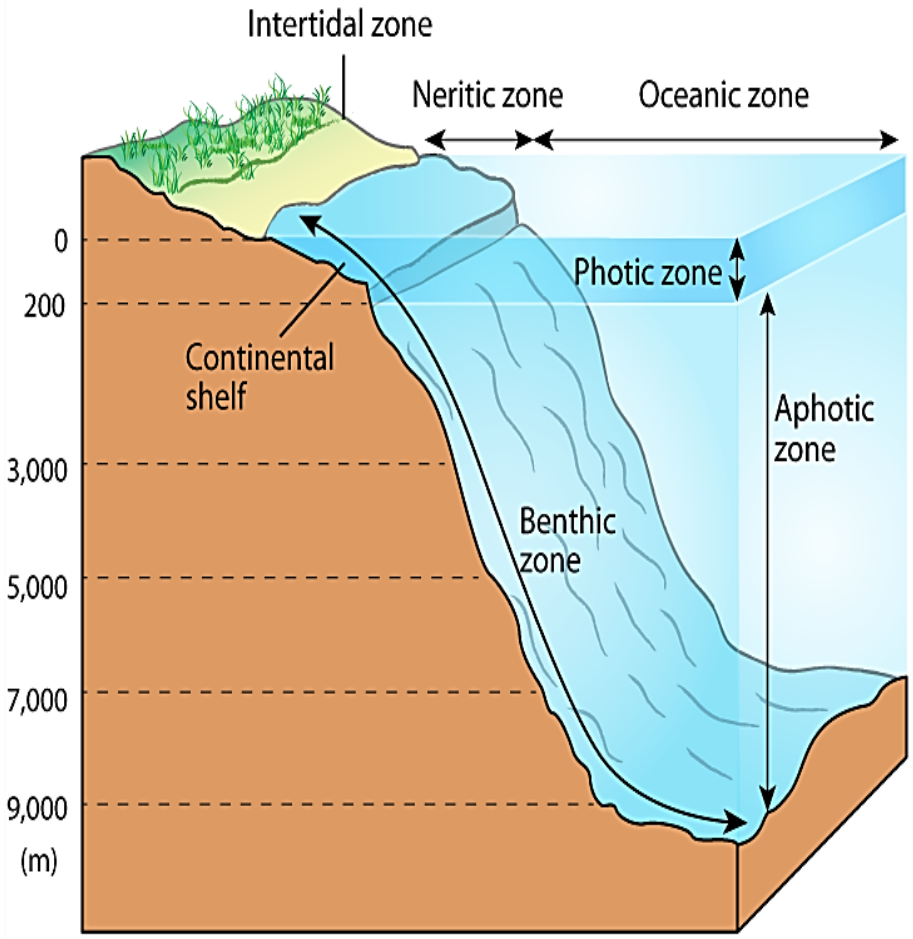
Stations 5 - 8
Zones of the Ocean

Zone	Estuary	Intertidal	Neritic	Open Ocean	Benthic
Also known as	N/A	Shore	Twilight	Photic and aphotic zones	Ocean floor Abyssal
Location	Where rivers and oceans meet				
Depth	N/A				
Animals found here					
Amount of Light	N/A			Slight light= photic; No light= aphotic	
Temperature	N/A				
Amount of Pressure	N/A				
Other Information					

Ocean Zones



The intertidal zone

is closest to shore. At high tide it is covered with water. At low tide, it is exposed to air. Living things must adapt to changing conditions and moving water in this zone.

The neritic zone

lies over the continental shelf. The water is not very deep. There are plenty of nutrients and sunlight. Many organisms live in this zone.

The oceanic zone

is the open ocean out past the continental shelf. The water may be very deep. Nutrients may be scarce. Fewer organisms live in this zone.

The photic zone

is the top 200 meters of water. This zone has enough sunlight for photosynthesis. That's why there are more living things here than in the aphotic zone.

The aphotic zone

is water below 200 meters. There isn't enough sunlight here for photosynthesis. Living things must eat whatever drifts down from above or each other. That's why there are fewer living things here than near the surface.

The bentic zone

is on the ocean floor. The ocean floor drops as you move away from the continents. There are fewer living things on the ocean floor where the water is very deep.

Station 5: What is an Estuary?

