Chapter Five
Living Resources & Biological Communities

Within every habitat, communities of organisms exist in close relationship to each other. Communities may be as small as an oyster bar or as large as the entire Bay. The relationships among species form a complex web. Some organisms produce food and others serve as prey. Some communities, like submerged aquatic vegetation (SAV) provide both food and cover. Many organisms fit into more than one of these categories. The functions within a given community are almost endless, and the Chesapeake supports countless communities both large and small.

Change is characteristic of ecological systems, including Chesapeake Bay. Germination of plant seeds, birth of animals, growth, local movement and migration affects the species composition of each community as does changes in water quality, loss of habitat or overharvesting.

Some variations, such as seasonal changes in abundance, follow a predictable pattern. Every year, waterfowl migrate to the Bay to spend the winter feeding in uplands, wetlands and shallow water areas. Then, each spring, they return to northern parts of the continent to breed. After mating each summer, female blue crabs migrate to the mouth of the Bay to spawn, while the males remain in the upper and middle Bay. Anadromous fish, like shad and herring, spend most of their lives in the ocean, but each spring enter the Bay and migrate into freshwater to spawn. These are just a few of the seasonal variations that occur.

BAY FACT: Wetlands are among the most productive ecosystems in the world, producing more food, (in the form of detritus) than many agricultural fields.

Some Bay communities are prone to rapid population fluctuations of one or more species. This is particularly true of plankton. Rapid changes in plankton diversity and abundance may occur hourly or daily due to the interaction of biological, physical and chemical factors.

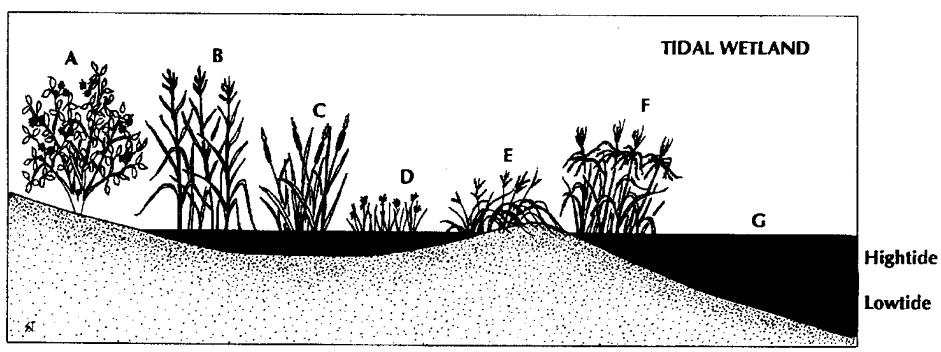
Many species exhibit long-term patterns in population abundance and distribution. For example, croakers suffer high mortalities during exceptionally cold weather. This fish was abundant in the Bay during the late 1930s and early 1940s. It is believed that relatively mild winters in the late 1930s and early 1940s promoted the high numbers of croakers. Human induced pressures can affect long term patterns. Striped bass declined rapidly in late 1970s and through the 1980s due to over-harvesting and subsequent reproductive failure.

Individual species may belong to a variety of communities and use different habitats throughout their life cycles. Habitats are connected and communities often overlap. Changes in a particular habitat may not only affect the communities it supports but other habitats and communities as well.

In the Chesapeake, wetlands, SAV beds, plankton, fish and bottom-dwellers ate biological communities supported by the Bay's varied habitats. Wetlands are transitional areas between uplands and water. SAV beds range from mean low tide to a depth of about 2 meters or where light becomes limiting to plant growth, although some freshwater specks thrive up to 3 meters deep. Open water supports the plankton community, composed mostly of minute creatures that float and drift with the movement of the water, and the nekton community, the fish and other swimmers who move freely throughout the Bay and its tributaries. The bottom sediments support benthic organisms.

• Wetlands

Wetlands, environments subject to periodic flooding or prolonged saturation, produce specific plant communities and soil types. The presence of water affects the types of soils that develop and the types of plants and animals that live there. Wetlands are characterized by hydrophytic vegetation (water-loving plants adapted to wet soils) and hydric soils (saturated or periodically flooded soils). There are two broad categories of wetlands in the Chesapeake Bay watershed. Wetlands within the reach of tides are considered tidal. Salinity in tidal wetlands ranges from fresh to saltwater. Nontidal or palustrine wetlands are freshwater areas unaffected by the tides. Wetlands receive water by rain, groundwater seepage, adjacent streams and, in the case of tidal wetlands, tides. Salinity, substrate and frequency of flooding determine the specific plant and animal life a wetland can support.

