth, temperature, salinity, and a host of biological factors favor some corals and reef inhabitants over others. These conditions vary greatly across a reef and result in both horizontal and vertical zonation of the species that form the reef. For example, certain species are found on the reef buttress while others are found associated with the reef flat or lagoon. In addition to coral species, other algal and animal species also can be found in predictable locations on the reef.

Although biologists acknowledge that occasional catastrophic mortality may be beneficial to reefs in that it helps maintain their extraordinary biodiversity, it is clear that reefs worldwide are threatened by human activities. Sometimes episodes of mass mortality are due to natural causes, such as storms, predators or pathogens. Sedimentation, nutrification, and other human-related phenomena also result in wide-spread coral mortality. One group predicts that nearly 60% of the Earth’s coral reefs will die within 30 years, succumbing to pollution, destructive fishing practices, bleaching, and a host of diseases.
Reefs worldwide are dominated by benthic orectolobid sharks (nurses, wobbegongs, and bamboo sharks) and more typical pelagic carcharhinid sharks (blacktips, whitetips, tigers, and reef sharks).

Coral-reef fishes have evolved adaptations that have enabled them to succeed in the reef environment. The most obvious of these adaptations is spectacular coloration. Coloration probably evolved for concealment, disguise and/or advertisement. Another interesting adaptation that has evolved in reef fishes is that of cleaning symbiosis in which one species removes and eats parasites from another species. This type of symbiosis is a mutualism because one species picks external parasites to eat and the other species is rid of the irritating parasites.

Sexual, mating, and other reproductive strategies are equally diverse in reef teleosts. About one-quarter of all reef-fish species place sticky benthic eggs in a guarded nest on the reef, whereas the majority of reef teleosts are pelagic spawners that release many thousands of gametes into the water column. The recruitment of post-larval reef fishes to a coral reef is essential to maintaining the health and diversity of the reef itself. Post-larval fishes that do settle on reefs are offspring either of residents of that reef or fishes living upcurrent on adjacent reefs. It is crucial for managers and conservationists to determine the relative contributions made by each source of recruited larvae. The great diversity of reef fishes also results in an equally great diversity of sexual systems, from more typical species with separate sexes to complex systems involving simultaneous hermaphrodites (that produce both eggs and sperm) to sequential hermaphrodites that change sex.

The 100 or so species of sea snakes are relatives of the highly venomous cobras, coral snakes, and kraits. Most sea snakes are highly derived, and are able to complete their entire life cycle at sea, remaining underwater for eight hours or more. Most sea turtles (seven species are known) frequent coral reefs and seagrass meadows, often navigating over great distances to return to preferred nesting beaches year after year.

Manatees and dugongs are the only herbivorous marine mammals. They use their prehensile snouts to graze on a wide variety of sea grasses and the occasional macroalga.

Objectives

1. To introduce the anatomy and systematics of corals.
2. To summarize the biogeographical limits of coral-reef development.
3. To describe the symbiotic relationship between corals and zooxanthellae that represents the basis for the coral-reef ecosystem.
4. To describe the succession of the different types of coral reefs, namely fringing reefs, barrier reefs, and atolls.
5. To describe both asexual and sexual reproduction in corals.
6. To examine the details of coral-reef zonation.
7. To review the causes of coral diversity and catastrophic mortality.
8. To explore special adaptations in reef fishes, namely symbiotic relationships and coloration.
9. To summarize the amazing diversity of mating and sexual strategies employed by reef teleosts.
10. To review the natural history of marine tetrapods that frequent coral-reef areas.

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