Via http://water.epa.gov/type/oceb/nep/about.cfm

An estuary is a partially enclosed body of water along the coast where freshwater from rivers and streams meets and mixes with salt water from the ocean. Estuaries and the lands surrounding them are places of transition from land to sea and freshwater to salt water. Although influenced by the tides, they are protected from the full force of ocean waves, winds, and storms by such land forms as barrier islands or peninsulas.

Estuarine environments are among the most productive on earth, creating more organic matter each year than comparably-sized areas of forest, grassland, or agricultural land. The tidal, sheltered waters of estuaries also support unique communities of plants and animals especially adapted for life at the margin of the sea. Many different habitat types are found in and around estuaries, including shallow open waters, freshwater and salt marshes, swamps, sandy beaches, mud and sand flats, rocky shores, oyster reefs, mangrove forests, river deltas, tidal pools, and seagrasses.

Thousands of species of birds, mammals, fish, and other wildlife depend on estuarine habitats as places to live, feed, and reproduce. And many marine organisms, including most commercially-important species of fish, depend on estuaries at some point during their development. Because they are biologically productive, estuaries provide ideal areas for migratory birds to rest and re-fuel during their long journeys. Because many species of fish and wildlife rely on the sheltered waters of estuaries as protected spawning places, estuaries are often called the "nurseries of the sea."

Estuaries provide us with a suite of resources, benefits, and services. Some of these can be measured in dollars and cents, others cannot. Estuaries provide places for recreational activities, scientific study, and aesthetic enjoyment. Estuaries are an irreplaceable natural resource that must be managed carefully for the mutual benefit of all who enjoy and depend on them. Estuaries have important commercial value and their resources provide economic benefits for tourism, fisheries, and recreational activities. The protected coastal waters of estuaries also support important public infrastructure, serving as harbors and ports vital for shipping and transportation.

Estuaries also perform other valuable services. Water draining from uplands carries sediments, nutrients, and other pollutants to estuaries. As the water flows through wetlands such as swamps and salt marshes, much of the sediments and pollutants are filtered out. This filtration process creates cleaner and clearer water, which benefits both people and marine life. Wetland plants and soils also act as natural buffers between the land and ocean, absorbing flood waters and dissipating storm surges. This protects upland habitat as well as valuable real estate from storm and flood damage. Salt marsh grasses and other estuarine plants also help prevent erosion and stabilize shorelines.

Coastal counties are growing three times faster than counties elsewhere in the nation. Unfortunately, this increasing concentration of people upsets the natural balance of estuarine ecosystems, threatens their integrity, and imposes increased pressures on vital natural resources like estuaries. What happens on the land affects the quality of the water and health of the organisms that live in an estuary. For example, if a river or stream flows through an agricultural area, it picks up fertilizer, manure, and pesticides from farming operations that run off the land after a rainstorm. As it passes urbanized and suburbanized areas, it gathers fertilizers or pet waste that wash off lawns, untreated sewage from failing septic tanks, wastewater discharges from industrial facilities, sediment from construction sites, and runoff from impervious surfaces like parking lots.

Station 5: The Intertidal Zone

The intertidal zone, also known as the littoral zone, in marine aquatic environments is the area of the foreshore and seabed that is exposed to the air at low tide and submerged at high tide, i.e. the area between tide marks. In the intertidal zone the most common organisms are small and most are relatively uncomplicated organisms. This is for a variety of reasons; firstly the supply of water which marine organisms require to survive is intermittent. Secondly, the wave action around the shore can wash away or dislodge poorly suited or adapted organisms. Thirdly, because of the intertidal zone's high exposure to the sun the temperature range can be extreme from very hot to near freezing in frigid climates (with cold seas). Lastly, the salinity is much higher in the intertidal zone because salt water trapped in rock pools evaporates leaving behind salt deposits. These four factors make the intertidal zone an extreme environment in which to live.

The intertidal zone, experiences the effects of tidal and longshore currents and breaking waves to a depth of 5 to 10 meters (16 to 33 feet) below the low-tide level, depending on the intensity of storm waves. The zone is characterized by abundant dissolved oxygen, sunlight, nutrients, generally high wave energies and water motion, and, in the intertidal subzone, alternating submergence and exposure. A typical rocky shore can be divided into a spray zone (also known as the Supratidal Zone, which is above the spring high-tide line and is covered by water only during storms, and an intertidal zone, which lies between the high and low tidal extremes. Along most shores, the intertidal zone can be clearly separated into the following subzones: high tide zone, middle tide zone, and low tide zone.

