Coastal Dunes

Patrick Hesp

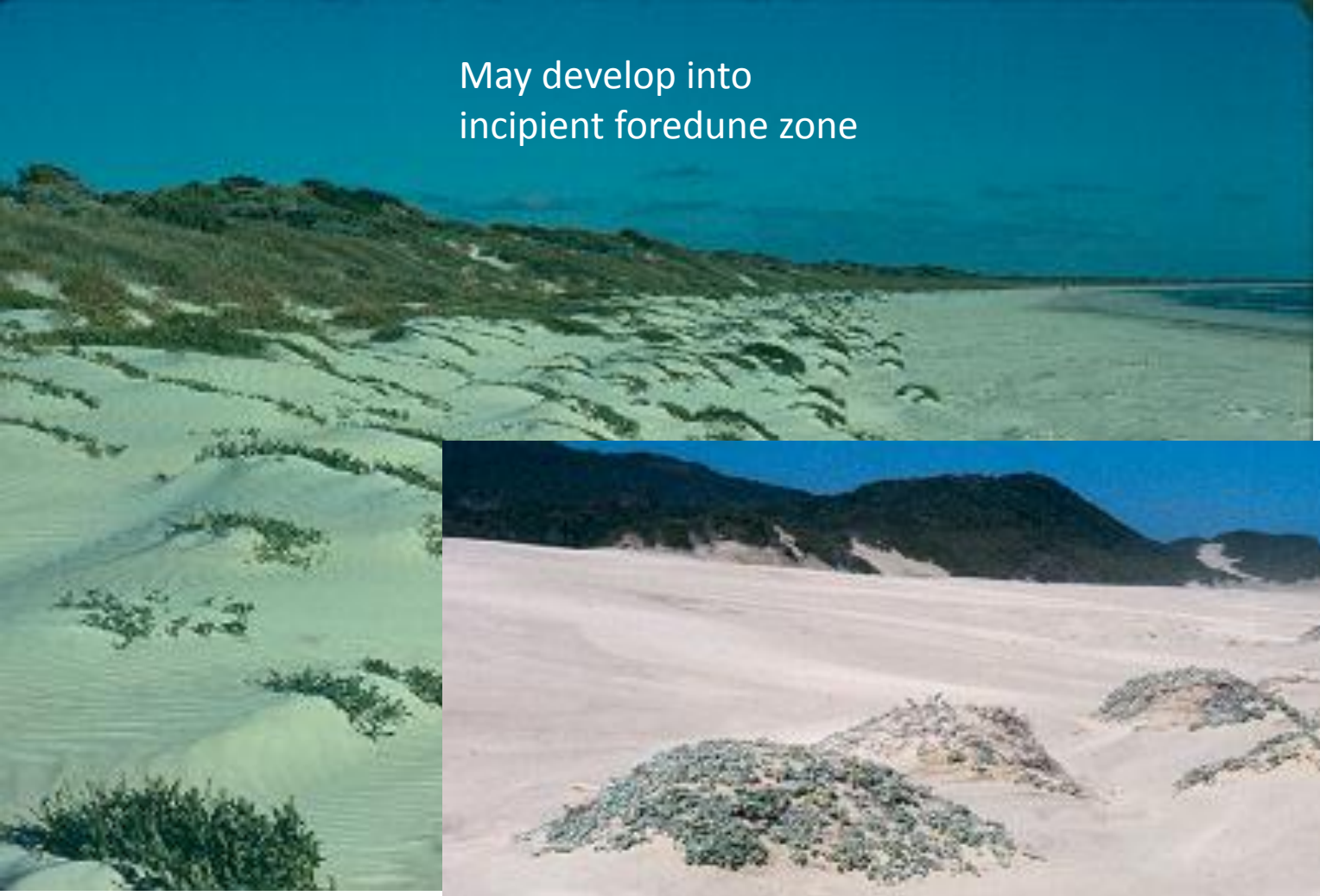
Department of Geography and Anthropology, Louisiana State University

Foredunes
Foredune Plains
Blowouts
Parabolic Dunes
Transgressive Dunefields

Incipient (“embryo”) Foredunes - new, or developing foredunes formed by aeolian sand deposition within pioneer plant communities on the backshore.

Established Foredunes - develop from incipient foredunes, distinguished by the growth of intermediate, often woody plant species, and commonly by their greater morphological complexity, height, width and age.