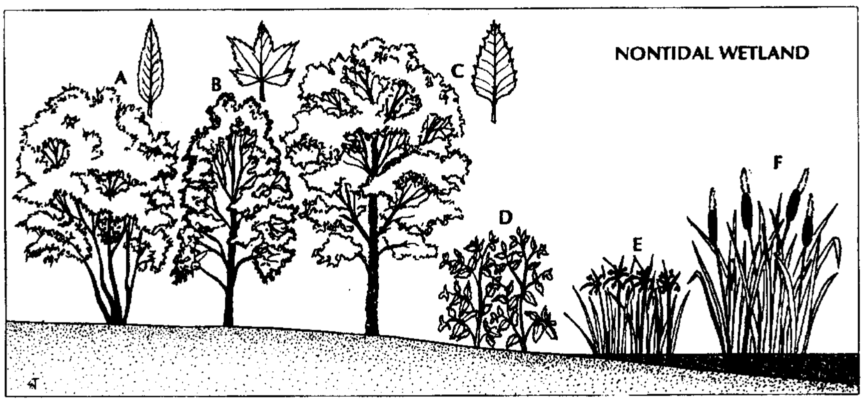


A Button bush *(Cephalanthus occidentalis)*
B Big cordgrass *(Spartina cynosuroides)*
C Narrow-leaved cattail *(Typha angustifolia)*
D Black needlerush *(Juncus roemerianus)*
E Saltmeadow cordgrass *(Spartina patens)*
F Wild rice *(Zizania aquatica)*
G Widgeon grass *(Ruppia maritima)*

Tidal wetlands are dominated by nonwoody or herbaceous vegetation and subjected to tidal flooding. These wetlands have a low marsh zone (flooded by every high tide) and a high marsh zone (flooded by extremely high tides). Plants such as smooth cordgrass are found in the low marsh zone of brackish and saltwater marshes. The high marsh zone may be dominated by saltmeadow cordgrass, black needlerush, saltgrass or marsh elder. Freshwater marshes also have low and high zones. Along the water's edge you may find wild rice, arrow arum, pickerel weed and pond lily. In the high zone, cattail and big cordgrass may be prevalent.

Nontidal wetlands frequently contain bulrush, broadleaved cattail, jewel weed, spike rushes and sedges. Forested wetlands, often referred to as swamps, may have permanent standing water or may be seasonally flooded. Trees commonly found in forested wetlands include red maple, black gum, river birch, black willow, Atlantic white cedar and bald cypress. Willows, alders and button bushes are types of shrubs present in forested wetlands.

Approximately 1.7 million acres of wetlands remain in the Chesapeake Bay watershed, less than half of the wetlands that were here during colonial times. Of the remaining wetlands, 12 percent are tidal and 88 percent are nontidal.



Nontidal Wetland

A. Black Willow (*Sale Nigeria*)
B. Red Maple (*Acer rubric*)
C. River Birch (*Betula nigra*)
D. Jewelweed (*Impatiens capensis*)
E. River bulrush (*Scirpus fluviatillis*)
F. Broad-leaved cattail (*Typha latifolia*)

Often viewed as wastelands, wetlands were drained or filled for farms, residential developments, commercial buildings, highways and roads. Over the past several decades our understanding and appreciation of wetlands has increased.

Plant diversity, biochemical reactions and hydrology of these habitats make them extremely productive. Wetlands support huge quantities of plant biomass. The huge amount of visible plant material in wetlands makes up only the above-ground biomass. The below-ground biomass, composed of root and rhizome material, is often more than double the above-ground biomass. This creates a tremendous reservoir of nutrients and chemicals bound up in plant tissue and sediments.

Many of the Bay's living resources depend on these wetland habitats for their survival. Tidal wetlands are the wintering homes for great flocks of migratory waterfowl. Other wildlife, including muskrats, beaver, otter, song birds and wading birds, rely on wetlands for food and cover. Fish and shellfish, many of which are commercially valuable, use wetlands as spawning or nursery areas. Thousands of aquatic animals, including reptiles, amphibians, worms, insects, snails, mussels and tiny crustaceans, thrive in wetlands and are food for other organisms.