High tide zone (upper mid-littoral) The high tide zone is flooded during high tide only, and is a highly saline environment. The abundance of water is not high enough to sustain large amounts of vegetation, although some do survive in the high tide zone. The predominant organisms in this sub region are anemones, barnacles, brittle stars, crabs, green algae, isopods, limpets, mussels, sea stars, snails, whelks and some marine vegetation. The high tide zone can also contain rock pools inhabited by small fish and larger seaweeds. Another organism found here is the hermit crab, which because of its portable home in the form of a shell does extremely well as it is sheltered from the high temperature range to an extent and can also carry water with it in its shell.

Middle tide zone (lower mid-littoral) The middle tide zone is submerged and flooded for approximately equal periods of time per tide cycle. Consequently temperatures are less extreme due to shorter direct exposure to the sun, and therefore salinity is only marginally higher than ocean levels. However wave action is generally more extreme than the high tide and spray zones. The middle tide zone also has much higher population of marine vegetation, specifically seaweeds. Organisms are also more complex and often larger in size than those found in the high tide and splash zones. Organisms in this area include anemones, barnacles, crabs, green algae, isopods, limpets, mussels, sea lettuce, sea palms, sea stars, snails, sponges, and whelks. Again rock pools can also provide a habitat for small fish, shrimps, krill, sea urchins and zooplankton. Apart from being more populated, life in the middle tide zone is more diversified than the high tide and splash zones.

Low tide zone (lower littoral) This sub region is mostly submerged - it is only exposed at the point of low tide and for a longer period of time during extremely low tides. This area is teeming with life; the most notable difference with this sub region to the other three is that there is much more marine vegetation, especially seaweeds. There is also a great biodiversity. Organisms in this zone generally are not well adapted to periods of dryness and temperature extremes. Some of the organisms in this area are abalone, anemones, brown seaweed, crabs, green algae, hydroids, isopods, limpets, mussels, nudibranchs, sculpin, sea cucumber, sea lettuce, sea palms, sea stars, sea urchins, shrimp, snails, sponges, surf grass, tube worms, and whelks. Creatures in this area can grow to larger sizes because there is more energy in the localized ecosystem and because marine vegetation can grow to much greater sizes than in the other three intertidal sub regions due to the better water coverage: the water is shallow enough to allow plenty of light to reach the vegetation to allow substantial photosynthetic activity, and the salinity is at almost normal levels. This area is also protected from large predators such as large fish because of the wave action and the water still being relatively shallow.

Station 6: Neritic Zone.

The Neritic Zone is a shallow marine environment extending from mean low water down to 200-metre (660-foot) depths, generally corresponding to the continental shelf. Neritic waters are penetrated by varying amounts of sunlight, which permits photosynthesis by both planktonic and bottom-dwelling organisms. The zone is characterized by relatively abundant nutrients and biologic activity because of its proximity to land. Coarse, land-derived materials generally constitute the bottom sediments, except in some low-latitude regions that favor production of calcium carbonate sediments by such organisms as algae, bacteria, and corals.

The neritic zone is the relatively shallow part of the ocean between the low tide mark and the continental shelf. From the point of view of marine biology it forms a relatively stable and well-illuminated environment for marine life, from plankton up to large fish and corals, while physical oceanography sees it as where the oceanic system interacts with the coast.

In marine biology, the neritic zone, also called coastal waters, the coastal ocean or the sublittoral zone, refers to that zone of the ocean below the low tide mark where sunlight reaches the ocean floor, that is, where the water is never so deep as to take it out of the photic zone. It extends from the low tide mark to the edge of the continental shelf, with a relatively shallow depth extending to about 200 meters (110 fathoms or 667 feet). Above the neritic zone lie the intertidal (or eulittoral) and supralittoral zones; below it the continental slope begins, descending from the continental shelf to the abyssal plain and the pelagic zone.