Swash deposited seeds of Cakile species



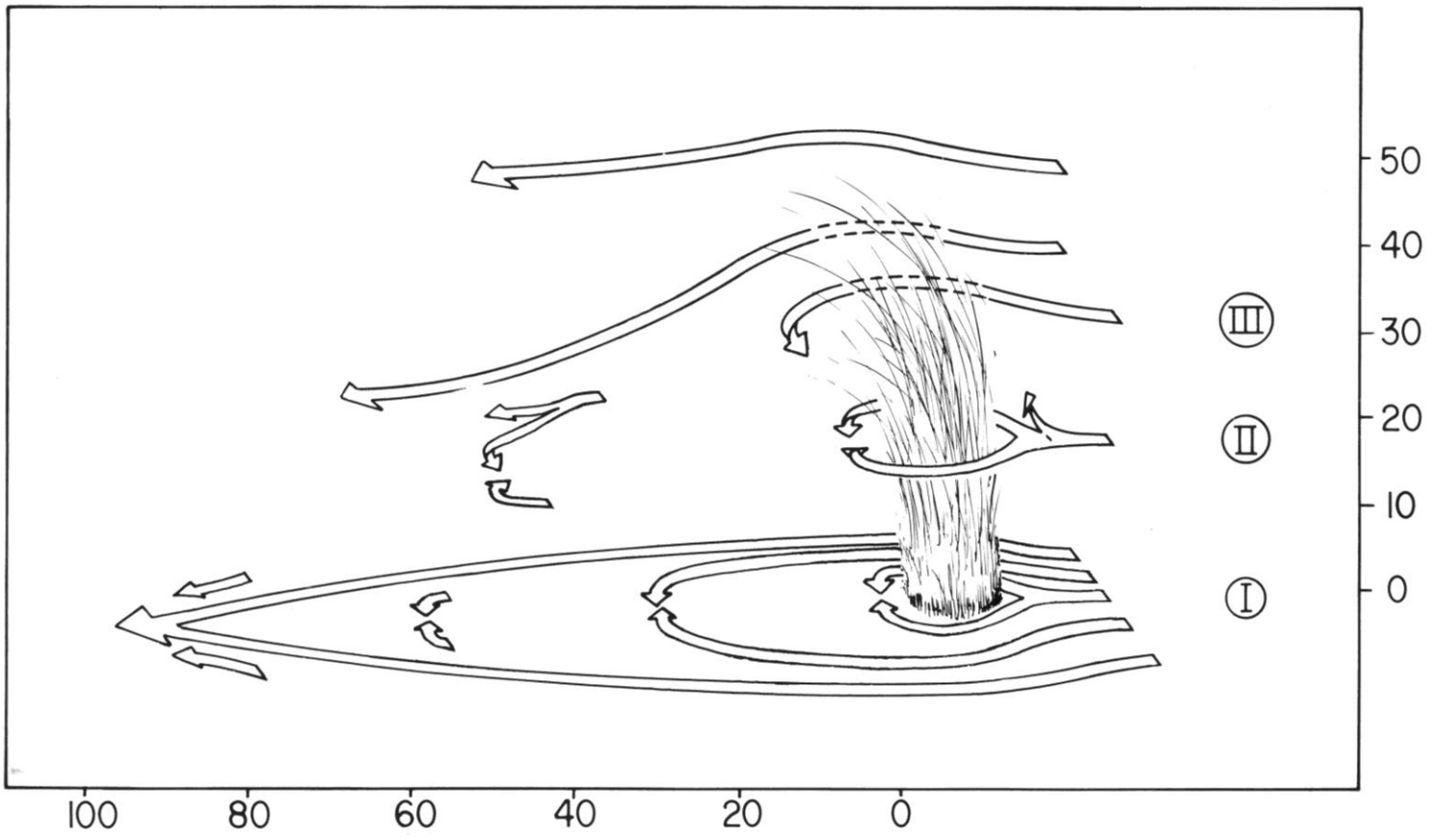
Cakile in southern Australia

Arctotheca in South Africa


Laterally continuous growth of pioneer
species above the high spring tide line.

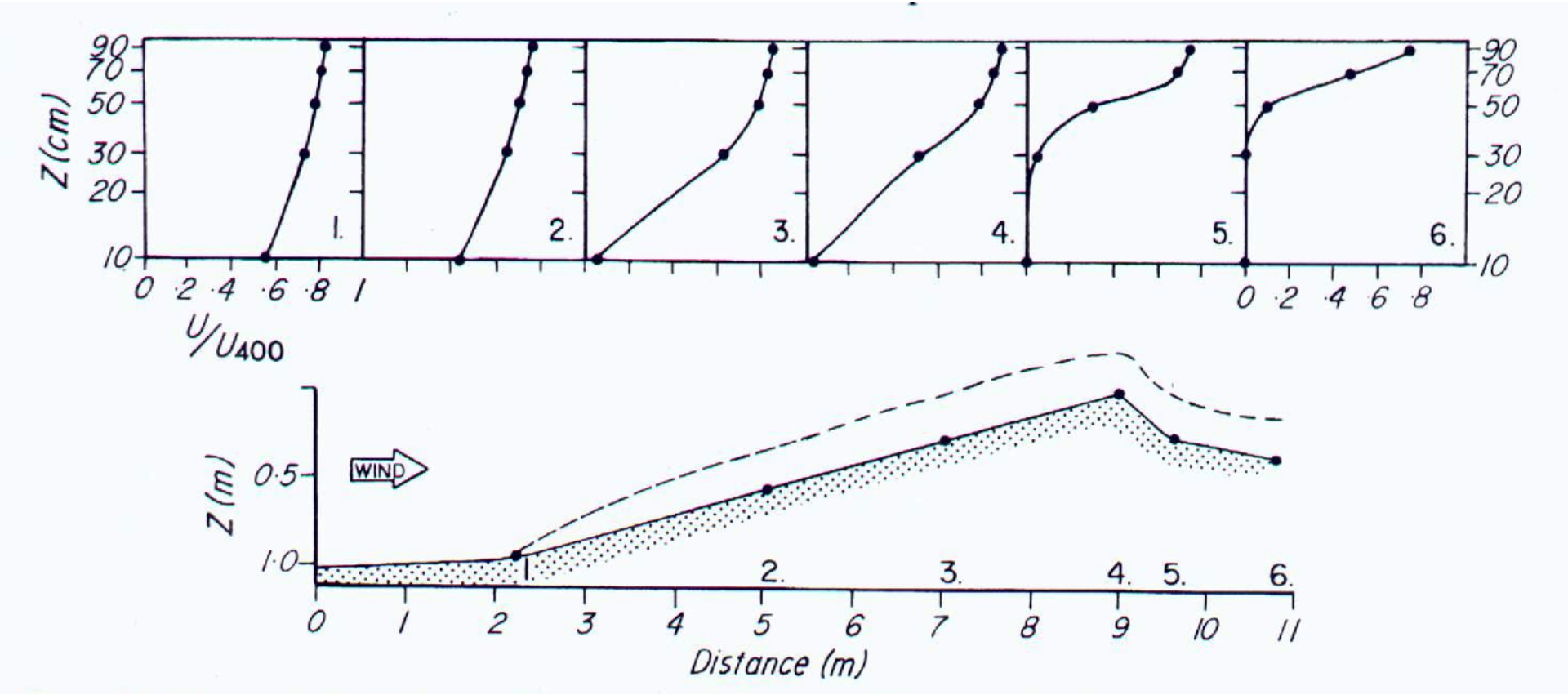
Individual plants develop nebka and shadow dunes as they trap sand.

Nebkha (or nabkha) – dune formed in and around clumps of grass, herbs, bushes etc.

