Estuarine and Shoreline Successions

What you need to know
Factors involved in sand dune formation
Sand dune succession: psammosere development
Mudflat/saltmarsh succession: halosere development

Introduction:

Depositional features at the coast may be temporary or longer-lasting but others are transformational; they undergo change from one form to another over relative short periods of time measured in decades.

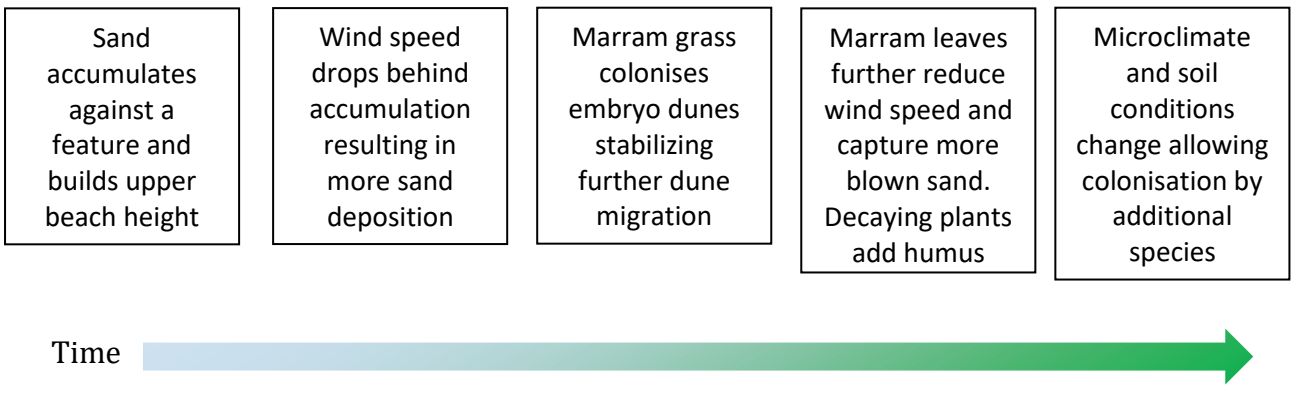
Environmental habitats at the coast alter as a result of plant succession, which cause changes to micro-climate features and soil states, and which – in turn – create more favourable conditions for new plant species to colonise a section of shoreline.

Sand dune development:

Sand dunes are more likely to develop behind an active beach zone where:

- The gradient of the ground inland adjacent to a beach is relatively flat.
- Strong onshore winds provide the energy input to move sand inland from a beach.
- A beach is composed of fine sand particles rather than shingle, pebbles or rocks.
- A large area of beach is exposed at low tide.

As dry sand grains are blown inland by saltation (series of bounces) and rolling over the surface they are likely to accumulate against natural or human obstacles. Marram grass, being tolerant of very sandy conditions often colonises upper beach zones and begins to stabilize sand movement in a positive feedback cycle that accentuates the initial change:



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Psammosere development:

Sand dunes may grow in front and behind initiating dunes. Over time a succession of plants colonises a dune system which also gives a longitudinal profile from upper beach extending inland. As new sand dunes evolve towards heath and pine woodland inland, the ecological succession is called a psammosere.

Embryo dune	Foredunes	Yellow dune	Grey dune	(Dune slack)	Heath & woodland
Upper beach area. Mobile dunes accumulate sand	Colonisation by hardy species tolerant of aridity, salt, wind and exposure such as marram and sea sandwort	A vegetation mat develops on the upper and back dune surfaces stabilising the dune system	Fixed dunes where accumulating humus changes sand to develop a soil horizon with more moisture and nutrients. Plantains, wild thyme and sea buckthorn colonise.	(May occur in front of, or behind, grey dune.) Depression where water table is close to the surface so moisture-loving plants colonise such as flag iris and willow.	Sandy soils have developed that can support scrub heaths of willow and birch, pine trees and a climate climax of alder and oak trees.

Estuarine/saltmarsh development:

Mudflats at the edges of estuaries are frequently zones of net deposition of fine sediment. Over time these may evolve into saltmarsh ecosystems with colonisation by plants that can tolerate high salt conditions and frequent inundation at high tide and exposure at low tide.

A positive feedback loop operates, amplifying the initial deposition as submerged and semi-submerged plants trap more sediment and reduce water velocity leading to increased deposition. Plant life-cycles deposit decaying material on top of which new plants grow, gradually raising the height of the saltmarsh. As height increases, saline conditions reduce, inundation is less frequent and different seral stages occur towards a climax community. Plant succession occurring in conditions of water is termed a hydrosere. A sub-set occurring in salt (as opposed to fresh) water is known as a Halosere.

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Halosere succession:

Submerged estuary shore	**Mudflat** Saltmarsh establishment	**Low saltmarsh** Saltmarsh stabilisation	**High saltmarsh** Saltmarsh maturity	**Climax vegetation**
Marine algae and sea lettuce are early colonizers of nearly permanently submerged mudflat where tidal water is clear enough to let high light levels through. They help stabilize the estuary mud.	Pioneer species trap sediment and calm tidal waters flowing amongst early colonisers. Plants such as glasswort and cordgrass (spartina) increasingly raise the surface above low tide. Max. 4 hrs exposure.	Colonisation by hardy grass species that can tolerate high saline and pH conditions such as plantains, sea aster and thrift. Max 4 hrs. submergence.	Vegetation is dominated by low-growing flowering plants such as scurvy grass and sea lavender, with sedges and rushes in hollows and creek banks.	Deciduous woodland develops that shades and dominates competition. Species are non-halophytic (non-salt-tolerant) such as alder, birch and eventually, oak.

Rates of succession

The rate at which ecosystems develop to a climatic climax from initial colonisation may be relatively rapid (measured in centuries) or take longer (over thousands of years) depending on growth rates and abundance of colonising species. But many environments are interrupted before attaining climax stability as conditions change. It may be a change in climate, sea level, or another key environmental factor.

Primary succession: uninterrupted development from first colonisation to climax vegetation.

Secondary succession: a succession that takes over once natural conditions have changed and replaces a primary succession sequence.

Plagioclimax: where human intervention has interrupted the natural succession that would have taken and delivered an alternative climax of vegetation by, for example, allowing sheep to graze a saltmarsh.

^What an epic A* Key Term!