

# Coastal Dunes

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**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

May develop into  
incipient foredune zone



*Cakile* in  
southern  
Australia



*Arctotheca* in South  
Africa





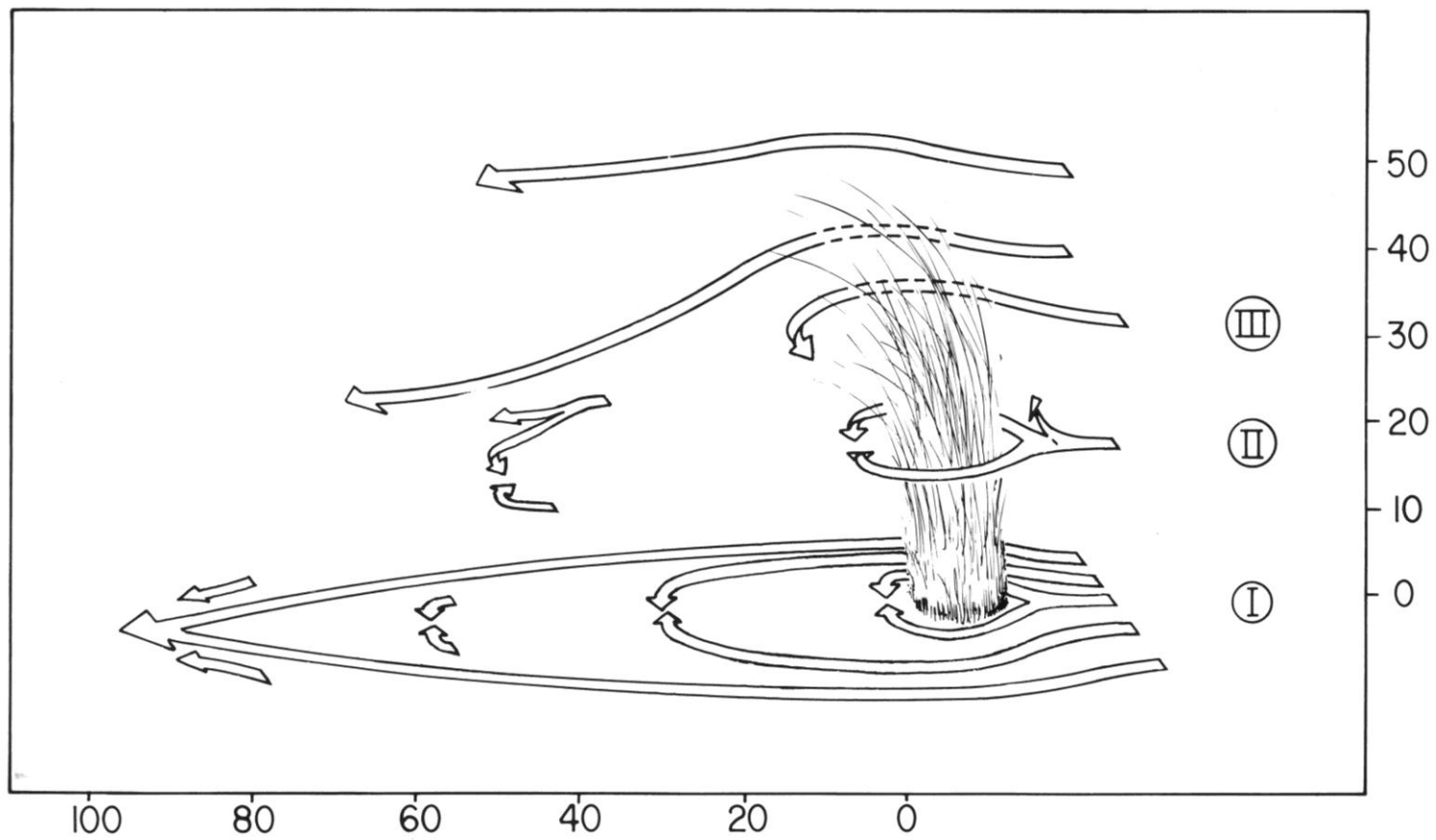
Laterally continuous growth of pioneer species above the high spring tide line.



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



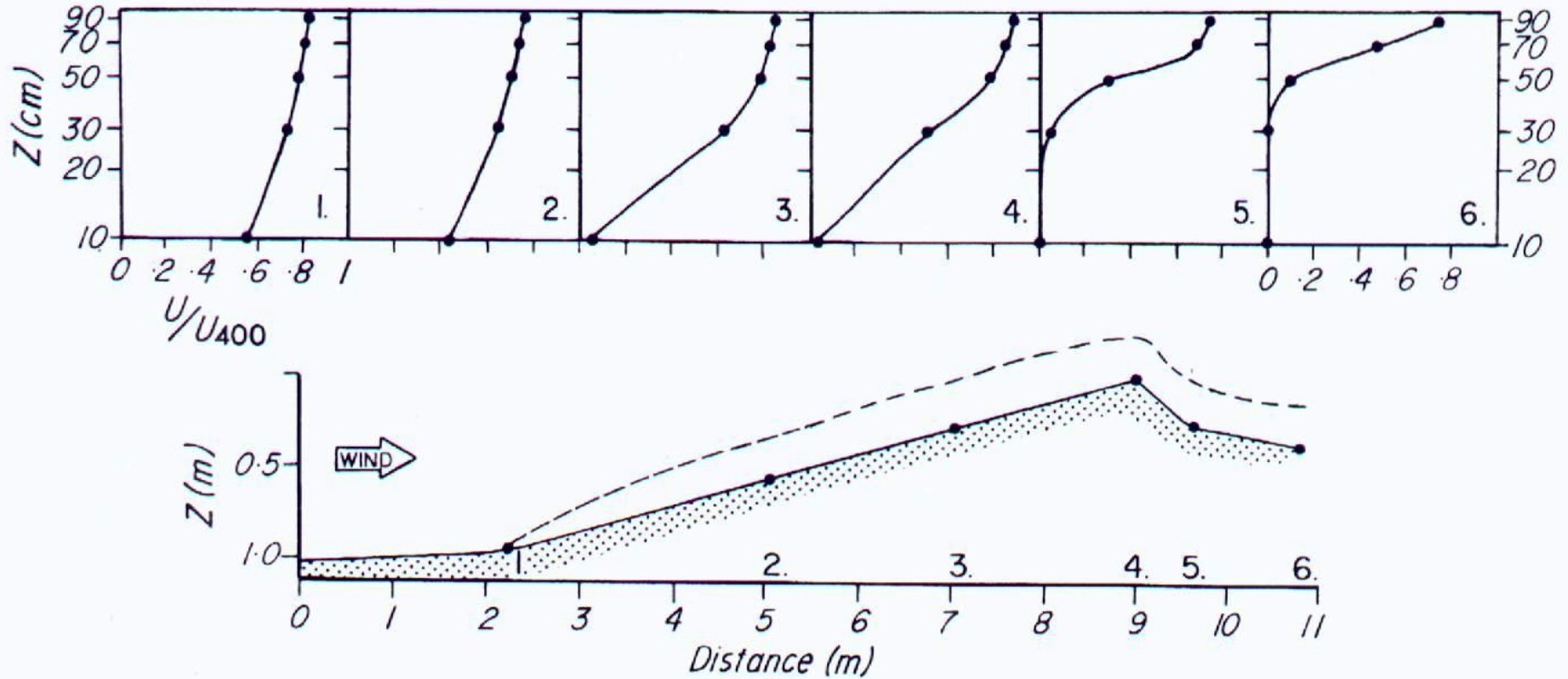
**Nebkha (or nabkha) – dune formed in and around clumps of grass, herbs, bushes etc.**