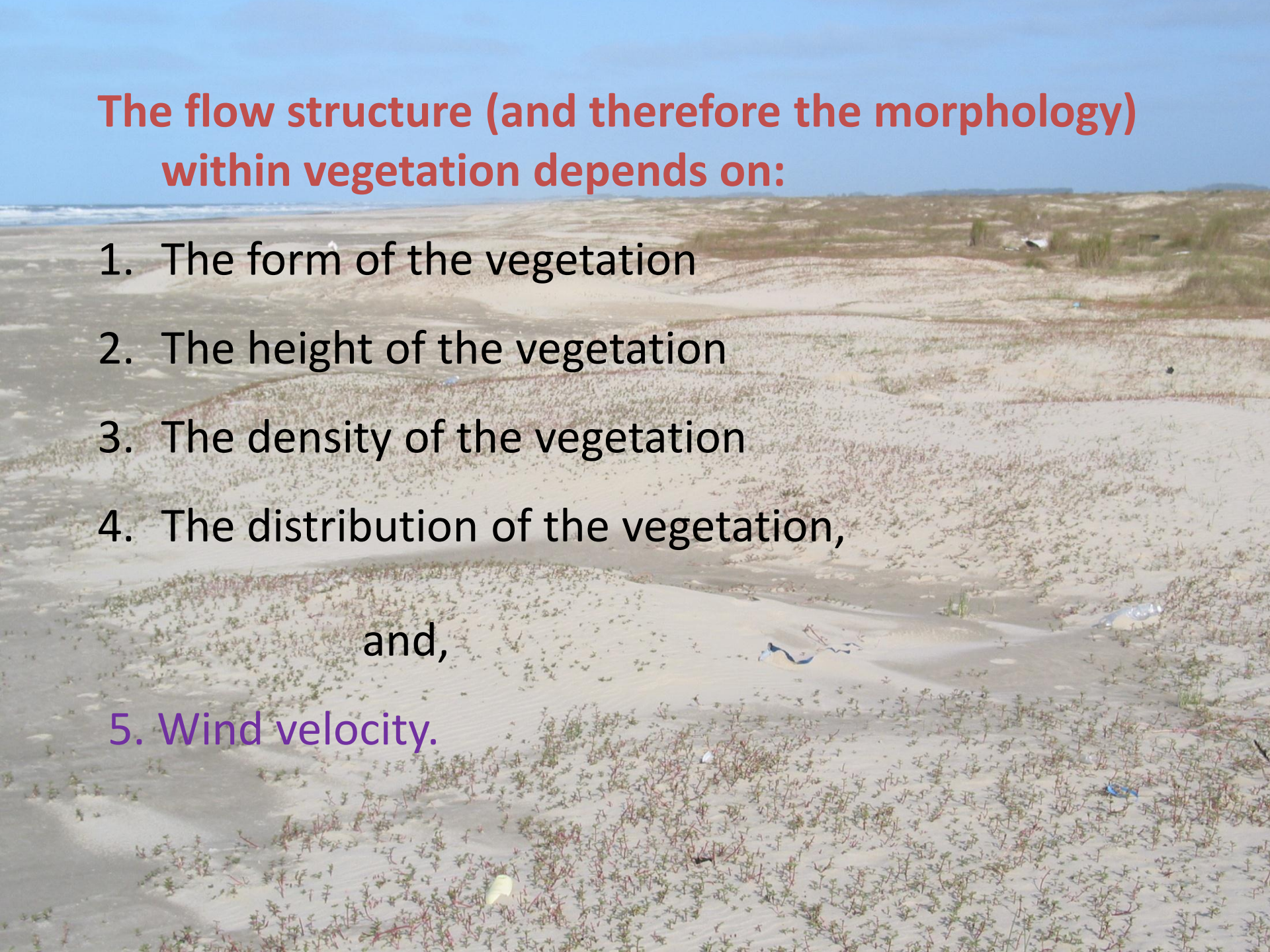


SOURCE: P.A. Hesp, 1981; The formation of shadow dunes. J. Sedimentary Petrology 51 (1): 101-111.

Flow across a small incipient foredune. Dashed line is top of plant canopy. (see Hesp, 1983)




Ridges develop as sand is preferentially trapped within the first few metres due to plant drag. Swales develop as low to non-depositional zones.

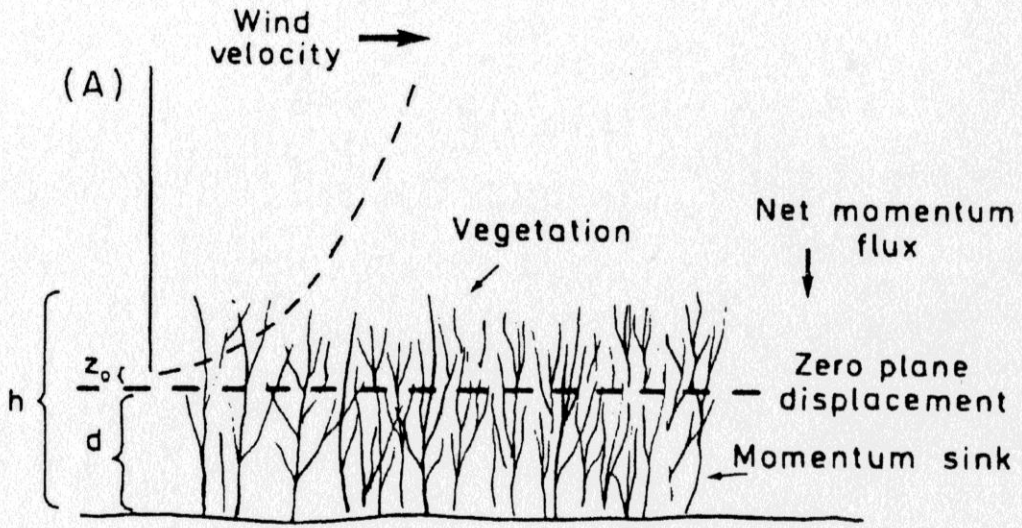


The flow structure (and therefore the morphology) within vegetation depends on:

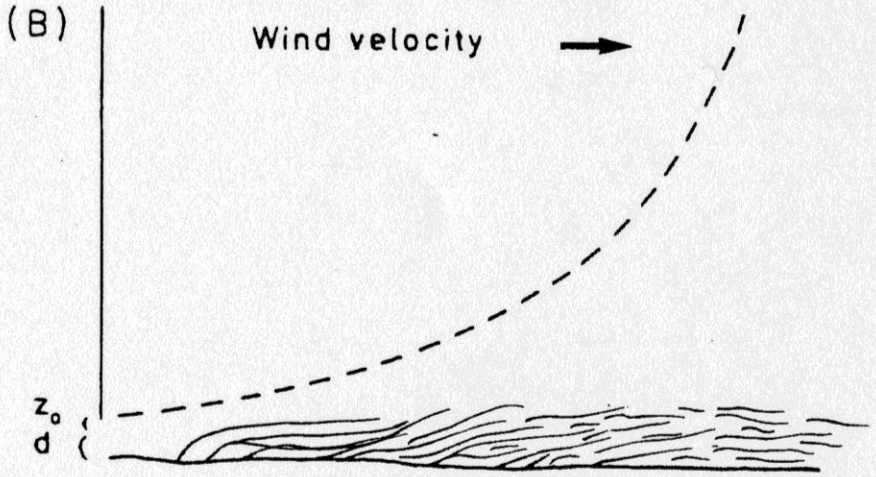
1. The form of the vegetation
2. The height of the vegetation
3. The density of the vegetation
4. The distribution of the vegetation,