Within the neritic, marine biologists also identify the following:

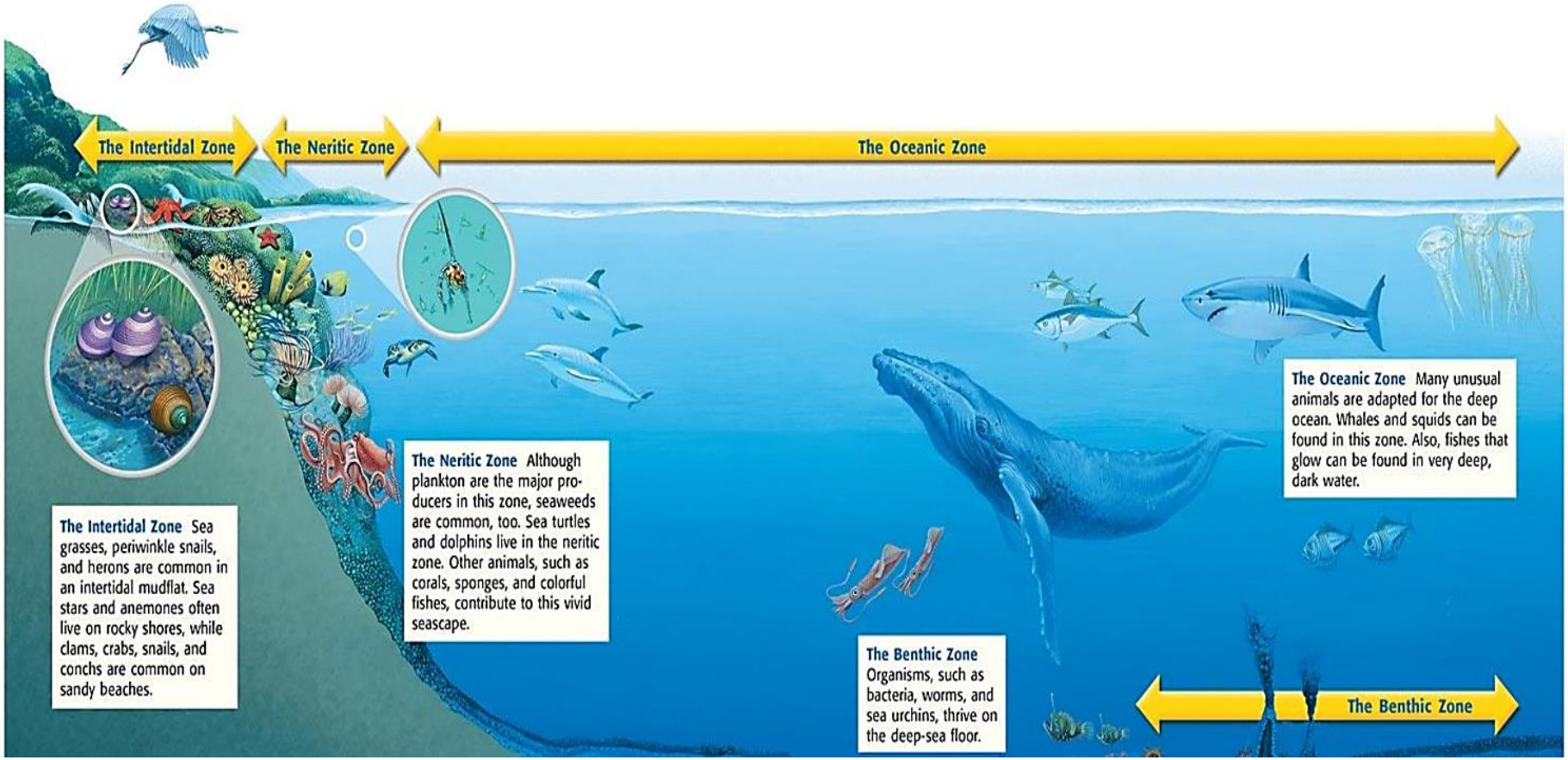
- The infralittoral zone is the algal dominated zone to maybe five metres below the low water mark.
- The circalittoral zone is the region beyond the infralittoral, which is dominated by sessile animals such as oysters.
- The subtidal zone is sometimes defined as the shallower region of the neritic zone close to the shore.

The neritic zone is permanently covered with generally well-oxygenated water, receives plenty of sunlight and has low water pressure; moreover, it has relatively stable temperature, pressure, light and salinity levels, making it suitable for photosynthetic life. In particular, the benthic zone (shallow ocean floor) in the neritic is much more stable than in the intertidal zone.