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



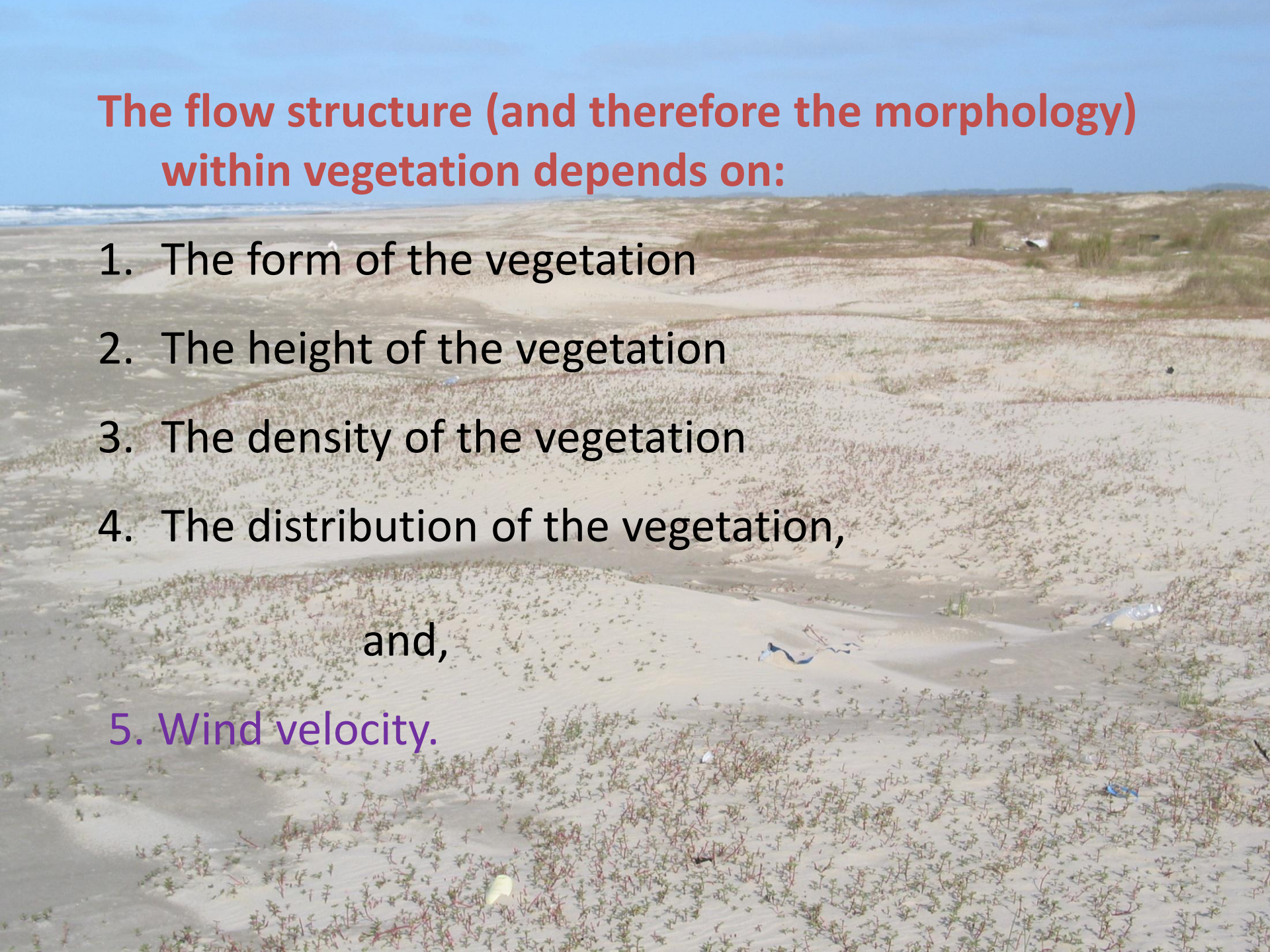
Flow across a small incipient foredune. Dashed line is top of plant canopy. (see Hesp, 1983)