The abundance of food and shelter provided by wetland vegetation is essential to other members of this community. A host of invertebrates feed on decomposing plants and animals. This nutrient-rich detritus is also available to juvenile stages of fish and crabs. A dense layer of microscopic plants and animals, including bacteria and algae, coats the land surface and serves as food. Stems of larger plants provide another good source of food. Decomposing plants and animals are the major food source for many other wetland inhabitants.

BAY FACT: Two thirds of the nation's commercial fish and shellfish depend on wetlands as nursery or spawning grounds.

Wetlands are also important for controlling flood and storm waters. Fast moving water is slowed by vegetation and temporarily stored in wetlands. The gradual release of water reduces erosion and possible property damage. Coastal wetlands absorb the erosive energy of waves, further reducing erosion.

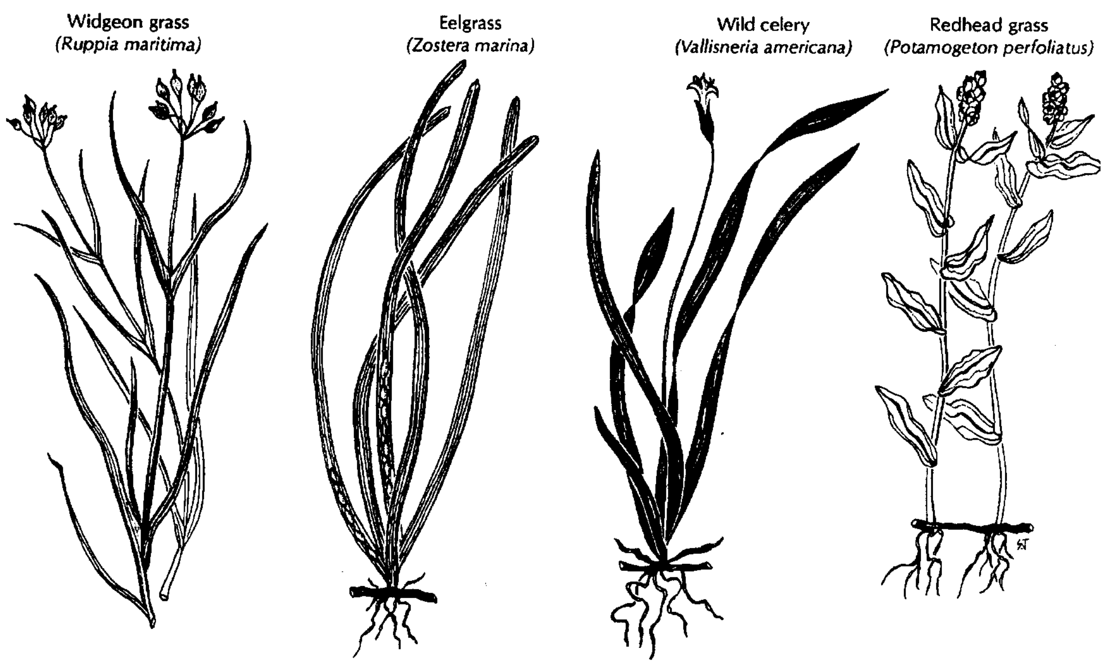
Poised between land and water, wetlands act as buffers, regulating the flow of sediments and nutrients into rivers and the Bay. As water runs off the land and passes through wetlands, it is filtered. Suspended solids, including sediment and pollutants, settle and are trapped by vegetation. Nutrients, carried to wetlands by tides, precipitation, runoff and groundwater, are trapped and used by wetland vegetation. As plant material decomposes, nutrients are released back into the Bay and its tributaries, facilitated by floodwaters or tides.

Economically, wetlands provide opportunities for fishing, crabbing and hunting. Other popular activities include hiking, birdwatching, photography and wildlife study. People are lured by the beauty of wetlands and much leisure time is spent simply enjoying the sights and sounds these areas can offer.

• Submerged Aquatic Vegetation

In the shallow waters of Chesapeake Bay, underwater grasses sway in the aquatic breeze of the current. Known as submerged aquatic vegetation or SAV, these amazing plant communities provide food and shelter for waterfowl, fish, shellfish and invertebrates. Like other green plants, SAV produces oxygen, a precious and sometimes lacking commodity in the Chesapeake Bay. These underwater plants filter and trap sediment that can cloud the water and bury bottom-dwelling organisms like oysters. As waves roll into SAV beds, the movement is slowed and energy is dispelled, protecting shorelines from erosion. During the growing season, SAV takes up and retains nitrogen and phosphorus, removing excess nutrients that could fuel unwanted growth of algae in the surrounding waters.

