The sands of time

In less than a human lifetime, the sands of a beach can become dry land. ***Gary Skinner****, Catalyst's Biology editor and resident photographer, explains how.*

In nature, everything changes. Mountain ranges which seem to remain unchanged throughout our lifetime are slowly but surely eroding, and over the millions of years of geological time will cease to exist. Even an everyday beach, of the kind where you may have spent holidays, is not a permanent feature. In some parts of the world such beaches are being eroded away. In others, fascinatingly, they are growing and adding to the land area.

In the photograph on pages 10-11 of this issue of Catalyst you can see some of the stages of this growth process.

How dunes start

Fine particles of sand brought down into the sea from eroding mountains are eventually washed onto the beach. Here, onshore winds blow and the sand particles are carried inland. Sometimes, sand may build up around an obstacle on the beach. This may be something non-living, such as a dead branch or even a bit of litter, or it may be a small plant which has managed to take root in the shifting sand – some plant species are adapted to be able to do this. Whichever it is this leads to the formation of a small pile of sand, sometimes referred to as an embryo dune.

An embryo dune can provide habitat for the highly-adapted pioneer plants which first take a hold in the shifting sand beaches. Over time, these plants accumulate organic chemicals through the process of photosynthesis, using carbon dioxide from the atmosphere and water from the sand. Their roots, which are generally very spreading and deep, hold the sand together and provide a habitat for other plants. As these plants die the nutrients locked in their bodies are released by decomposition and add to the quality of the sand as a medium for growth. It is now becoming soil.

The vast root system of a group of marram grass plants

The pioneer plants have now changed the environment where they live so that it is suitable for other plants which, although they do not have the adaptations of the pioneers, are better suited to growing in the changed environment produced by the pioneers. These bigger plants will now compete with the pioneers for light, minerals and water. Slowly but surely, the pioneers are eliminated and the bigger plants take over. Although not so highly adapted as the pioneers this next stage are still very specialised. They include large grasses such as marram and lyme grass. Their root systems go many feet into the sand, leading to the formation of often gigantic dunes.

The photograph on pages 10-11 shows many of the features of a typical developing dune system.


Marram grass *Ammophila arenaria* and lyme grass, *Leymus arenarius* are both important dune builders. They out compete the pioneers once the former have improved the soil.
Couch grass; there several related spec important pioneers
Woodland growing on areas which were sand a few hundred years ago
Sea Rocket (*Cakile maritima*), another pioneer.

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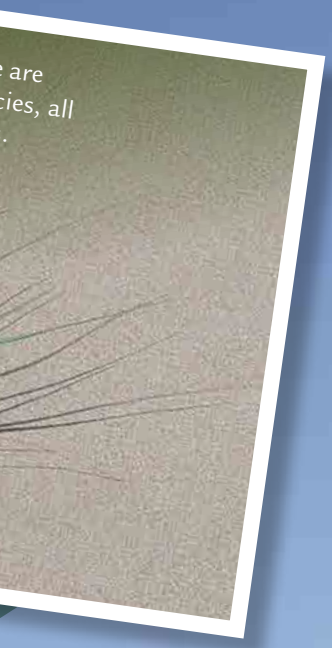
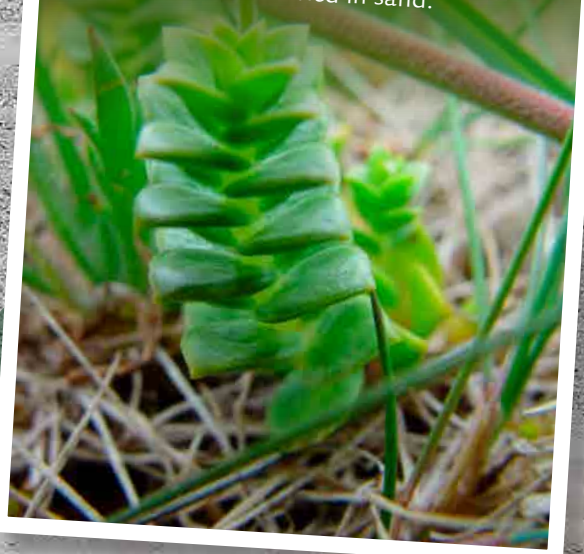


The sea

Sea-sandwort (*Honkenya peploides*), a pioneer plant. This plant is adapted to living in the salty environment near the sea. It has fleshy leaves which store water. The roots are extensive and it can produce new shoots when buried in sand.