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



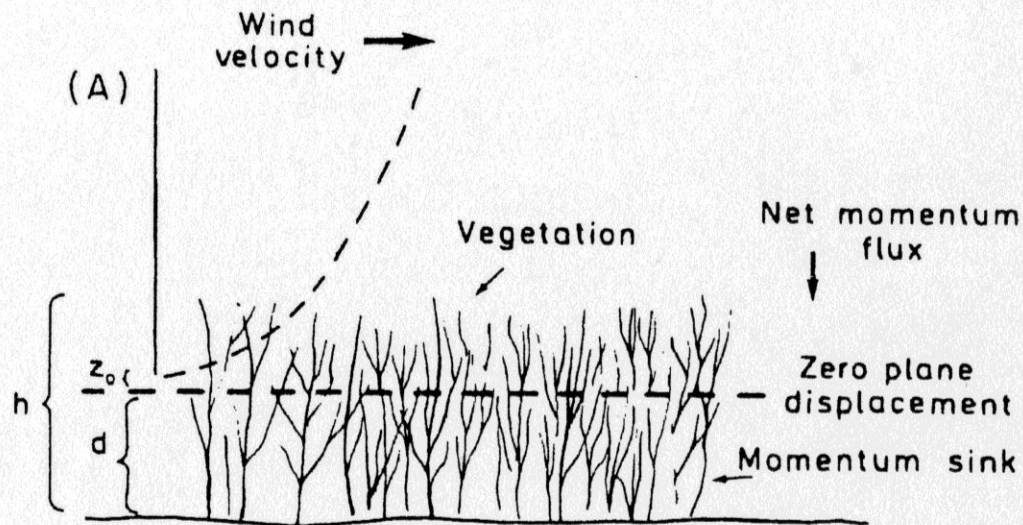




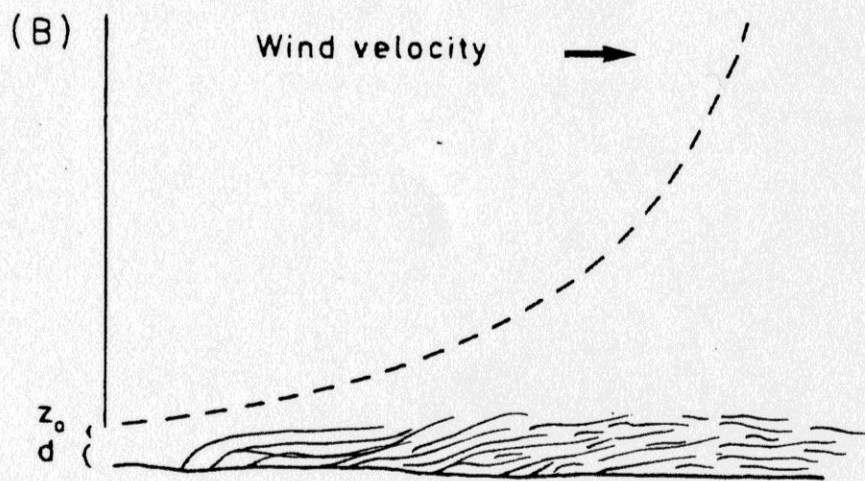
The flow structure (and therefore the morphology)  
within vegetation depends on:

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.





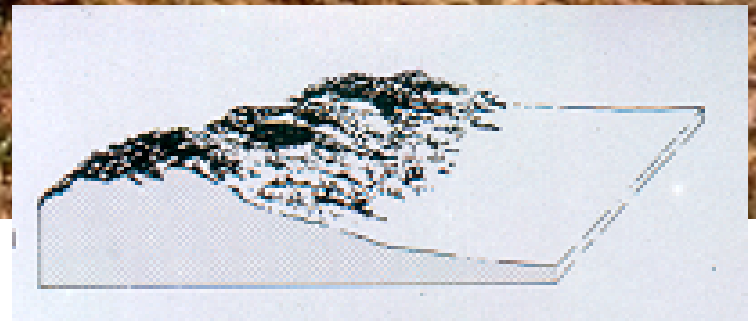
h = Stand height  
 d = Depth of zero plane displacement  
 $z_0$  = Focus