and,

5. Wind velocity.



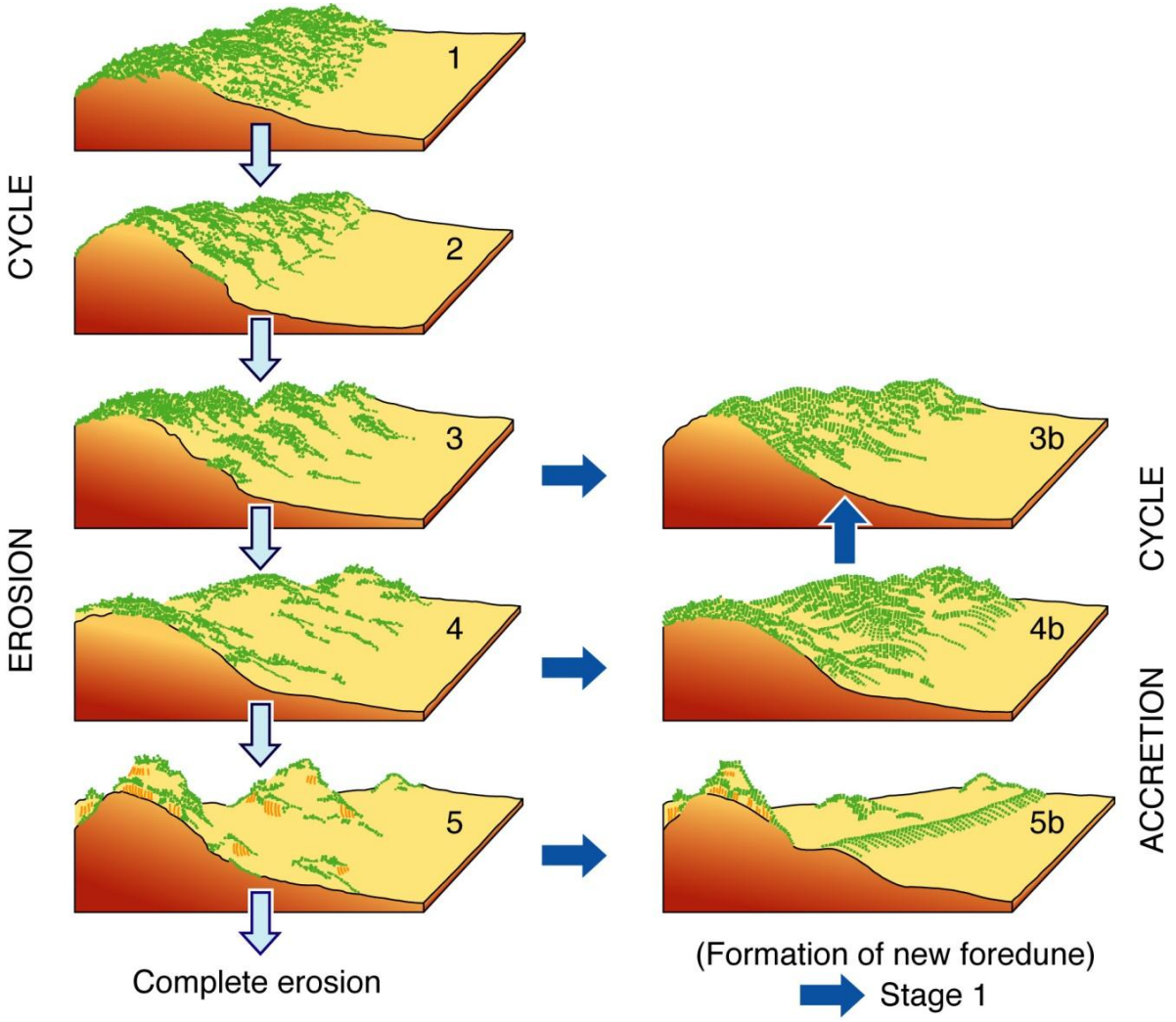
h = Stand height
d = Depth of zero plane displacement
z_o = Focus



From RWG Carter book

Wind velocity profiles over dense vegetation stands at (A) normal wind speeds and (B) extreme high wind speeds.

ESTABLISHED FOREDUNES



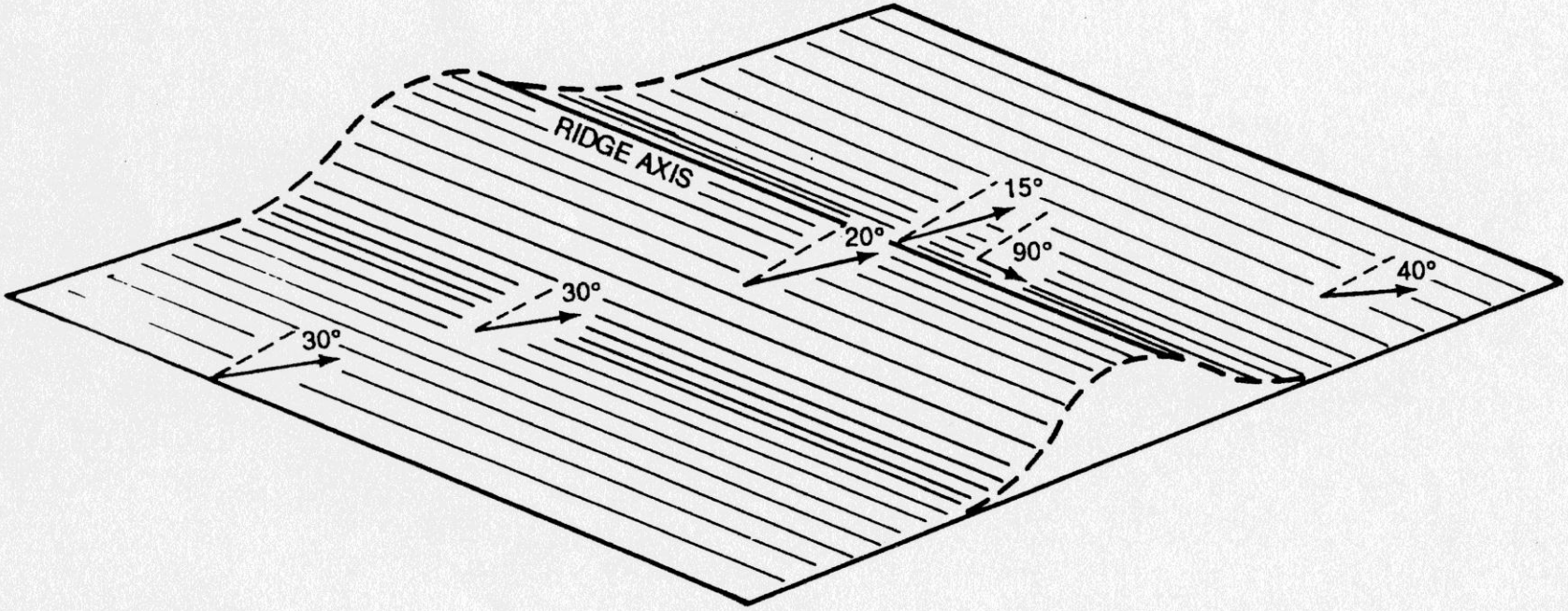
Or to see evolution from one type to another….