Like a forest, field, or wetland, an SAV bed also serves as habitat for many aquatic animals. Microscopic zooplankton feed on decaying SAV and, in turn, are food for larger Bay organisms. Minnows dart between the plants and graze on tiny organisms that grow on the stems and leaves. Small fish seek refuge from larger and hungrier mouths. Shedding blue crabs conceal themselves in the vegetation until their new shells have hardened. Thus, SAV is a key contributor to the energy cycling in the Bay. SAV is a valuable source of food, especially for waterfowl. In the fall and winter, migrating waterfowl search the sediment for nutritious seeds, roots and tubers. Resident waterfowl may feed on SAV year-round.



Widgeon grass *(Ruppie maritima)* | Eelgrass *(Zostera marina)* | Wild celery *(Vallisneria americana)* | Redhead grass *(Potamogeton perfoliatus)*

There are thirteen species of SAV commonly found in the Bay or nearby rivers. Salinity, water depth and bottom sediment determine where each species can grow. Survival of SAV is affected most by the amount of light that reaches the plants. Poor water quality resulting in less light penetration is the primary cause for declining SAV.

Factors that affect water clarity, therefore, also affect the growth of SAV. Suspended sediment and other solids cloud the water, blocking precious sunlight from the grasses. Excessive amounts of suspended sediment may cover the plants completely. Sources of suspended sediments include runoff from farmland, building sites and highway construction. Shoreline erosion also adds sediment to the Bay. Land development, boat traffic and loss of shoreline vegetation can accelerate natural erosion.

Nutrients, although vital to all ecosystems, can create problems when present in excessive amounts. Major sources of nutrients lnclude sewage treatment plants, acid rain, agricultural fields and fertilized lawns. High levels of nutrients stimulate rapid growth of algae, known as blooms. Algae blooms cloud the water and reduce the amount of sunlight reaching SAV. Certain types of algae grow directly on the plants, further reducing available sunlight.

Historically, more than 200,000 acres of SAV grew along the shoreline of Chesapeake Bay. By 1978, a survey of SAV documented only 41,000 acres. Declining water quality, disturbance of SAV beds and alteration of shallow water habitat all contributed to the Bay-wide decline. The absence of SAV translates into a loss of food and habitat for many Chesapeake Bay species.

Water quality is the key to restoring grasses to the Bay. Scientists have identified the water quality conditions and requirements necessary for the survival of five SAV species from wild celery found in freshwater, to sago pondweed, redhead grass and widgeon grass found in more estuarine water and eelgrass found in the lower Bay in saltier water. Each species is an important source of food for waterfowl. SAV is making a comeback. Water quality is beginning to improve due to the ban of phosphates in detergents, reduction of fertilizer use by farmers and homeowners, protection of shallow water habitat and the reduction of nutrients in sewage effluent. In 1984 only 38,000 acres of SAV were reported in the Bay and its tidal tributaries. By 1993 more than 73,000 acres of SAV were reported, representing an 85 percent increase from the low 9 years earlier.

• Plankton

Mainly unseen by the naked eye, a community made up of predominantly microscopic organisms also fuels the ecosystem we call the Chesapeake Bay. These tiny plants and animals, called plankton, drift with the water largely at the mercy of the currents and tides. Some of the tiny creatures move up and down in the water column to take advantage of light. Others will drop below the pycnocline, an intermediate layer where the increase in salinity is more pronounced, to avoid being washed out to the ocean.

Phytoplankton are any single-celled plants. Like higher plants, phytoplankton require light to live and reproduce. Therefore, the largest concentrations occur near the surface. Salinity affects phytoplankton distribution with the largest number of species preferring the saltier waters near the mouth of the Bay. The amount of nutrients in the water is a major determinant in the abundance of these plants. The largest concentrations of phytoplankton in the Bay occur during the spring when nutrients are replenished by freshwater runoff from the watershed. These high concentrations produce the characteristic brown-green color of estuarine and near-shore waters. Although there are many species of phytoplankton, the major types in the Bay are diatoms and dinoflagellates. When dinoflagellates dominate the water, a red-tinted bloom, called a mahogany tide, is produced.

Mahogany tides typically occur on warm, calm days often following rain. Diatoms, which are present throughout much of the year, may account for 50 per cent of total algal production.