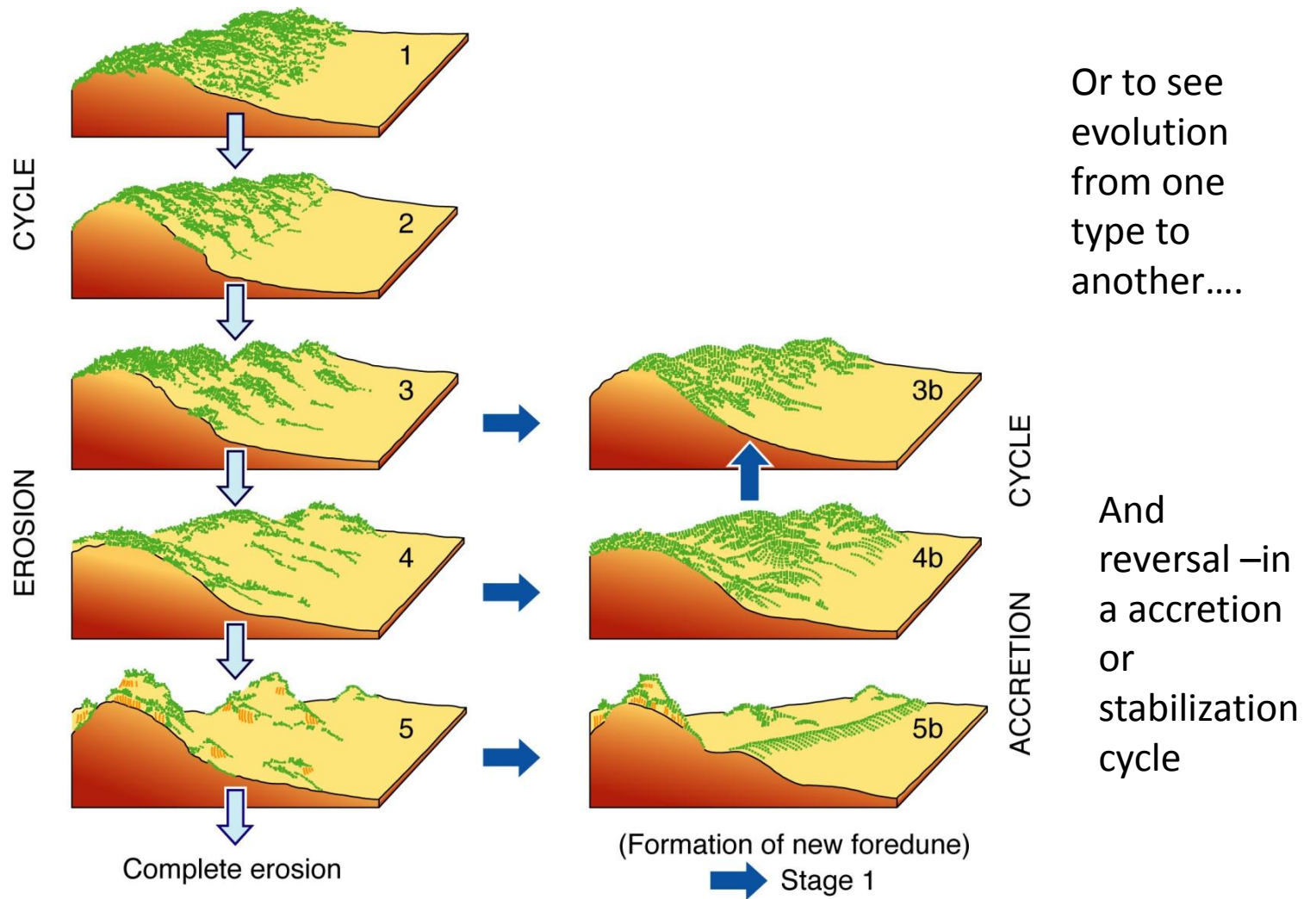
From RWG Carter  
 book

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

# ESTABLISHED FOREDUNES





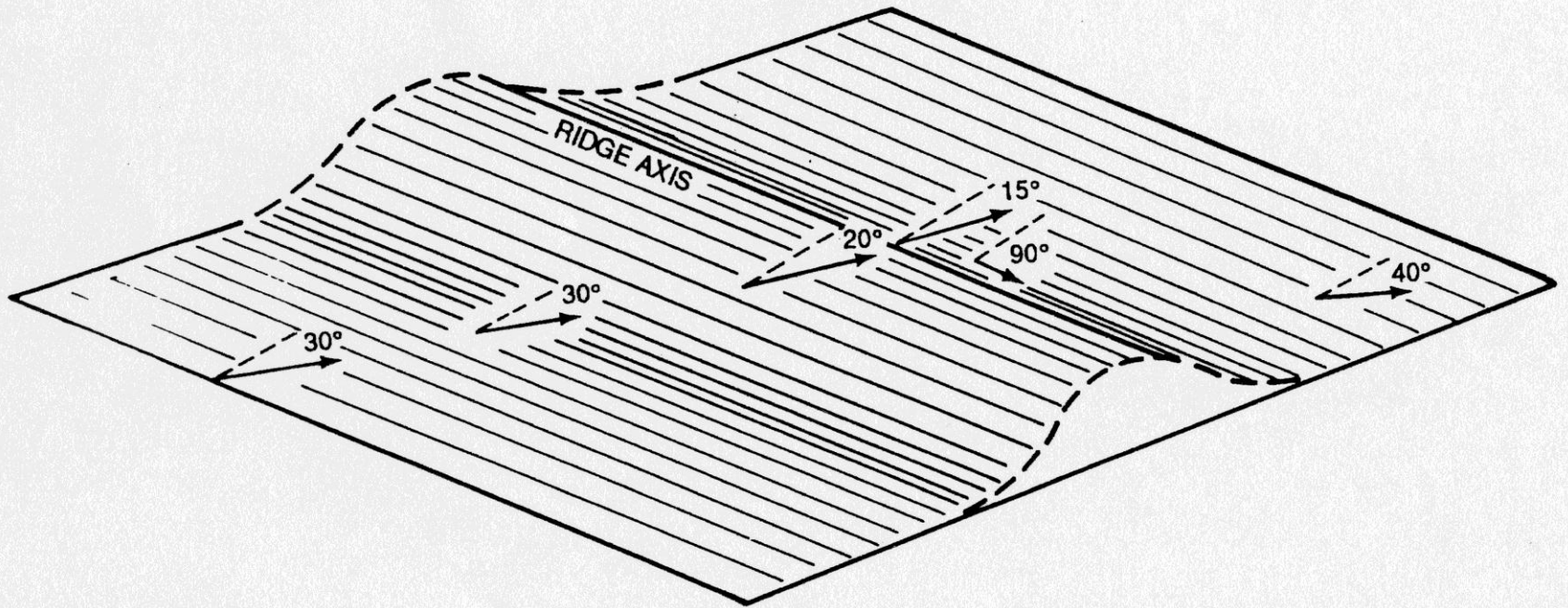


**P.A. Hesp**, 1988; Foredune morphology, dynamics and structures. *J. Sedimentary Geology Special Issue: Aeolian Sediments* 55: 17-41.

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

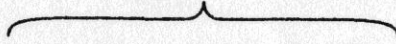


Velocity vector at 1m height over a 2D ridge



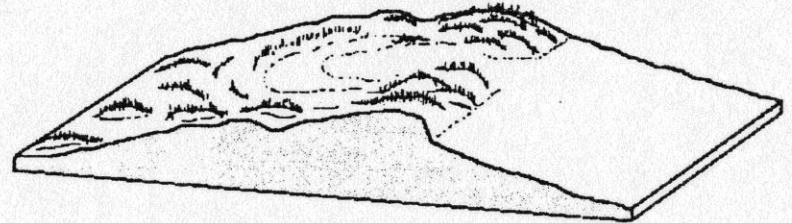
Source: K.R. Rasmussen, 1989. Roy Soc Edinburgh Proc (Sect B).

WAVE EROSION  
EVENT



Minor to major wave erosion

D



Various scales of overwash

(or)

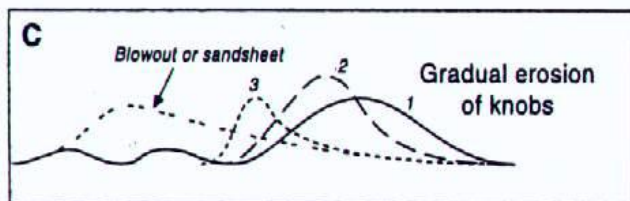
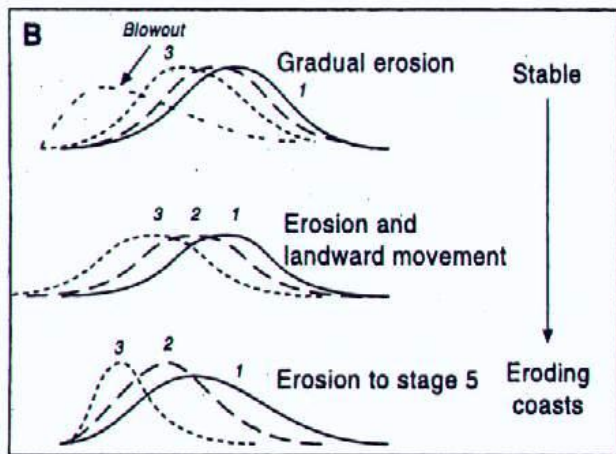


An aerial photograph of a beach showing a complex, wavy pattern of sand ridges and troughs, known as foredunes. The patterns are repetitive and rhythmic, creating a textured, almost cellular appearance. The colors range from light tan to dark brown, highlighting the shadows and highlights of the sand's undulations.