And reversal –in a accretion or stabilization cycle

P.A. Hesp, 1988; Foredune morphology, dynamics and structures. J. Sedimentary Geology Special Issue: Aeolian Sediments 55: 17-41.

P.A. Hesp, 2002. Foredunes and Blowouts: initiation, geomorphology and dynamics. Geomorphology 48: 245-268.

Velocity vector at 1m height over a 2D ridge



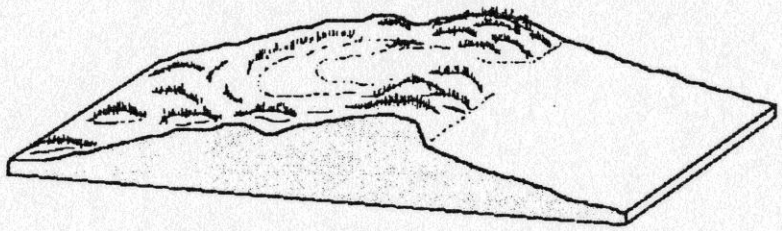
Source: K.R. Rasmussen, 1989. Roy Soc Edinburgh Proc (Sect B).

WAVE EROSION
EVENT

D

Minor to major wave erosion

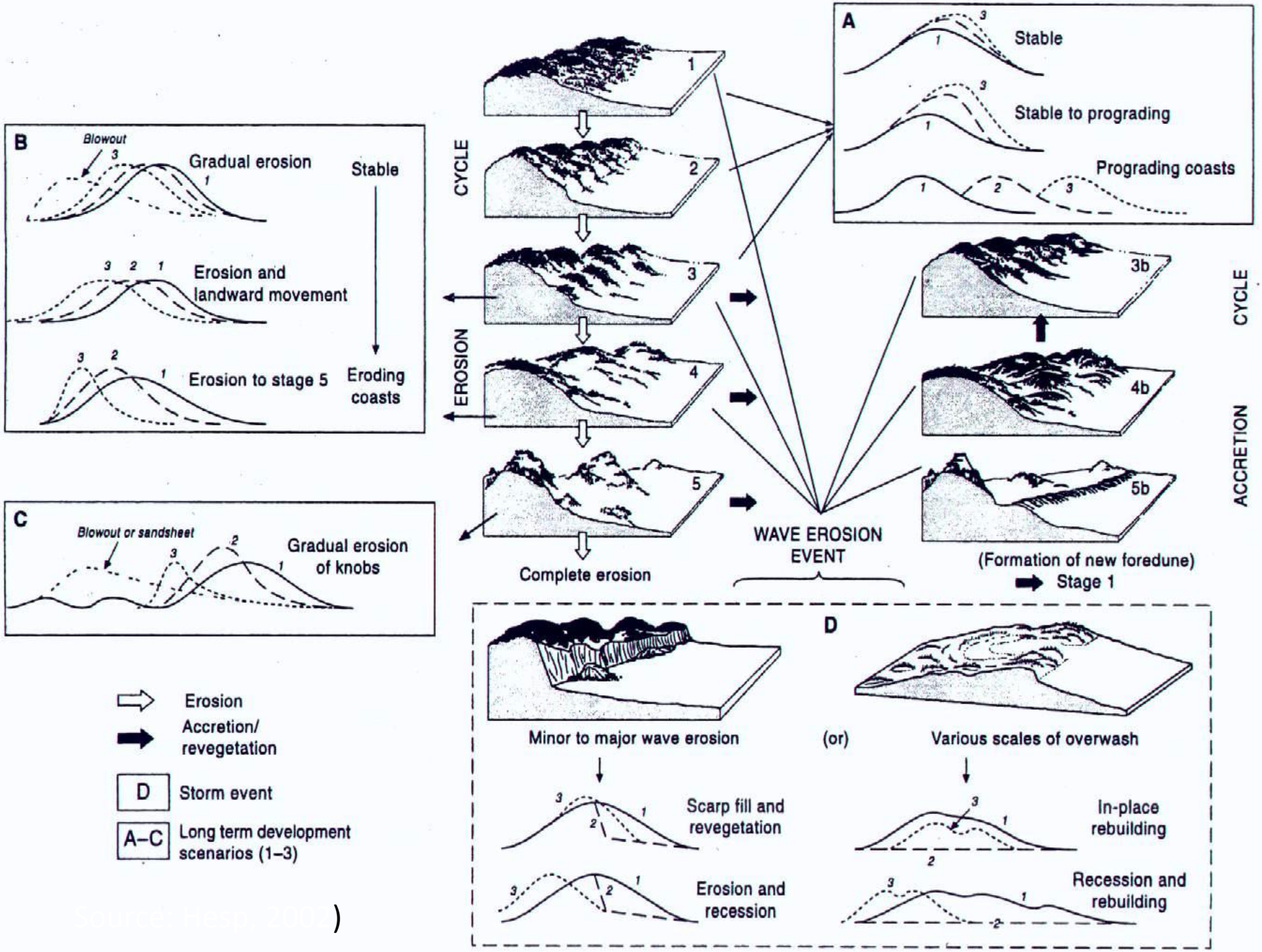
(or)



Various scales of overwash

Foredunes

Foredunes reflect the short, medium and long term surfzone-beach-dune processes operating on any particular beach.