The above characteristics make the neritic zone the location of the majority of sea life:♫2𝄞 they result in high primary production by photosynthetic life such as phytoplankton and floating Sargasso; zooplankton, free-floating creatures ranging from microscopic foraminiferans to small fish and shrimp, feed on the phytoplankton (and one another); both trophic levels in turn form the base of the food chain (or, more properly, web) that supports most of the world's great wild fisheries. Corals are also mostly found in the neritic zone, where they are more common than in the intertidal zone as they have less change to deal with.

Marine Zones

The life in a marine ecosystem depends on water temperature, water depth, and the amount of sunlight the area receives.



Station 7: The Oceanic Zone

The oceanic zone begins in the area off shore where the water measures 200 meters (656 feet) deep or deeper. It is the region of open sea beyond the edge of the continental shelf and includes 65% of the ocean's completely open water. The oceanic zone has a wide array of undersea terrain, including crevices that are often deeper than Mount Everest is tall, as well as deep-sea volcanoes and ocean basins. While it is often difficult for life to sustain itself in this type of environment, some species do thrive in the oceanic zone (Col).

The oceanic zone is subdivided into the epipelagic, mesopelagic, and bathypelagic zones. The epipelagic (euphotic) zone, also called the sunlit zone, receives enough sunlight to support photosynthesis. The temperatures in this zone range anywhere from 40 to −3 °C (104 to 27 °F)(NHPTV). The mesopelagic (disphotic) zone, where only small amounts of light penetrate, lies below the epipelagic zone. This zone is often referred to at the Twilight Zone due to its scarce amount of light. Temperatures in the mesopelagic zone range from 5 to 4 °C (41 to 39 °F). The pressure is higher here, it can be up to 1,470 pounds per square inch (10,100,000 Pa) and increases with depth (NHPTV).

90% of the ocean lies in the bathypelagic (aphotic) zone into which no light penetrates. This is also called the midnight zone. Water pressure is very intense and the temperatures are near freezing range 0 to 6 °C (32 to 43 °F)

Oceanographers have divided the ocean into zones based on how far light reaches. All of the light zones can be found in the oceanic zone. The epipelagic zone is the one closest to the surface and is the best lit. It extends to 200 metres and contains both phytoplankton and zooplankton that can support larger organisms like marine mammals and some types of fish. Past 200 meters, not enough light penetrates the water to support life, and no plant life exists (NHPTV).

There are creatures however, which thrive around geothermal vents, or geysers located on the ocean floor that expel super heated water that is rich in minerals. These organisms feed off of chemosynthetic bacteria, which use the super heated water and chemicals from the hydrothermal vents to create energy in place of photosynthesis. The existence of these bacteria allow creatures like squids, hatchet fish, octopuses, tube worms, giant clams, spider crabs and other organisms to survive (Knight).

Due to the total darkness in the zones past the epipelagic zone, many organisms that survive in the deep oceans do not have eyes, and other organisms make their own light with bioluminescence. Often the light is blue green in colour, because many marine organisms are sensitive to blue light. Two chemicals, luciferin and luciferase that react with one another to create a soft glow. The process by which bioluminescence is created is very similar to what happens when a glow stick is broken. Deep-sea organisms use bioluminescence for everything from luring prey to navigation (Knight).

The oceanic zone is home to a wide variety of marine species because plants can grow here and water temperatures are relatively warm. Lots of marine animals can be found in the sunlit zone including sharks, tuna, mackerel, jellyfish, sea turtles, seals and sea lions and stingrays. There are not a lot of places to hide in the sunlit zone! Some species have an adaptation called countershading. These animals are dark on the top and lighter on their undersides. When a predator is looking down on them from above, they blend into the darker waters below. When a predator is looking at them from below, they blend into the lighter waters above.

Animals that live in the twilight zone must be able to survive cold temperatures, an increase in water pressure and dark waters. There are no plants in this zone, because there is not enough light for photosynthesis. Octopus, squid, and the hatchet fish are some of the animals that can be found in this zone.

Many animals in this zone have thin bodies that help them hide from predators. Other organisms in this zone are red or black in color to better blend in with the dark water. When a predator is looking up at them, they are so thin that they are hard to see!

Some fish, like viper fish and the hatchet fish, have sharp fangs and large mouths that help them catch food. Other fish have large eyes that help them see in the dark waters. Most of the fish in this zone don't chase their food. They either stalk it or wait for it to float or swim by. Some animals that live in this zone make their own light with bioluminescence. They make light with special organs in their bodies called photophores. The photophores give off a greenish light.

