LEIGH WARNEMINDE

COMMUNITY TRAINING PROGRAM

COASTAL ECOLOGY:

DUNES

WETLANDS

HEATHS

and

FORESTS

Written and Presented by Jan Heisler © *1998*

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INTRODUCTION

Along the eastern part of the continent, we have a very long coastal strip, consisting on the coastal dune systems, plains and foothills, between the ocean and the Great Divide. Because the extremities lie between latitude 43°39'S and 10°41'S, the climate varies from monsoonal tropical, to cool temperate – but always under the influence of the Pacific Ocean, and in most places, the barrier formed by the Great Divide.

In South-east Queensland, the sub-tropical temperatures are tempered by sea breezes near the coast, where the summers are warm and humid, and the winters mild and drier. The foothills of the Great Divide are in some areas, quite close to the sea, and influence the variations in temperature and rainfall.

The diagram below illustrates a "typical" coastal environment, where the foredunes are subject to the full force of the salt winds, which have less and less influence as we travel inland, and where the topography affords protection. The soils nearest the coast tend to be impoverished sands (although other soils may be found in places, including clays, shales, depositional loams, and even basalts from ancient lava flows). These above-ground, and below-ground, factors influence the vegetation which grows in any particular place.

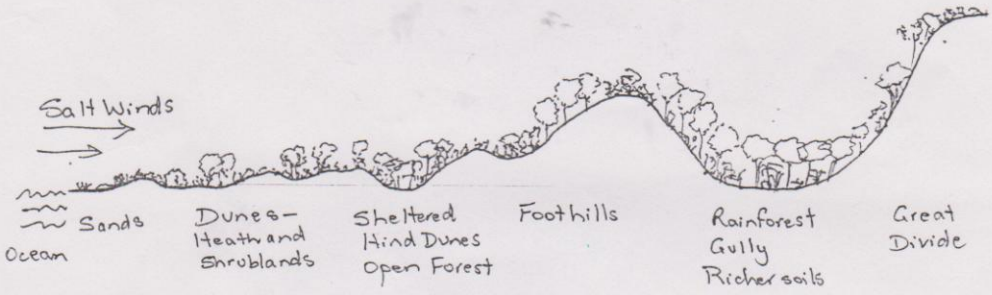

Fig. 1: A "typical" coastal environment, showing the influence of coastal winds, rain and soils on the vegetation.

Along the Sunshine Coast, the differences in vegetation between the coastal dune systems, the coastal plain, and the nearby hills, may be clearly seen.

THE COASTAL DUNE SYSTEMS

About 100,000 years ago, before the last Ice Age, the sea level was several metres higher than at present, and large quantities of sand moved along the coast, forming the coastal sand dunes known as the Pleistocene Barrier. With the last Ice Age, to about 20,000 years ago, the sea level dropped dramatically, and the former seabed became a coastal plain.

Then about 6,500 years ago, melting ice caps caused sea levels to rise again. Wind and waves again moved large amounts of sand onshore, to form most of the present-day dunes (the Holocene barrier) which ceased developing about 2,000 years ago when the transport of sand from the continental shelf ceased. This means that there is little additional sand being fed onto the coast, resulting in a receding shoreline. These dunes supported a diversity of vegetation types ranging from rainforest and woodland through to heath and grassland.

Typically, a coastal system in its natural state may have:

- a **beach**
- an **incipient dune** (a newly formed dune supplied with windblown sand which may be stabilised with grasses and creepers), the presence of which indicates a beach-building phase
- a **foredune** (frontal dune) – generally higher – the seaward side can give an indication of present-day processes
- **hind dunes**

The dunes are nature's last line of defence:

- They act as a barrier, restricting the intrusion of waves, wind, salt spray and sand into the back beach areas.
- They act as a reservoir for resupplying sand to a beach during times of storm attack and erosion.
- They provide for a transition from marine to terrestrial environments.
- Calm weather induces beach and dune build-up.

Today, natural dune formations are normally found only in areas away from major population centres. In some areas, dune systems have been completely covered by development. Seawalls have prevented sand from further contributing to the coastal system. In some situations, the lack of a dune to act as a natural buffer to wave and wind action and to provide a sand source for the beach can result in the beach being lost and development threatened. Beach nourishment with sand is one method of long term (?) maintenance in such circumstances.

In many areas, dunes have been removed, replaced, or adversely affected by:

- residential development
- protection works (e.g. sea walls)
- modifications to the dune shape
- uncontrolled pedestrian or vehicular access
- sand mining or sand extraction

Where dunes are inadequate, areas at the back of the beach may be subject to flooding from the ocean, sand inundation, structural damage from wave attack, or foreshore erosion. Dune systems provide a natural defence system which mitigate these hazards.

The dunes along the Gold Coast, much of the Sunshine Coast, and the surf beach area on Bribie Island, for example, were developed without consideration for the natural processes. The natural cycle of dune building and erosion needs to be understood to ensure that the future use of the dunes is compatible with the natural system.