> BAY FACT: One drop of Bay water may contain thousands of phytoplankton.

Changes in chemical conditions, such as the addition of nutrients, can cause rapid increases in the numbers of algae. These algal blooms can have serious consequences. They block light from reaching SAV beds. Even after they die, they can cause problems. Deposition and subsequent decomposition of large masses of plankton in the mainstem of the Bay can deplete dissolved oxygen, suffocating other estuarine animals.

Phytoplankton are the major food source for microscopic animals called zooplankton. Dominating the zooplankton are the copepods, a group of any crustaceans, about one millimeter long, and fish larvae. Zooplankton are distributed according to salinity levels. Distribution patterns are also related to those of their main food source, the phytoplankton. Zooplankton also feed on other particulate plant matter and bacteria.

The tiny larvae of invertebrates and fish are also considered zooplankton. Although this planktonic stage is only temporary, the larvae are a significant part of the community. These larvae are consumed by larger animals, and may, as they grow, consume copepods.

Another group of zooplankton found in the Bay are the protozoa. These single-celled animals feed on detritus and bacteria. They, in turn, become food for larvae, copepods and larger protozoa.

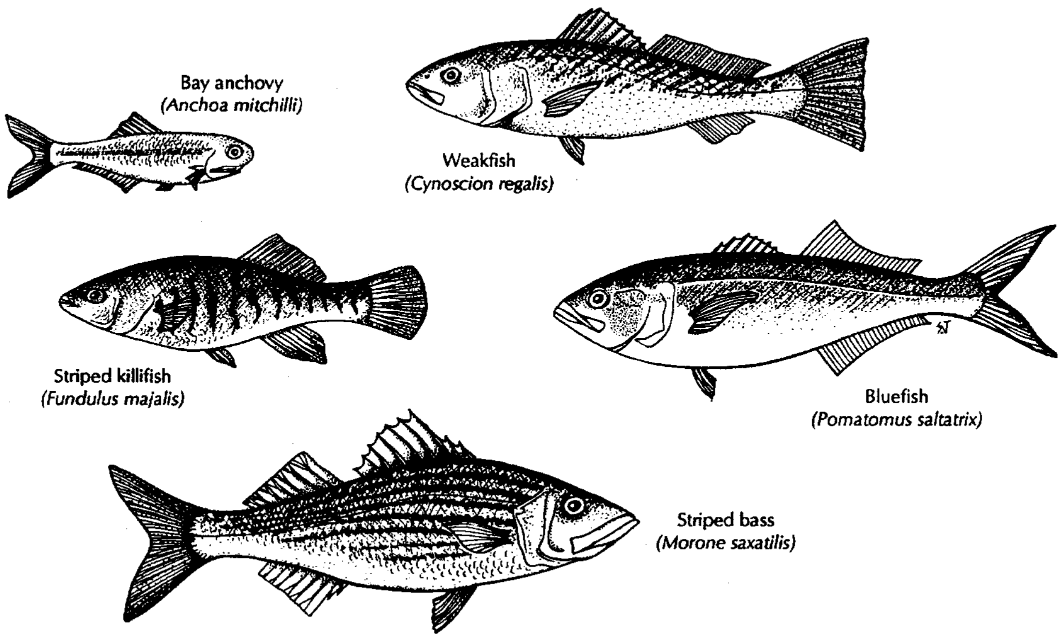
Bacteria play an important role in the Bay. They are essentially the decomposers. Their primary function is to break down dead matter. Through this process, nutrients in dead plant and animal matter again become available for growing plants. Bacteria are eaten by zooplankton and other filter feeding animals in the Bay.

Bacteria can be residents of the Bay or introduced through various pathways, including human sewage and run off from the land. Coliform bacteria are normal resident bacteria found in the intestines of mammals. The presence of coliform in a body of water indicates that human or other animal wastes are present. Coliform bacteria are an indicator that disease producing pathogens may be present in the water.

Clearly visible to the unaided eye, jellyfish and comb jellies are the largest zooplankton. Some of these gelatinous creatures swim, though they are still at the mercy of the water currents. Jellyfishes have tentacles with stinging cells used to stun prey. The most famous jellyfish in the Chesapeake is the sea nettle. Sea nettles feed voraciously on other zooplankton, including fish larvae, comb jellies, and even small fish. Because of the large volume of water in their bodies, few animals, except sea turtles, prey on sea nettles. Comb jellies, lacking the stinging cells of nettles, capture prey with adhesive cells. They too consume vast quantities of small copepods and zooplankton, especially oyster larvae.

