BETWEEN THE TIDES AND A HARD PLACE

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Imagine living in an environment where every day is stressful. The area just beyond the high-water mark of neap tides along the seashore is an example of such an environment. The organisms that live here have to cope with the combined extremes of both land and sea environments: salt spray, immersion in salt water, drenching by heavy rainfall, heating by the sun, freezing winter temperatures, unstable substrates such as sand, gravel, boulders or bare rock crevices, and exposure to strong winds. How do they cope?

Top. **The maritime form of wild cineraria, *Senecio elegans*, with its succulent leaves and stems.**
Above. **The seaweed *Porphyra* and the glasswort *Sarcocornia littorea* side by side high up on the sea shore. *Porphyra* can dry out completely for up to seven days, and recover in minutes once re-hydrated.**
Photos: G. Maneveldt.

Animals generally find it easier to survive in this harsh environment because they can escape when the going gets too tough. Plants (both terrestrial and marine) on the other hand, have to either tolerate it or succumb, and indeed they have found astonishing ways of coping.

For terrestrial plants living on the shore (we will call them maritime plants) the main problem is how to survive in a salty environment. A characteristic feature of many of these plants is succulence. They have to store lots of fresh water in their tissues, as seawater is too salty for them to use directly, and they must store it whenever it is available. Maritime plants are often subjected to the desiccating effects of salt laden winds that deposit toxic salts on them, they get blasted by sea sand or buried in it, and are subjected to intense solar radiation both direct and reflected. To cap it all they grow in organically poor soils that have little water holding capacity. They use a variety of mechanisms to cope in this saline environment. Some can selectively control salt absorption at root level. Others secrete excess salt via salt glands on the surfaces of leaves. Some, like glassworts and the soutbossie *Chenolea diffusa* actually concentrate salt in their tissues, diluting the salt by storing it in their succulent parts (they compartmentalize the salt in parts of the plant where high salt concentrations will not affect normal metabolism). Glassworts with their waterproof bodies are so tough that they are one of the few flowering plants that can truly be said to live in salt water as many are covered by the sea at almost every high tide. Some glassworts can even tolerate a salinity of up to 75 parts per 1000. When one considers that the ocean is on average about 33 parts per 1000, one can readily appreciate the resilience of these plants.

This environment is also a prime habitat for the establishment of lichens, which are able to survive extremes of heat, cold and drought. They are capable of living in this hostile environment because of their ability to dry out completely; shutting down their metabolism when conditions become too severe. It is also believed that their complex chemistry allows them to control light exposure, repel herbivores, kill attacking microbes and discourage competition from plants. These are important adaptations for life in the marginal habitat.

Seaweeds too have a hard time surviving in this environment for they have to cope with problems associated with prolonged exposure to air. All the vital functions of life such as respiration, photosynthesis, growth and reproduction must be adapted to two completely different environments. Probably their greatest stresses are desiccation and temperature extremes.

Porphyra, an abundant seaweed on rocky substrates within this zone, is able to lose almost all its thallus fluid, drying out to a crisp, paper thin film only about 10% of its original mass. While many other seaweeds would die if they lost this much turgidity, this species readily recovers once re-hydrated. Often this seaweed has to rely on salt spray for re-absorption of valuable life-giving seawater. Thin seaweeds like *Porphyra* also lose their water content very fast, but overcome the problem by growing in dense populations where they can cover and shade each other when exposed.

Other seaweeds, less tolerant of desiccation stress, survive in high shore tidal pools. Here however they have to cope with salinity stress as these tidal pools become extremely saline under hot, dry conditions and tend toward fresh water under rainy conditions. The few seaweeds (mostly green seaweeds like *Ulva, Enteromorpha* and *Monostroma*) adapted to this environment have a high salinity tolerance ranging from as little as 3 parts per 1000 to as much as 115 parts per 1000. They are able to regulate the amounts of dissolved internal salts, keeping their internal osmotic pressures somewhat higher than the surrounding medium. This process prevents loss of water to the surrounding saline environment allowing them to maintain fairly constant turgidity.

A high shore tide pool overgrown with the green seaweed *Ulva*.
Photo. G. Maneveldt.

Surprisingly, besides mangroves, there appear to be no true specialists within this environment. Some terrestrial plants such as *Sarcocornia* (glasswort) are saltmarsh plants while others like *Tetragonia fruticosa* (sprawling duneweed or kinkelbossie) are early colonizers of sandy, calcareous areas typical of beach dunes. The seaweed *Porphyra*, despite being very abundant beyond the high neap tide mark, does occur throughout the intertidal area. The reason that these plants survive in this harsh environment is probably a combination of two factors: a greater tolerance of extreme conditions and reduced competition from plants that cannot tolerate it between the tides.

WHAT DOES THAT MEAN?

glasswort or glasswort samphire
A sprawling perennial succulent with stems jointed and no obvious leaves.

neap tide
Tide that occurs soon after the moon's first and third quarters, in which high-water level is at its lowest.

thallus
A plant body not differentiated into true leaves, stems and roots. It is often a flattened structure.

Below left. **A dense mat of the glasswort *Sarcocornia littorea* and the soutbossie *Chenolea diffusa*.**
Below right. **Sprawling duneweed or kinkelbossie, *Tetragonia fruticosa*, growing in beach sand. It is often a pioneer species of beach dunes.**
Photos: G. Maneveldt.