COASTAL VEGETATION

Soils are generally deep, sandy, freely drained, and leached of nutrients. As vegetation establishes on the bare sand, organic matter (O.M.) from the vegetation and associated fauna is incorporated into the soil. As the O.M. accumulates, the water holding capacity of the soil increases, promoting plant establishment and growth. In time, some of the O.M. is dissolved in water and carried down through the sand, along with other soil components, particularly iron, which are deposited some distance from the surface, where a hard pan, known as coffee rock, forms. The depth of this hard pan in an important factor in the type of vegetation, as it may form a barrier to drainage. Where this occurs, wet heathlands or swamp forests may be found.

ZONATION: Usually 3 zones of vegetation, grading into each other, are found:

1. An unstable **strandline zone** of colonising herbs and grasses (Open Herbland/Open Grassland) e.g.Beach Spinifex (*Spinifex sericeus)*, Pig Face (*Carpobrotus* spp.), Beach Morning Glory (*Ipomoea brasiliensis*), Beach Fan Flower (*Scaevola calendulacea).*

2. A semi-stable **foredune zone**, of shrubs and associated ground plants (Heathland). Trees are often absent, or may be represented by scattered mallees (multi-stemmed trees which have re-sprouted from lignotubers after fire), Coastal Screw Pines (*Pandanus* spp), or Coastal She-oaks (*Casuarina equisetifolia)*. These areas are species rich, and the vegetation is essential to the stability of the sandy coasts, protecting the soils from erosion and sheltering the plant communities beyond.

The windward or seaward side of the foredunes is generally stabilised by the mat-forming plants of the strandline zone, and tufted herbs e.g. Swordgrass (*Lomandra* spp.), and Flax Lily (*Dianella* spp.) The frequency of fire influences the foredune vegetation – grasses, herbs and bracken dominate where fire is a frequent occurrence, while thickets of shrubs (e.g. banksias and tea-trees) tend to dominate where there has been no fires for more than 10 years or so.

3. A stable **hind-dune zone** covered with open forest or woodland. In some areas, littoral (coastal) rainforest may be found, but much of this vegetation has been lost, due to coastal development. Where the water table is high, paperbark swamp forests occur. These more sheltered areas are dominated by trees, with an understorey of shrubs and ground covers, and may also be subjected to frequent fires.

Zonal patterns are often complex and variable due to the ever-changing nature of the dune environment, but tend to be more stable beyond the first of the hind dunes.

Fauna: Apart from the marine fauna of the intertidal zone (crabs, shellfish, worms etc), and the sea birds, the main animals you could expect to find in the foredune areas are reptiles – small lizards, and the occasional snake – and a limited variety of birds and insects. The hind dunes offer a greater variety of wildlife, including various birds, reptiles, bats, and marsupials such as possums, bandicoots etc.

DISTURBANCE

The dune systems near populated areas frequently suffer high disturbance levels. These may take the form of:

Physical disturbance:

- people pressure – including over-use
- vehicles
- development
- removal of vegetation

Fire:

- changes in fire frequency
- timing of fires

Other disturbances:

- nutrient additions
- weeds (wind, stormwater, dumping etc.)

WETLANDS

There are a number of different types of wetlands, depending on the physical factors present, including:

SALT MARSH

- Found along low-lying coasts – salt flats and estuaries, at sea level
- Dominated by a number of species, including glassworts, sampires, salt grasses, saltbushes

MANGROVES

- Found along coasts and estuaries, and near-coastal river banks
- Dominated by one or more species of mangrove trees or shrubs
- Often fringed by forests of swamp she-oak (*Casuarina glauca*)

The plants found in these habitats have adaptations to:

- salinity
- anaerobic soils

FRESHWATER WETLANDS

- Found beyond the salt zone, and sometimes for a considerable distance inland
- Dominated by **paperbark forests** with understorey of sedges and other plants tolerant of wet soils, **wet heaths (Wallum)** with a high species diversity, or **sedgelands** dominated by rushes and sedges
- High water table, due to barrier formed by rock or O.M.
- Surface water present in certain places, or after rain

Fauna: A wide variety of bird species is found in wetlands, as either permanent or temporary residents. The mangroves are nursery for many marine species, including fish, crabs and shellfish. Small animals, including water rats, are also found.

THE COASTAL PLAIN AND HILLS

These areas are usually sheltered from the worst of the winds, either by physical barriers or distance. The soils vary, but are generally low in nutrients. **Sclerophyll Open Forests** dominated by eucalypts are common. These forests may have several layers, including the tree canopy, a secondary tree canopy, and a dense understorey of shrubs, herbs and other groundcovers. The leaf litter is slow to break down, so tends to accumulate (creating fuel for bushfires) and the humus content of the soil is limited.

Tall Open (Wet Sclerophyll) Forests are found on sheltered slopes and better soils. These are characterised by tall eucalypts, often mixed with other tree species, having tall straight trunks, high branching, and narrow crowns. The understorey may be sclerophyllous shrubs and ground covers, along with softer-leaved plants, ferns and tree ferns. Where these communities form an ecotone (transition zone) between the dry forest and moister rainforest, the understorey usually consists of rainforest type plants forming a secondary layer which reduces the light available to the ground, and results in a sparse ground cover of ferns and herbs adapted to low light conditions. Soils have more nutrients, and are moister, than those of the Open Forests, and the leaf litter breaks down into humus more rapidly, but may still tend to accumulate.