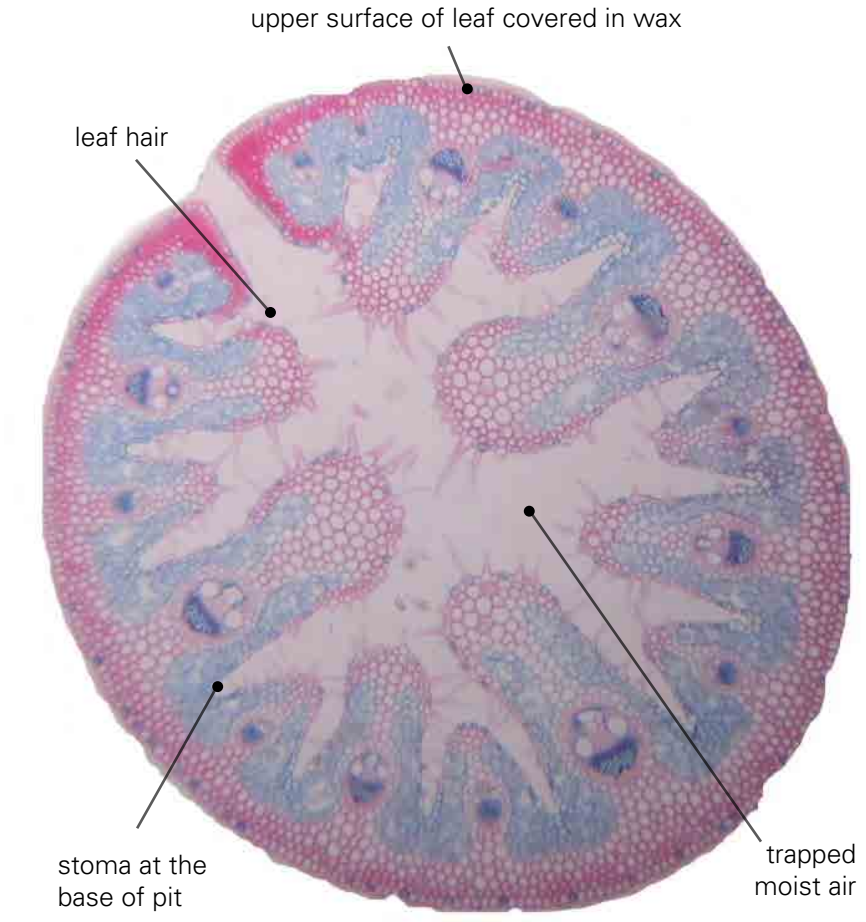


Some material on the beach. This is accumulating a mini-dune of sand

Growing on sand

How do pioneer species in an environment where water is a problem? It is salty in the soil which makes it difficult to take up and the constant winds make the atmosphere a very drying one. The pioneers usually have succulent leaves in which they can store water.

And how does marram grass survive when, for example, a storm may bury it in sand? Marram is adapted to grow upwards and out of the top of the dune. In addition, marram and lyme grass have leaves that can curl into a cylinder in order to limit the loss of water in the constant wind. The lower surface of the leaf, where stomata take in carbon dioxide, also loses a lot of water. In a particularly drying atmosphere the leaves curl so that the stomata are protected on the inside, away from the wind.



Cross section of a curled marram grass leaf, showing features which limit water loss in a dry environment.

Soil, getting richer

As these large grasses die they add nutrients to the soil and make the environment suitable for even less demanding plants that will, again, outcompete them. The environment now changes from one dominated by one or two species of large grasses to a much more varied habitat.

Looking towards the sea from a few hundred metres inland, in the varied habitat behind the giant dunes

The soil is now rich enough to support the growth of shrubs and bushes, and even these finally give way in a natural system to trees which will form a woodland.

Woodland growing on dunes which would have been bare sand on a beach a few hundred years ago

In most parts of Britain natural succession has been affected by human activity. Very often what should be woodland growing on old dunes is occupied by a golf course. However, there are still many places around our coasts where you can see sand dune succession.

Gary Skinner is Biology editor of Catalyst. All photographs on pages 9-12 by the author.