# Foredunes

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

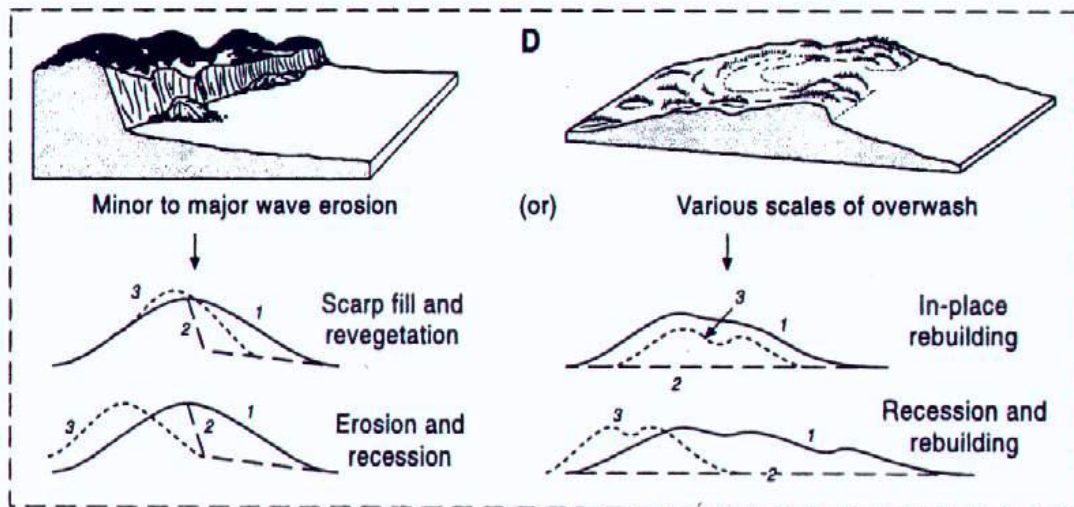
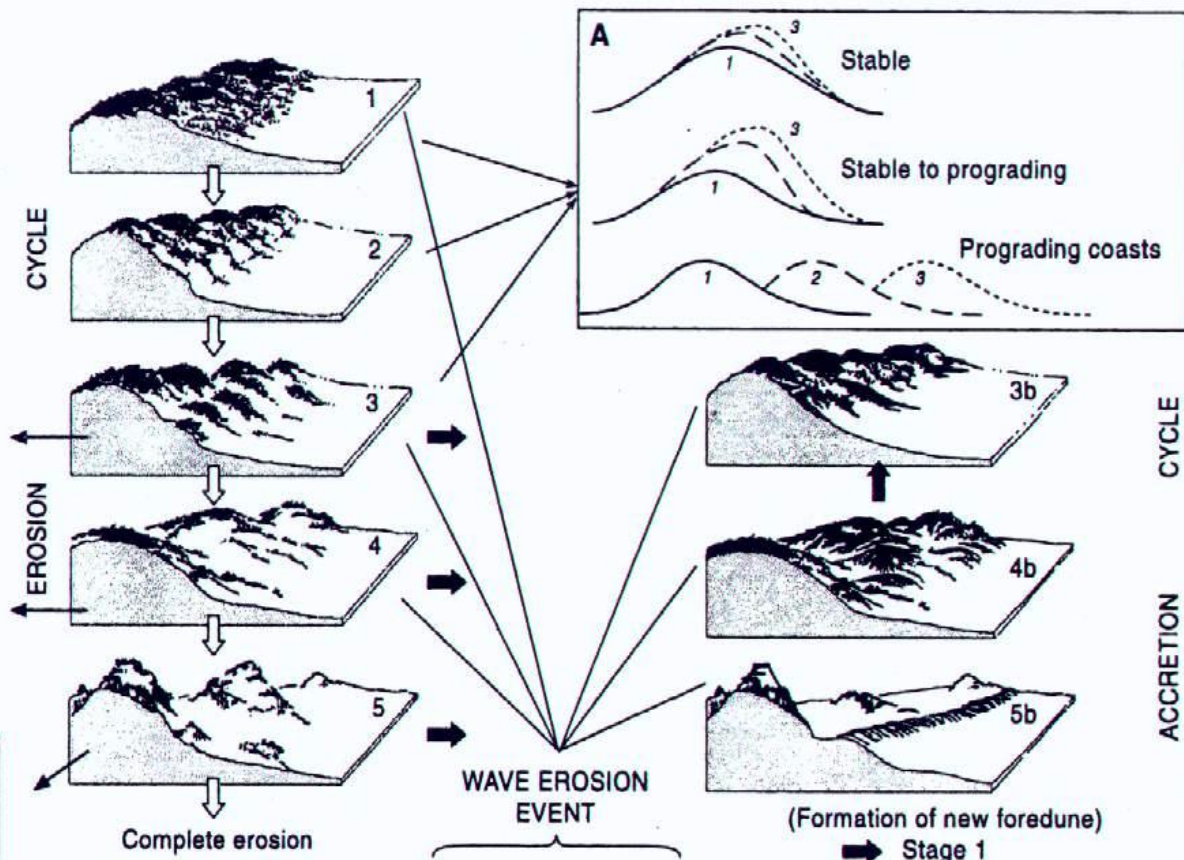




⇨ Erosion  
 ⇨ Accretion/  
 revegetation

**D** Storm event

**A-C** Long term development scenarios (1-3)





An aerial photograph of a sand dune field. The dunes are arranged in a roughly parallel, wavy pattern, creating a series of ridges and troughs. The lighting is from the side, casting long, soft shadows that emphasize the three-dimensional texture of the sand. In the upper right quadrant, there is a distinct, circular depression or hollow, which is a blowout. The text is overlaid on the image, with the word 'blowout' highlighted in yellow.