• The Swimmers

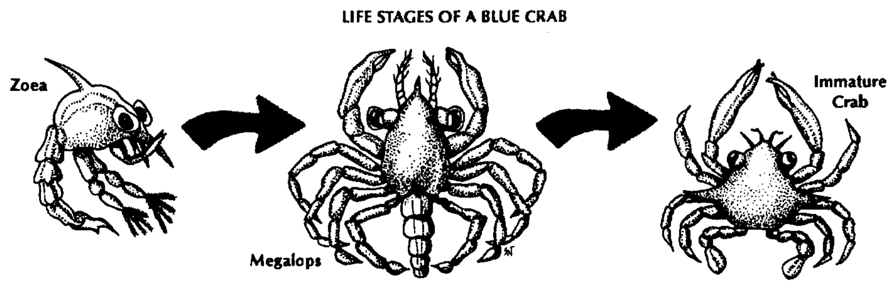
Swimmers comprise the nekton community. These organisms can control and direct their movements. This group includes fish and some crustaceans and other invertebrates. Approximately 250 species of fish can be found in the Chesapeake Bay. They can be divided into permanent residents and migratory fish. The residents tend to be smaller in size and do not travel the huge distances that migratory species do.



Smaller resident species, like killifish, normally occur in shallow water where they feed on a variety of invertebrates. The bay anchovy, the most abundant fish in the Bay, is a key player in the Chesapeake food web. Bay anchovies feed primarily upon zooplankton. Adult anchovies may also consume larval fish, crab larvae and some benthic species. In turn, the bay anchovy is a major food source for predatory fish like striped bass, bluefish and weakfish, as well as, some birds and mammals.

Migratory fish fall into two categories; anadromous, which spawn in the Bay or its tributaries, and catadromous fish, which spawn in the ocean. Anadromous fish migrate varying distances to spawn in freshwater. Some can even be considered Bay residents. For instance, during the spawning season, yellow and white perch travel short distances from the brackish water of the middle Bay to freshwater areas of the upper Bay or tributaries. Striped bass also spawn in the tidal freshwater areas of the Bay and major tributaries. Some remain in the Chesapeake to feed while others migrate to ocean waters. Shad and herring are truly anadromous, traveling from the ocean to freshwater to spawn and returning to the ocean to feed. Eels are the only catadromous species in the Chesapeake Bay. Although they live in the Chesapeake Bay for long periods, eels eventually migrate to ocean waters in the Sargasso Sea to

Life Stages of a Blue Crab



Zoea ⟶ Megalops ⟶ Immature Crab

spawn.

Other fish utilize the Bay strictly for feeding. Some, like croaker, drum, menhaden, weakfish and spot, journey into the Bay while still in their larval stage to take advantage of the rich supply of food. The abundance of menhaden supports a commercial fishing industry and provides food for predatory fish and birds. Bluefish enter the Bay only as young adults or mature fish.

Besides fish, crustaceans and invertebrates, like shrimp, crabs and worms, may be part of the nekton community. Larger animals like sharks, rays, sea turtles and occasionally dolphins and whales enter the Bay.

The blue crab is difficult to place in any one community, needing a variety of aquatic habitats, from the mouth of the Bay to fresher rivers and creeks, in order to complete its life cycle. Throughout the year crabs may burrow into the Bay bottom, shed and mate in shallow waters and beds of submerged aquatic vegetation or swim freely in open water. The first life stage of a blue crab, called the zoea, is microscopic and lives a planktonic free-floating existence. After several molts, the zoea reaches its second larval stage: the megalops. Another molt and a tiny crab form is apparent. Both juvenile and adult blue crabs forage on the bottom and hibernate there through the winter. In spring, the crab quickly begins migrating from the southern part of the Chesapeake to tidal rivers and northern portions of the Bay. During the rest of the year, adult blue crabs are dispersed through out the Bay, swimming considerable distances using their powerful paddle-like back fins.

