Oyster reef ecology

Olympia oyster bed. Illustration adapted from painting **Olympia Oysters**, part of Olympia Oyster Restoration Project Wayside, by Cory Ench and Catska Ench, 2003.

Oysters are bivalves (meaning "two shells") inhabiting coastal waters, generally between latitudes 64° North and 44° South. Large aggregations of oysters can sometimes cover extensive areas of bottom in estuarine areas and also may exist above the substrate attached to various objects such as stones, pilings, shipwrecks, and even discarded bottles. These dense groups of living oysters and shells are variously referred to as oyster bottoms, oyster beds, oyster bars, oyster banks, or oyster reefs. Because these terms sometimes are used interchangeably and are not well defined, it is important to note that not all species of oysters form dense clusters that we normally refer to as "oyster reefs". To help differentiate, we define oyster reefs here as large colonial aggregations of living oysters and oyster shells that can have submerged as well as intertidal portions, and provide habitat for a community (or "biocoenose") of other species (e.g., tunicates, fish, crabs, worms, mussels, bryozoans, and barnacles).

The best examples of oyster reefs are found along the Atlantic and Gulf coasts, where oyster reefs are formed by one species - Eastern oyster (*Crassostrea virginica*). As the older oysters die, they form the foundation for the reef and live oysters form a living layer atop and around the structure of older, nonliving shells. Besides being excellent and tasty sources of food, oysters and oyster reefs serve vital roles in estuarine ecosystems. For example, oysters filter the water and reduce turbidity by extracting phytoplankton and organic and inorganic particles from the water column. Good water clarity, in turn, promotes the growth of submerged aquatic vegetation (SAV), which provides habitat for juvenile crabs, fish, and other organisms. In addition, the reefs may provide some protection from waves and currents, resulting in more favorable growing conditions for SAV. The SAV can also influence sediment deposition, both by stabilizing the sediment with rhizomes and by acting as a sediment trap (floating particles drop to the bottom as they encounter the leaves).

Oyster reefs form a complex ecosystem on and within their matrices and provide large surface areas for attachment by other sessile organisms such as barnacles, tunicates, mussels, sea anemones, and tube worms. Many of these organisms, like oysters, are filter feeders and contribute to the overall filtration capacity of the reef. They also serve as food for other reef inhabitants, such as crabs and fish. Small crustaceans called amphipods are abundant on most oyster reefs and are favorite prey items for some fish. In addition to providing habitat for prey items, oyster reef crevices and empty shells provide habitat and protection for a variety of animals. Some fish (e.g., gobies, blennies, skilletfish, and oyster toadfish) deposit their eggs inside the empty oyster valves, where they are less likely to be eaten by predators. Other fish normally found on East and Gulf Coast oyster reefs include spot, pinfish, lizardfish, sea trouts or weakfishes, red drum, American eel, and black drum (an important oyster predator), which forage on the diverse invertebrate assemblage (Brietburg 1995).

In addition to providing habitat to many other species, and attachment substrate for other oysters, oyster reefs serve other important functions. Oysters are filter feeders and, because of their tremendous filtering capacity, they greatly enhance water clarity and quality. Oyster reefs in the United States are not only unique ecosystems that support multitudes of other organisms, but they are a valuable food source and

constitute important commercial fisheries.

Species of oysters native to the United States

Three primary species of oysters have been commercially harvested in U.S. waters: the Eastern oyster (*Crassostrea virginica*), the Pacific (Japanese) oyster (*Crassostrea gigas*), and the native Pacific or Olympia oyster (*Ostreola conchaphila* = *Ostrea lurida*). The Eastern and Olympia oysters are native to the United States, whereas the Pacific oyster was introduced to the West Coast from Japan in the late 1800s or early 1900s.

The Eastern oyster (Crassostrea virginica). Photo credit: Virginia Institute of Marine Science.

The Eastern oyster has always been the mainstay of the commercial oyster industries on the East Coast and Gulf of Mexico. It is found from the Gulf of St. Lawrence to the Gulf of Mexico and the West Indies (Galtsoff 1964) and tolerates a wide range of salinities - from about 5 parts per thousand (ppt) up to full-strength sea water (about 35 ppt), and up to 40 ppt in hypersaline lagoons in Texas. It inhabits estuaries and coastal areas in intertidal and subtidal areas and forms large reefs. The size of adult Eastern oysters can vary from 2 to14 inches, depending on environmental factors (Galtsoff 1964).

The native, or Olympia, oyster is found along the West Coast from Alaska to Baja California, mostly in intertidal habitats, mud flats and gravel bars at the mouths of small rivers, and subtidal beds in deeper bays. It is a small oyster, measuring only about 2 to 3 inches in length, and is relatively difficult to culture.

Populations of the Olympia oyster were overharvested along the West Coast in the 1800s, resulting in the eventual introduction of the Pacific oyster from Japan to help re-establish the oyster industry, particularly in the Pacific Northwest. Although the Eastern oyster was also introduced into some bays along the Pacific Coast, it did not become well established and generally failed to reproduce. The Pacific oyster is now the most important commercial species on the West Coast and is widely cultivated, especially in Washington State.

Other oyster species

The Pacific oyster (*Crassostrea gigas*), a non-native species, is normally found in the Indo-West Pacific region from Pakistan to Japan, and in Korean waters, the Philippine Islands, Borneo, Sumatra, and all along the China coast (Tchang and Tse-Kong 1956). It was introduced in several U.S. locations - e.g., Washington, Oregon, Alaska, San Francisco Bay, several Northeast states, and Chesapeake Bay - and in Canada (Carriker and Gaffney 1996). Some were even placed in Mobile Bay, Alabama (Galtsoff 1964). It has a thinner and less dense shell than the Eastern oyster and is more cupped, sometimes long and slender, and usually has distinct ruffles on the shell edges. It can reach up to 10 inches in length and is very tolerant of higher-salinity water.

Pacific oyster, Crassostrea gigas. Illustration credit: Pacific Coast Shellfisheries Association.

Although all oysters filter water and may serve as habitat for other organisms, not all species of oysters are reef builders, and oyster reefs do not exist on the West Coast as they do along the East and Gulf Coasts of the United States. For instance, the native, or Olympia, oyster found along the U.S. West Coast is relatively small and usually is found attached to rocks or dead shells. Reefs formed by native oysters are not nearly as large or extensive as those formed by the Eastern oyster and, in general, the native oyster is no longer found anywhere in abundance. The NOAA Restoration Center is funding several projects along the West Coast in an attempt to restore the native West Coast oyster.

Loss of oyster reefs

The loss of oyster reefs in the United States during the past 200 years has not only significantly decreased the amount of food harvested from them, but has also removed habitat for other estuarine animals and plants, decreased water quality, and reduced income and jobs for workers in the oyster industry. Once the nation's crown jewel of oyster production, oyster harvests in Chesapeake Bay have reached an all-time low, and the once massive reefs have been reduced to 1 percent or less of their former mass. Similar scenarios have occurred in other locations as well, due to disease, water pollution, overharvesting, cumulative loss of cultch base, and mining of shell resources.