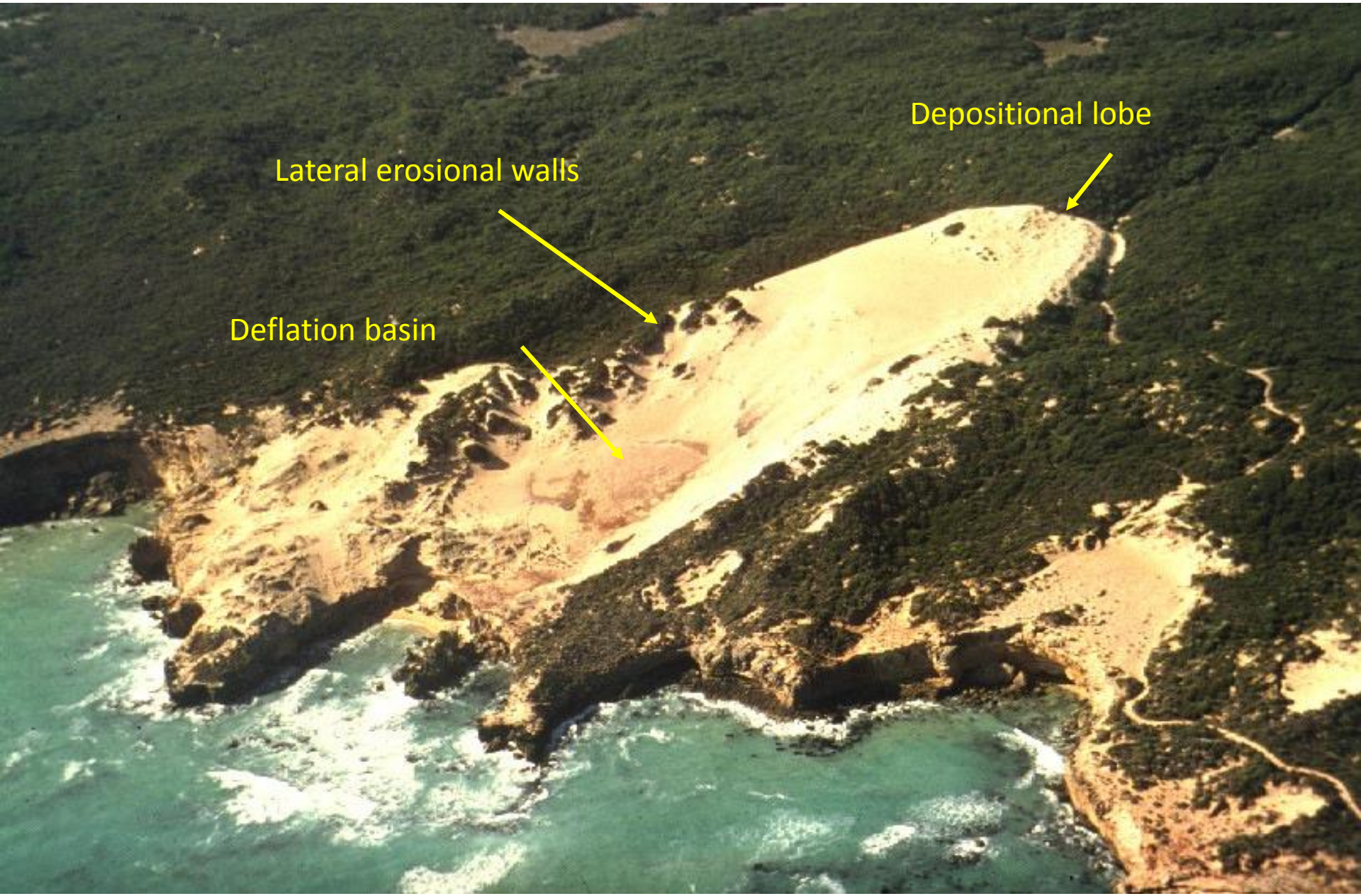


Source: Hesp 2011)

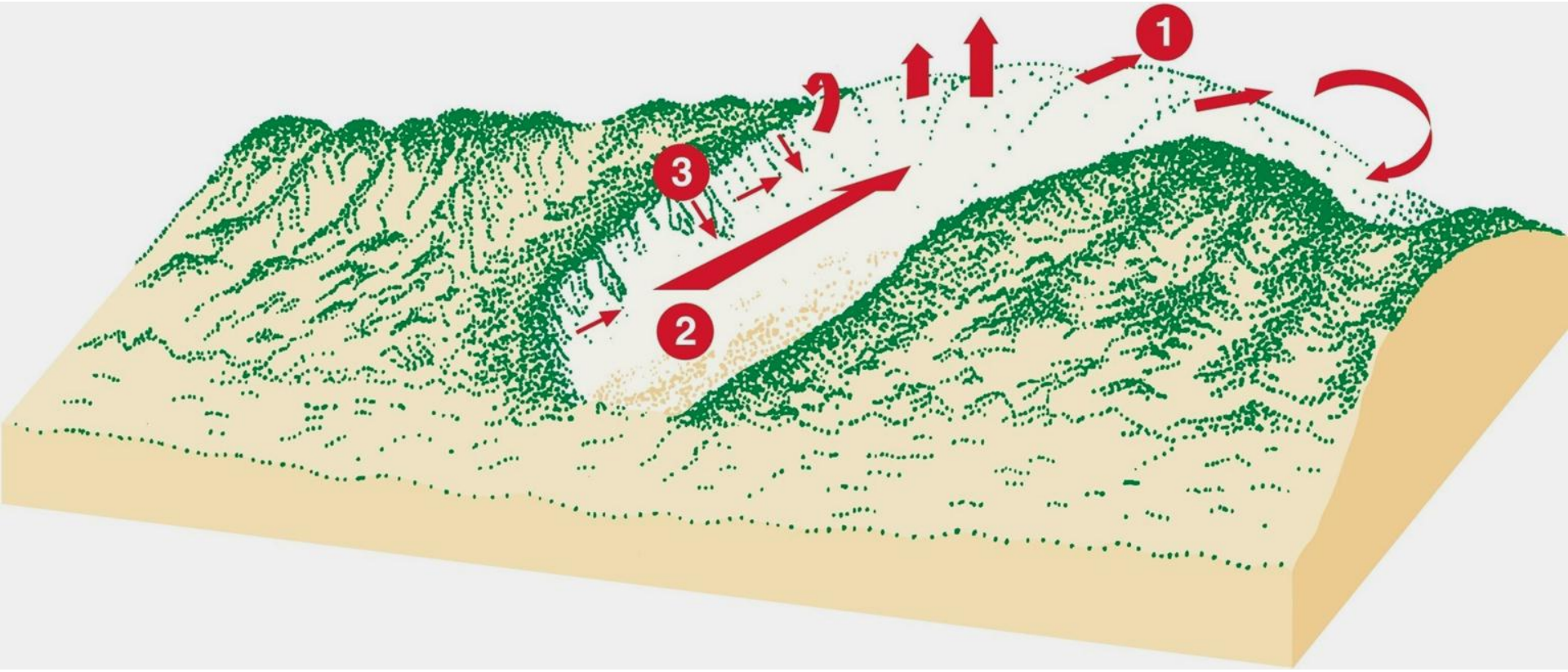
A **blowout** is a trough, cup or saucer shaped hollow formed by wind erosion on a pre-existing sand deposit.