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

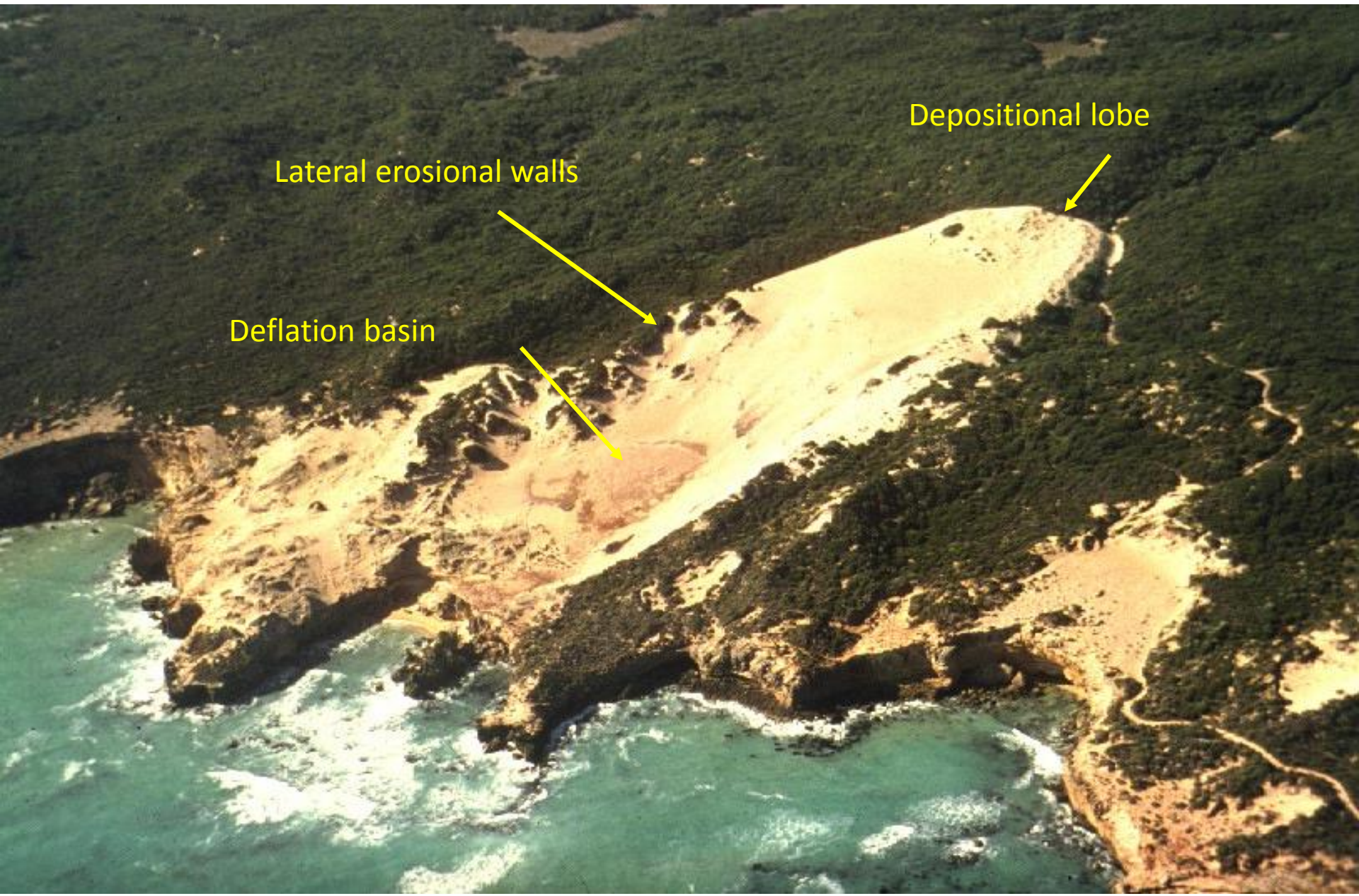
Blowouts are characterised by:

lateral erosion walls

deflation basin

depositional lobe





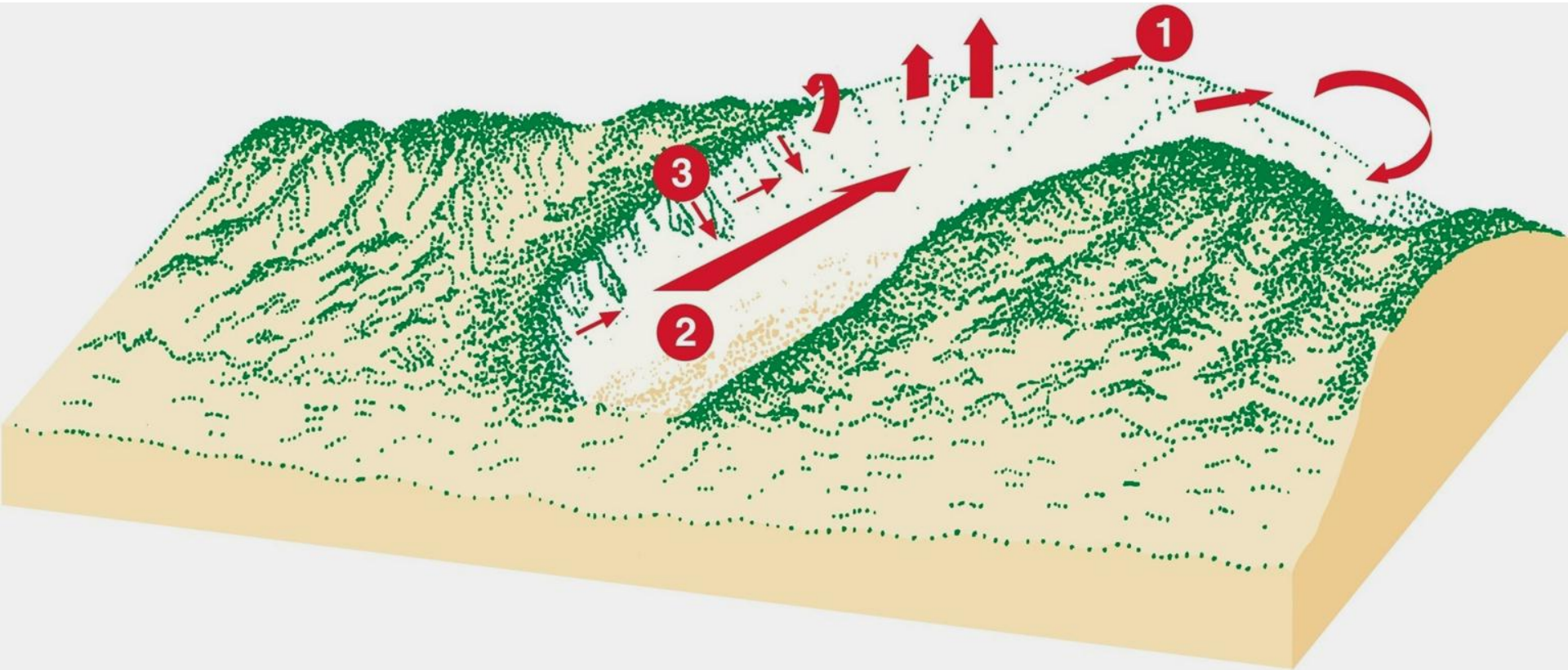
Depositional lobe

Lateral erosional walls

Deflation basin

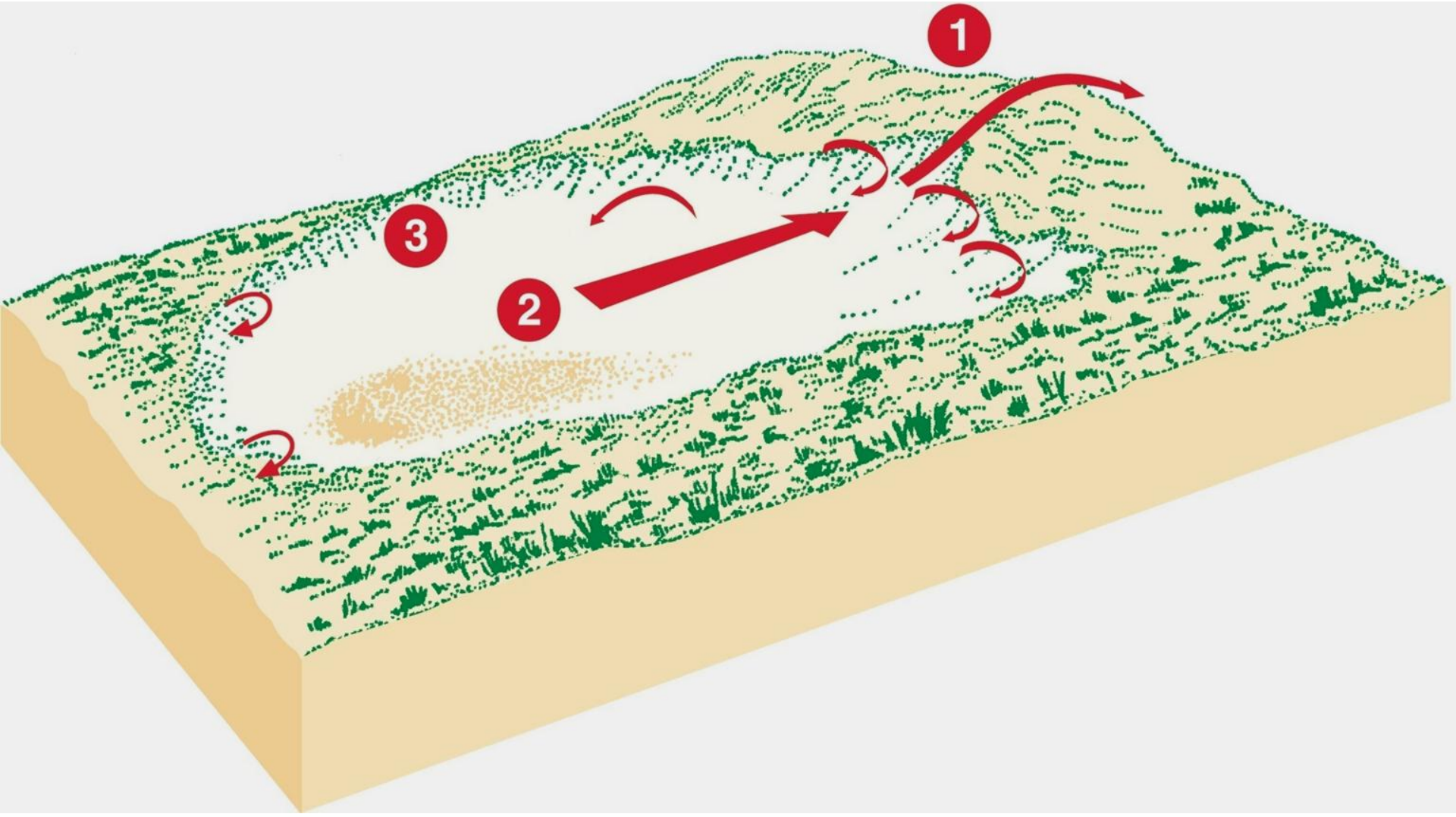


## Flow dynamics in a trough blowout



From Hesp "Coastal Dunes" booklet.

# Flow in a saucer blowout





# Parabolic Dunes





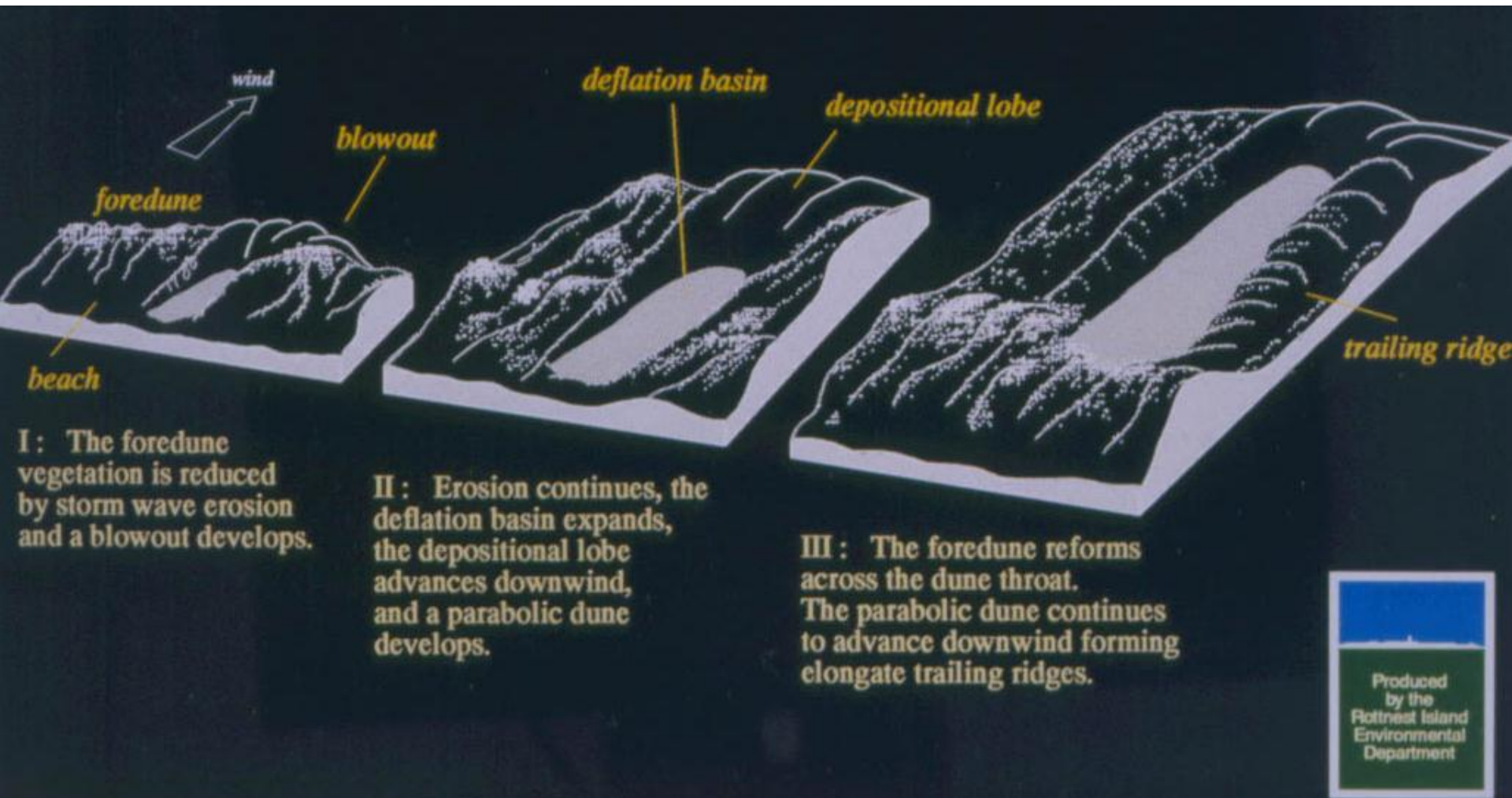
An aerial photograph of a desert landscape featuring numerous parabolic dunes. The dunes are arranged in a regular, repeating pattern, with each dune having a characteristic U-shaped or V-shaped ridge. The ridges are light-colored, while the basins between them are darker, indicating deflation. The overall appearance is a textured, wavy surface of sand 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.**