Fauna: The eucalypt forests are home to a wide variety of bird species, which are important pollinators and dispersers of seeds. Animals include possums, gliders, echidnas, bandicoots, wallabies etc. There is also a wide variety of insects and spiders.

Pockets of Closed Forest (Rainforest) are found in sheltered gullies and along water-courses, where the soils contain more nutrients, and are often derived from ancient lava flows. The trees have interlacing canopies with broad, large leaves which are held parallel to the ground and thus very little sunlight can penetrate (unlike the narrow eucalypt leaves, which hang down and let through much more sunlight). The understorey is sparse, and consists mainly of ferns, tree ferns and large-leafed herbs which are adapted to the low light conditions. The leaf litter breaks down quickly, forming a rich humus layer and recycling the nutrients much more quickly than in the sclerophyll forests and woodlands. Soils have more nutrients, are less acidic, are retain moisture. Although some rainforests are found on coastal sands (Littoral Rainforests), those with the greatest variety of species are found on the better soils.

Fauna: Rainforests are home to a wide variety of birds, which are vital in the pollination and fruit dispersal processes for many plant species. Small animals, including possums, gliders, wallabies, bats, and many others, live in rainforests, along with reptiles and frogs. The greatest variety of fauna, however, is to be found in the leaf litter and upper layers of the soil, where small organisms contribute to the breakdown of the leaves, twigs, and other plant matter and in the process return the nutrients to the soil.

PLANT ADAPTATIONS

Coastal ecosystems are very harsh environments. The plants have to cope with conditions such as salt winds, saline soils, very wet or very dry soils, and low nutrients, as well as relatively recent changes to a fire regime which was established thousands, and even millions, of years ago. Adaptations include:

Mangroves & Salt Marshes:

- dilution, exclusion or excretion of excess salt
- roots which extend above soil surface so can take in oxygen from the air (anaerobic soils – waterlogged, thus lacking oxygen)
- many mangroves have seeds which germinate on the plant, so that they are able to quickly take root before being washed away by the next tide

Fresh Water Wetlands and Wet (Wallum) Heaths:

- the ability to survive in waterlogged soils through root adaptations
- adaptations to low nutrient soils (including sclerophylly)
- adaptations to very low soil pH – many coastal soils, especially those of the Wallum heaths where the soils are rich in O.M. (→ peat) are very acidic

Rainforests:

- large leaves (to catch maximum light in a low light environment) with drip tips (to shed excess water)
- buttressed roots (for support in shallow soils, and to extract oxygen from the air)
- seed adapted to passing through the gut (usually of a bird) to aid in distribution (→ propagation problems)

Dry Heathlands, Eucalypt Forests and Woodlands

- sclerophylly – hard, dry leaves (low water supply, low nutrients)
- small leaves (salt laden winds, dryness)
- leaves which channel water down to the roots (infrequent rains, high drainage properties of soils)
- hairs on leaves, stomates (pores through which water is lost) reduced or turned away from the sun (reduce water loss)
- lignotubers (underground stems with dormant buds which can re-sprout after above-ground parts are destroyed, usually by fire)
- epicormic buds (dormant buds under the bark, which can resprout after above-ground parts are destroyed, usually by fire, to give temporary "food factory" until permanent leaf canopy is restored)
- hard, woody fruits (to protect seeds from fire) – in many cases, they do not open until the stem dies, the plant dies, or there is a fire
- hard seed coats (protect the seed, until softened by the heat of fire)
- underground rhizomes, bulbs or tubers (protected from fire)
- fire-promoted flowering (to produce copious seeds for regeneration after fire)
- ability to take advantage of added nutrients in the ash bed, released by fire
- fruits and seeds which are able to survive in the soil seed bank until conditions are suitable
- root system adaptations to low nutrient soils – mycorrhiza (beneficial fungus which grows on roots) and proteoid roots – able to exploit larger areas of soil to gather the scarce nutrients (especially phosphorus)
- nitrogen-fixing nodules on the roots (wattles, pea flowers and she-oaks) – able to fix nitrogen from the air so it can be used by plants – increase soil fertility

RELEVANCE OF THESE FEATURES TO PROPAGATION

- Consider the soil type, and particularly its moisture holding ability, when preparing propagating mixes (e.g. high drainage ability, high moisture retention)
- Amount of watering required
- pH of the mix
- Remove plants with dense hairs from mist as soon as possible after germination/striking
- Pre-treatment of seeds
- Avoiding root disturbance, including allowing plants to become pot-bound
- Application of type, and strength, of fertilisers
- Placement of plants for hardening off – sun/shade
- Consideration for species which need to be grown for replanting in a disturbed area, to provide a homes, nesting sites, shelter, and/or food for the fauna

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