It is very cold and completely dark in the midnight zone. Water pressure can be as much as two tons per square inch. Life isn't easy here and this zone has fewer organisms than the other zones. Because there is no light in this zone, some animals don't have eyes. There are no plants in this zone.

Station 8: Benthic Zone

The benthic zone is the ecological region at the lowest level of a body of water such as an ocean, including the sediment surface and some sub-surface layers. Organisms living in this zone are called benthos, e.g. the benthic invertebrate community, including crustaceans. The organisms generally live in close relationship with the substrate bottom and many are permanently attached to the bottom. The superficial layer of the soil lining the given body of water, the benthic boundary layer, is an integral part of the benthic zone, as it greatly influences the biological activity which takes place there. Examples of contact soil layers include sand bottoms, rocky outcrops, coral, and bay mud.

The benthic region of the ocean begins at the shore line (intertidal or eulittoral zone) and extends downward along the surface of the continental shelf out to sea. The continental shelf is a gently sloping benthic region that extends away from the land mass. At the continental shelf edge, usually about 200 meters deep, the gradient greatly increases and is known as the continental slope. The continental slope drops down to the deep sea floor. The deep-sea floor is called the abyssal plain and is usually about 4,000 meters deep. The ocean floor is not all flat but has submarine ridges and deep ocean trenches known as the hadal zone.

Benthos are the organisms which live in the benthic zone, and are different from those elsewhere in the water column. Many are adapted to live on the substrate (bottom). In their habitats they can be considered as dominant creatures, but they are often a source of prey for Carcharhinidae such as the lemon shark. [2] Many organisms adapted to deep-water pressure cannot survive in the upper parts of the water column. The pressure difference can be very significant (approximately one atmosphere for each 10 meters of water depth).

The benthic zone of the ocean is varied. There are mountains, trenches, volcanoes, flat muddy areas, sandy areas and rocky areas. There is a wide variety of life that makes its home on the ocean floor. Some organisms live in the mud, some crawl or swim along the bottom and some anchor themselves to the ocean floor. Life in the benthos region is organized by size. Macrobenthos are organisms that are larger than one millimeter like oysters, starfish, lobsters, sea urchins, shrimp, crabs and coral. Meiobenthos are between one tenth and one millimeter in size. Organisms in this group include diatoms and sea worms. Microbenthos are very tiny organisms like diatoms, ciliates and bacteria. They are smaller than one tenth of a millimeter.

Because light does not penetrate very deep into ocean-water, the energy source for the benthic ecosystem is often organic matter from higher up in the water column which drifts down to the depths. This dead and decaying matter sustains the benthic food chain; most organisms in the benthic zone are scavengers or detritivores. Some microorganisms use chemosynthesis to produce biomass.

Benthic organisms can be divided into two categories based on whether they make their home on the ocean floor or an inch or two into the ocean floor. Those living on the surface of the ocean floor are known as epifauna.[3] Those who live burrowed into the ocean floor are known as infauna.[4]

Sources of food for benthic communities can derive from the water column above these habitats in the form of aggregations of detritus, inorganic matter, and living organisms. These aggregations are commonly referred to as marine snow, and are important for the deposition of organic matter, and bacterial communities.[5] The amount of material sinking to the ocean floor can average 307,000 aggregates per m^2 per day.[6] This amount will vary on the depth of the benthos, and the degree of benthic-pelagic coupling. The benthos in a shallow region will have more available food than the benthos in the deep sea.

In oceanic environments, benthic habitats can be further zoned by depth. From the shallowest to the deepest are: the epipelagic (less than 200 meters), the mesopelagic (200–1,000 metres), the bathyal (1,000–4,000 meters), the abyssal (4,000–6,000 meters) and the deepest, the hadal (below 6,000 meters).

The lower zones are in deep, pressurized areas of the ocean. Because of the high pressures and seclusion neither tidal changes nor human impacts have had much of an effect on these areas, and the habitats have not changed much over the years. Many benthic organisms have retained their historic evolutionary characteristics. Some organisms are significantly larger than their relatives living in shallower zones, largely because of higher oxygen concentration in deep water.[78]

It is not easy to map or observe these organisms and their habitats, and most observation has been done through remote controlled submarines.