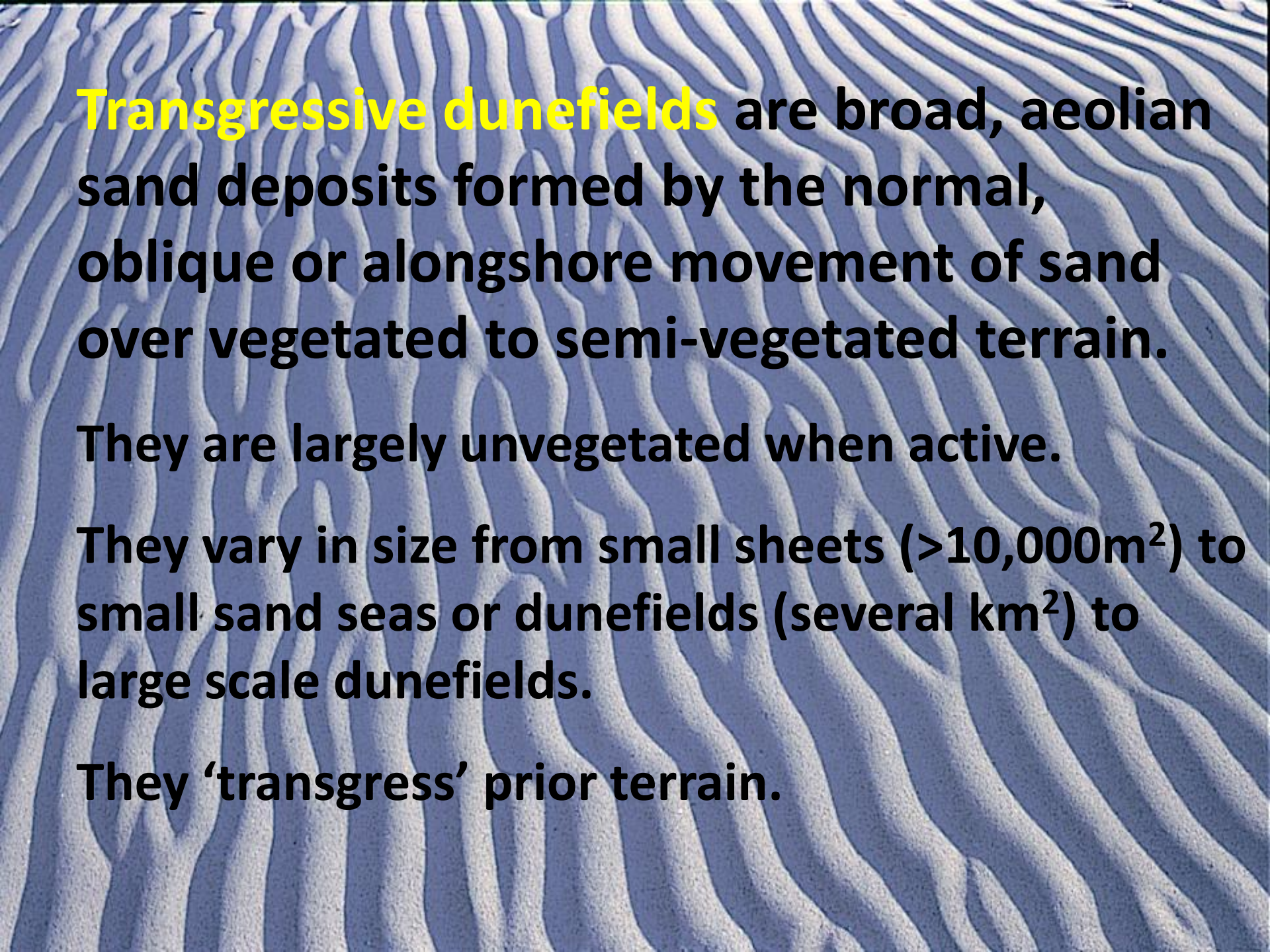


Development from, and elongation of a blowout



**Transgressive Dunefields**



An aerial photograph of a coastal landscape featuring numerous parallel, elongated sand ridges or dunes. The ridges are oriented roughly north-south and are separated by shallow, linear depressions. The overall appearance is that of a vast, textured expanse of sand, characteristic of a transgressive dunefield. The lighting creates soft shadows that emphasize the three-dimensional structure of the ridges.

**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 ( $>10,000\text{m}^2$ ) to small sand seas or dunefields (several  $\text{km}^2$ ) 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).