Blowouts are characterised by:

- lateral erosion walls
- deflation basin
- depositional lobe

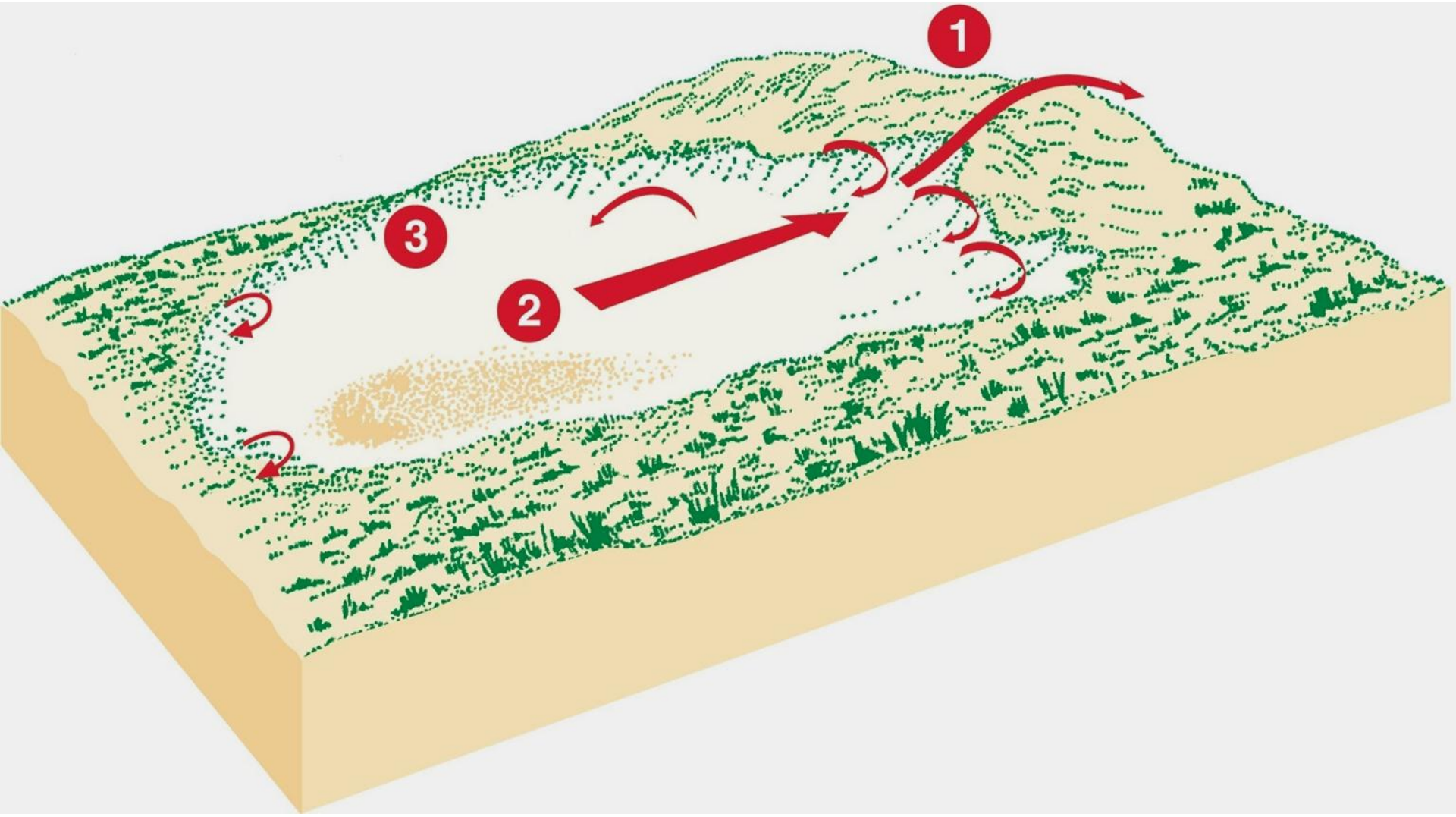

Depositional lobe
Lateral erosional walls
Deflation basin

Flow dynamics in a trough blowout

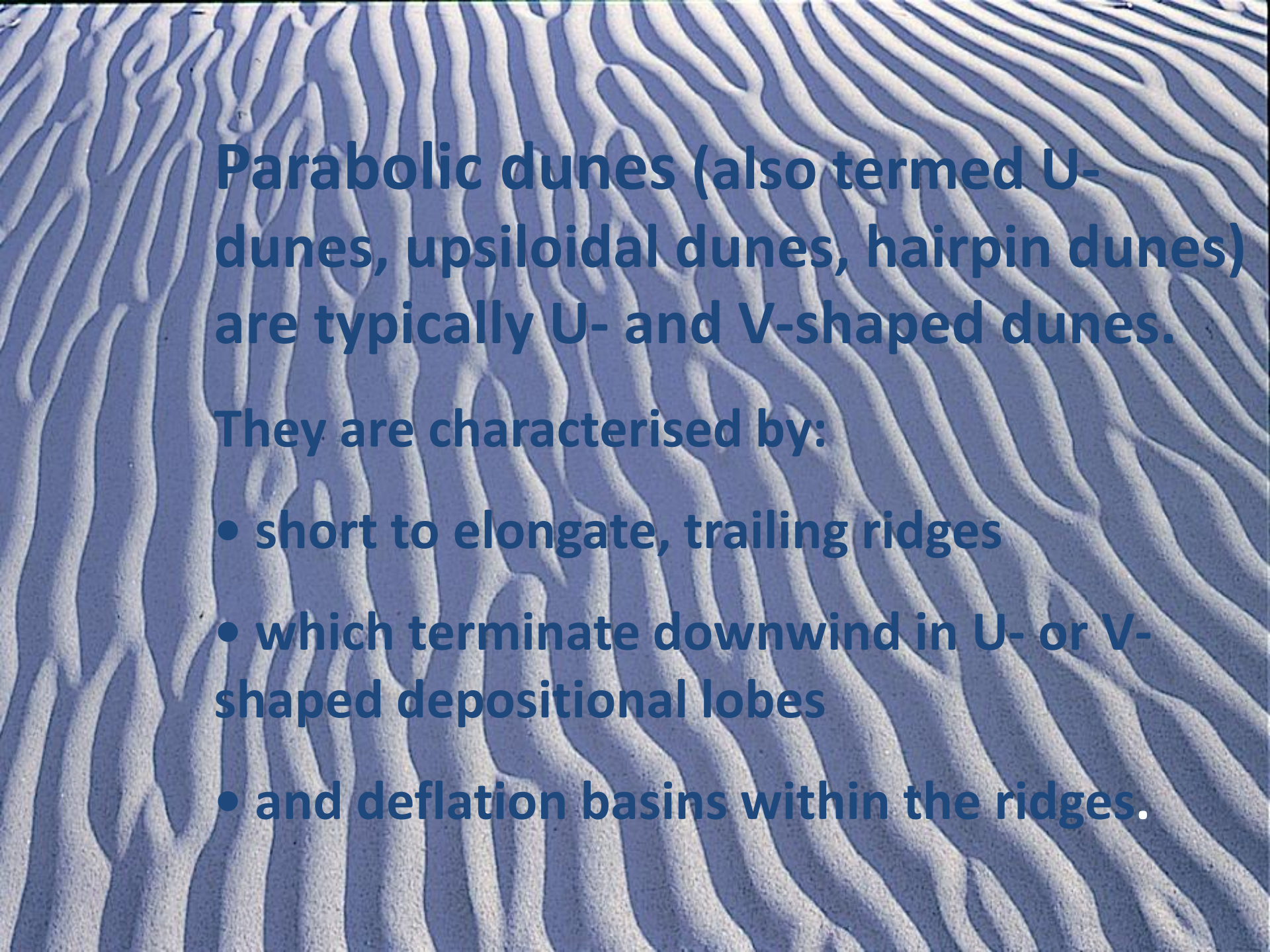


From Hesp “Coastal Dunes” booklet.

Flow in a saucer blowout



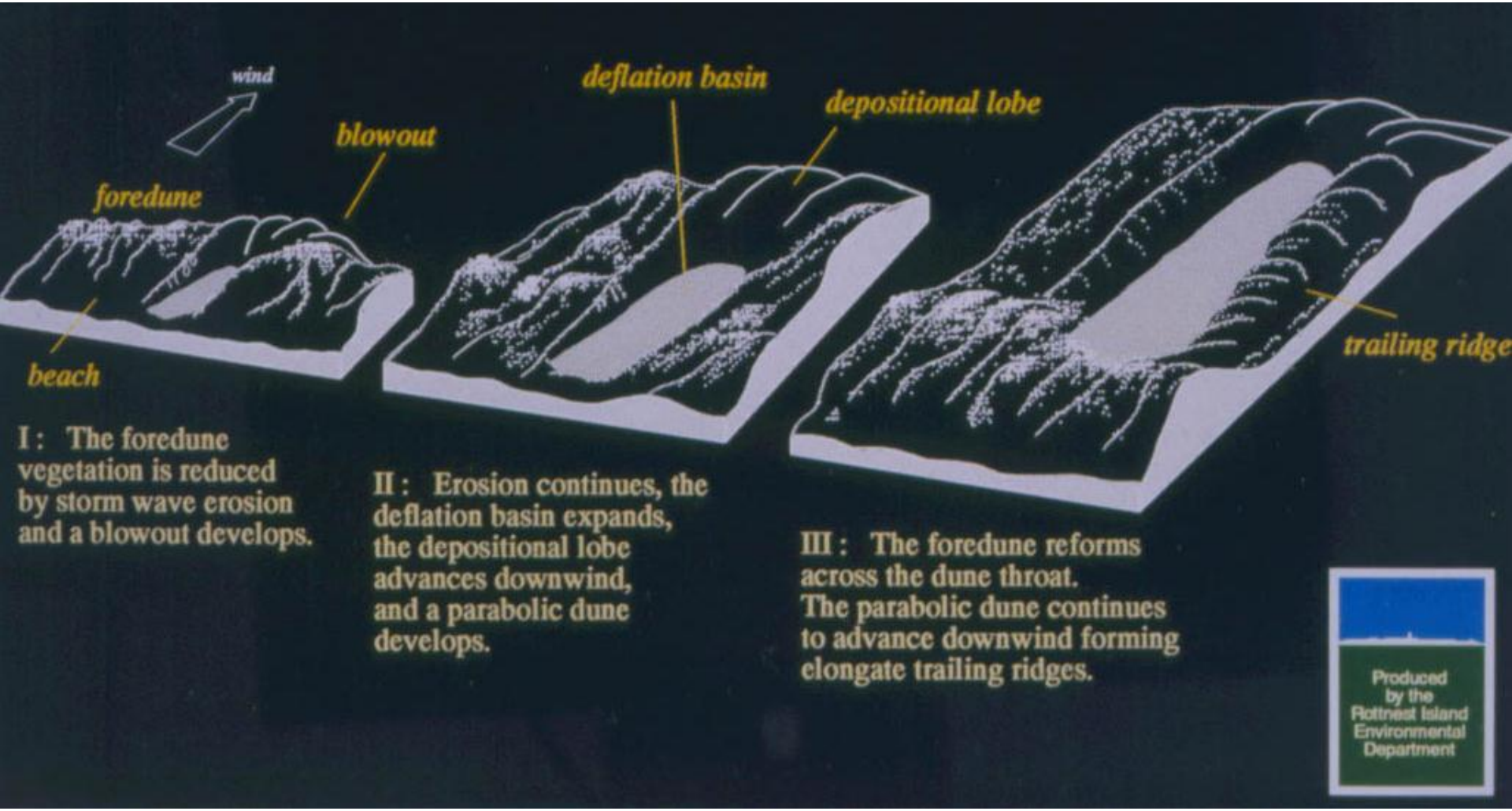

Parabolic Dunes



Parabolic dunes (also termed U-dunes, upsiloidal dunes, hairpin dunes) are typically U- and V-shaped dunes.

They are characterised by:

- **short to elongate, trailing ridges**
- **which terminate downwind in U- or V-shaped depositional lobes**
- **and deflation basins within the ridges.**



Development from, and elongation of a blowout

Transgressive Dunefields

Transgressive dunefields are broad, aeolian sand deposits formed by the normal, oblique or alongshore movement of sand over vegetated to semi-vegetated terrain.

They are largely unvegetated when active.

They vary in size from small sheets (>10,000m^2) to small sand seas or dunefields (several km^2) to large scale dunefields.

They 'transgress' prior terrain.

How formed?

1. Sea level change – fall or rise.
2. Shoreline erosion.
3. High sediment supply.
4. Climate change – e.g. changes in storminess and shoreline erosion.
5. Foredune height – wind shear thresholds.
6. Coalescence of blowouts and parabolics.
7. Topographic acceleration over clifftops.
8. Decrease in vegetation cover (e.g. by development of an arid phase; and fire.