• Life at the Bottom

The organisms that live on and in the bottom sediments of the Bay form complex communities. Known as benthos, these bottom-dwellers include animals, plants and bacteria. Benthic organisms are often differentiated by their habitat. Epifauna, like oysters, barnacles and sponges, live upon a surface. Worms and clams, considered infauna, form their own community structure beneath the bottom sediments, connected to the water by tubes and tunnels. The roots and lower portions of submerged aquatic vegetation supply the physical support for a wide variety of epiphytic organisms. An oyster bar, and the many species it supports, is another example of a benthic community. Benthic communities that exist on or in bare, unvegetated substrates are made up of molluscs, worms and crustaceans.

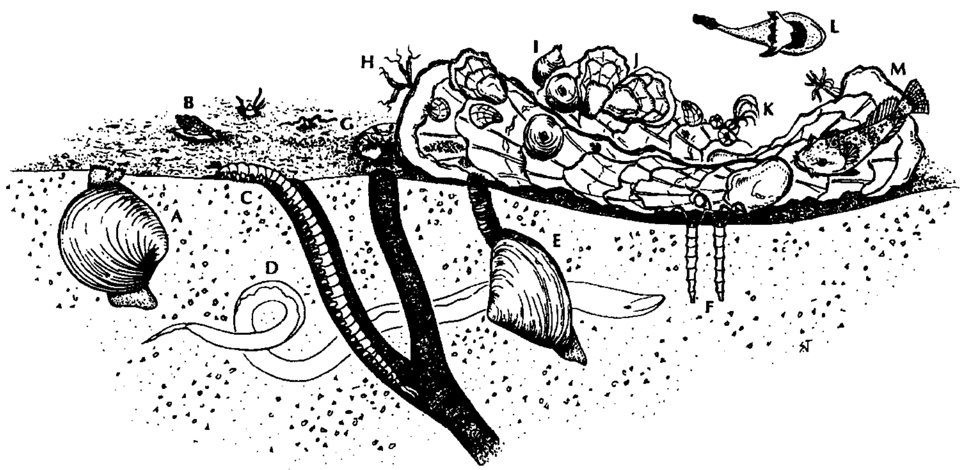
As with all aquatic life in the Bay, salinity affects the distribution of bottom-dwellers but sediment type also plays a role. Neither coarse sand nor soft mud support rich benthic populations. The best sediment for diverse benthic communities consists of a mixture of sand, silt and clay. Some organisms require specialized substrates. Oysters need a clean hard surface, preferably another oyster shell, on which the larval spat can attach or set. Oysters form a reef community that is important habitat for other benthic species.

BAY FACT: Oysters are alternate hermaphrodites meaning they can sense gender imbalances and change their sex.

The benthic community affects the physical and chemical condition of the water and sediments. Some build tubes or burrows through which they pump water. Infaunal deposit feeders, such as worms, plow through the sediments in search of food. Many benthic animals bind sediments together as fecal pellets that remain at the bottom. Predators, such as adult blue crabs, scurry across the bottom searching for food. These activities stir the sediments, increasing the rate of exchange of materials into the water column. This mixing also increases diffusion of oxygen into the sediments.

Filter feeders, like oysters and clams, pump large volumes of water through their bodies and extract food from it. As they filter water for food, they also remove sediments and organic matter, cleaning the water. Since many toxic substances are often present in sediments, benthic fauna are often exposed to and can be harmed by these pollutants.

Some benthic organisms, such as blue crabs, are widely distributed. Others are limited more by salinity. For example, hard clams and oysters require higher saline waters. Mid-salinity waters support soft-shelled clams. Brackish water clams are also found in lower salinities, along with freshwater mussels. Salinity also determines the distribution of certain benthic predators, parasites and diseases. MSX, a lethal parasite, and Dermo, a disease caused by another parasite, have decimated oyster populations of the mid and lower Bay, respectively. Oyster drills and starfish, which feed on oysters, are less of a problem in upper Bay waters because of their intolerance to low salinities.



Benthic Community

A. Hard clam (*Mercenaria mercenaria*)
B. Atlantic oyster drill (*Urosalpinx cinerea*)
C. Common clam worm (*Nereis succinea*)
D. Red ribbon worm (*Micrura leidyi*)
E. Soft-shelled clam (*Mya arenaria*)
F. Glassy tubeworm (*Spiochaetopterus oculatus*)
G. Black-fingered mud crab (*Panopeus herbstii*)
H. Whip mudworms (*Polydora ligni*)
I. Sea squirts (*Molgula manhattensis*)
J. Oyster spat
K. Ivory barnacle (*Balanus ebumeus*)
L. Skilletfish (*Gobiesox strumosus*)
M. American oyster (*Crassostea virginica*)