

Rocky shore

Inter tidal areas having solid rocky bottom, large boulders and igneous rocks are called rocky coasts. Rock types may vary from the hard, impervious granite type to the more porous soft rocks such as limestone, sand stone and chalk. The softer rocks degrade more easily to form cracks, crevices and rock pools. Generally rocky intertidal shore will have steep slopes as the structures are like vertical structures. Rocks provide a hard surface on which marine organisms can attach themselves. When the tide is out, the rocks are exposed and during this period large number of organisms such as seaweeds and other attached organisms are visible to the naked eye of the observer. A unique characteristic feature of the rocky inter tidal shore is the formation of zonation by various organisms with varying capacities to tolerate dessication and predation pressure. Generally, rocky intertidal shores have three distinct zones comprising the 'supralittoral fringe' zone (splash or spray zone), 'littoral' (mid- littoral) zone , and 'sublittoral fringe' zone.

Suprtidal Fringe zone

This upper intertidal zone, also called wave splash or spray zone, is the area lying above the highest high-tide mark that gets moisture only by the ocean spray of crashing waves. This area is a transitional area lying between land and sea and is a harsh and inhospitable area where only a very few specialised organisms can inhabit. The organisms living in this zone include a few terrestrial animals that can tolerate salt spray and occasional immersion and also some marine organisms which can resist exposure and dessication. E.g. gastropod snails (*Littorina neritoides*), encrusting black lichen (*Verrucaria* sp., *Calothrix* sp., and *Xanthoria parietina*), crabs (*Ocypode* spp.), sea-slater isopod (*Ligia oceanica*), acorn barnacle (*Semibalanus balanoides*) and occasionally flowering plants.

The periwinkle snail (*Littorina littorea*) feeds on these algae in the upper intertidal zone. The snails scrape the algae off the rocks with their rasping teeth, called a radula. The scavenging sea-slater, *Ligia oceanica* is a nocturnal one and takes shelter in damp cracks and crevices during day time.

Mid-Intertidal zone

Below the upper intertidal zone lies the mid-intertidal zone, which is the area between the high and low tide marks and also the largest of all the three intertidal zones. This area is occupied largely by barnacles, mussels, and seaweeds. Within this zone, barnacles are dominant in many regions of the world, with some distinct local variations in abundance. A variety of organisms may successfully compete for resources especially in the lower parts of this zone, as this area is covered with water most of the time. While in temperate waters, major animals include sedentary mussels, limpets, gastropods and polychaetes, in tropical regions barnacles dominate. Two common species of barnacles, the rock barnacle (*Balanus balanoides*) and the bay barnacle (*B. improvisus*), are found attached firmly on to the rocks by cementing or gluing so that the most powerful wave cannot dislodge them.

At high tide, barnacles are covered by water. During this time, they filter feed on plankton and organic debris by rhythmically whipping their feathery cirri to capture food. When the tide goes out, the barnacles are exposed to air for several hours, so they shut their shells tight to prevent them from drying. The barnacle's sharp, overlapping shells also help to protect it from predators. However, a marine snail called the dog whelk (*Nucella lapillus*) can drill a hole through the shell and eat the barnacle. For feeding on barnacles, the whelk produces an acidic secretion from its glandular foot, which softens the barnacle shell before the whelk drills into it with its radula.

Below the layer of barnacles lie seaweeds and a densely packed bed of mussels (*Mytilus edulis*, *Perna viridis*, *P.indica* etc.). Mussels attach to the rocks by means of byssal threads. The threads prevent the mussels from being dislodged by waves. Like barnacles, mussels are filter feeders. The beating of the mussels' tiny cilia (on the surface of their gill membranes) creates currents which carry food and oxygen into, and wastes out of, their shells. This bed of mussels attracts several predators. The dog whelk that eats barnacles also eats mussels. Sea stars creep over the mussel beds and consume large numbers of these bivalves. The blue mussel (*Mytilus edulis*) is found along the Atlantic and Pacific coasts and is harvested and eaten by humans. The brown seaweed called rockweed (*Pelvetia*, *Fucus*) also lives in the mid-intertidal zone. When the tide is low, thick mats of rockweed can be seen hanging or draped over the rocks. The seaweed clings to the rocks by means of its holdfast pad. Rockweed provides cover for a variety of marine animals that live in and among the rocks, such as snails, limpets, small crabs, and worms. When the tide is high, rockweed floats near the surface, buoyed up by its gas-filled bladders.

Rock Pools

Rock pools are found at all levels on the shore but the largest ones are generally found at the lower levels of the shore. The depth of rock pools ranges from a few centimetres to a few meters, but all must contain some permanent water to designate as rock pool. The volume of rock pools ranges from a few litres to a few cubic meters with weekly to monthly variations dependent on season, volume, surface to volume ratio and the amount of vegetation. The environmental conditions are most suitable in the rocky pools in comparison to other habitats of littoral zone. The forms found in these pools are sponges, hydroids, sea anemones, bryozoans, copepods, snails, limpets, mussels and tunicates.

Lower Intertidal Zone

Below the bed of mussels lies the lower intertidal zone, which is dominated by seaweeds. The red seaweed commonly known as Irish moss (*Chondrus crispus*) grows like a thick carpet over the rocks in this zone. When the tide is low, spaces between the rocks retain water, forming small habitats known as tide pools. Tide pools are like natural aquarium tanks that contain algae, invertebrates (such as snails and crabs), and small fish.

Sub-tidal Zone

Below the lower intertidal zone is the underwater sub-tidal zone. The rocky coast sub-tidal zone has an abundance of life. Sea urchins eat giant kelp, the biggest seaweed in the ocean, by feeding on its holdfasts. Sea stars cling to the rocks. The movement of the sea stars is dictated by the tides. When the tide comes in, the sea stars move from the sub-tidal zone to the intertidal zone to feed on the mussels. There is also a variety of sea anemones, as well as crabs and lobsters, hiding in the rock crevices. Lobsters come out of their hiding places at night to feed. Predatory fishes that come from the open ocean, prey on the abundant invertebrates.