

Higher Geography Biosphere Vegetation Succession: Sand Dunes

A PowerPoint resource to accompany the posters available at:

http://www.macaulay.ac.uk/soilposters/education_vegetation_6v2.pdf

http://www.macaulay.ac.uk/soilposters/education_vegetation_7v2.pdf





A definition of vegetation succession:

- The evolution of plant communities at a site over time- from pioneer species to climax vegetation
- At each stage of the succession the plant community alters the soil and microclimate, allowing the establishment of another group of species
- One community of plants is therefore replaced by another as the succession develops
- Eventually a climax community is reached where the vegetation is in a state of equilibrium with the environment and there is no further influx of new species



Psammosere:

A vegetation succession on sand dunes

- In Scotland there are 5000 ha of partly vegetated sand
- 500+ vegetation types grow there
- Dune belts illustrate well the development of vegetation from pioneer species to climax vegetation
- The plants which grow there have to adapt to an environment which is :
 - dry
 - salty
 - mobile
 - lacking in nutrients



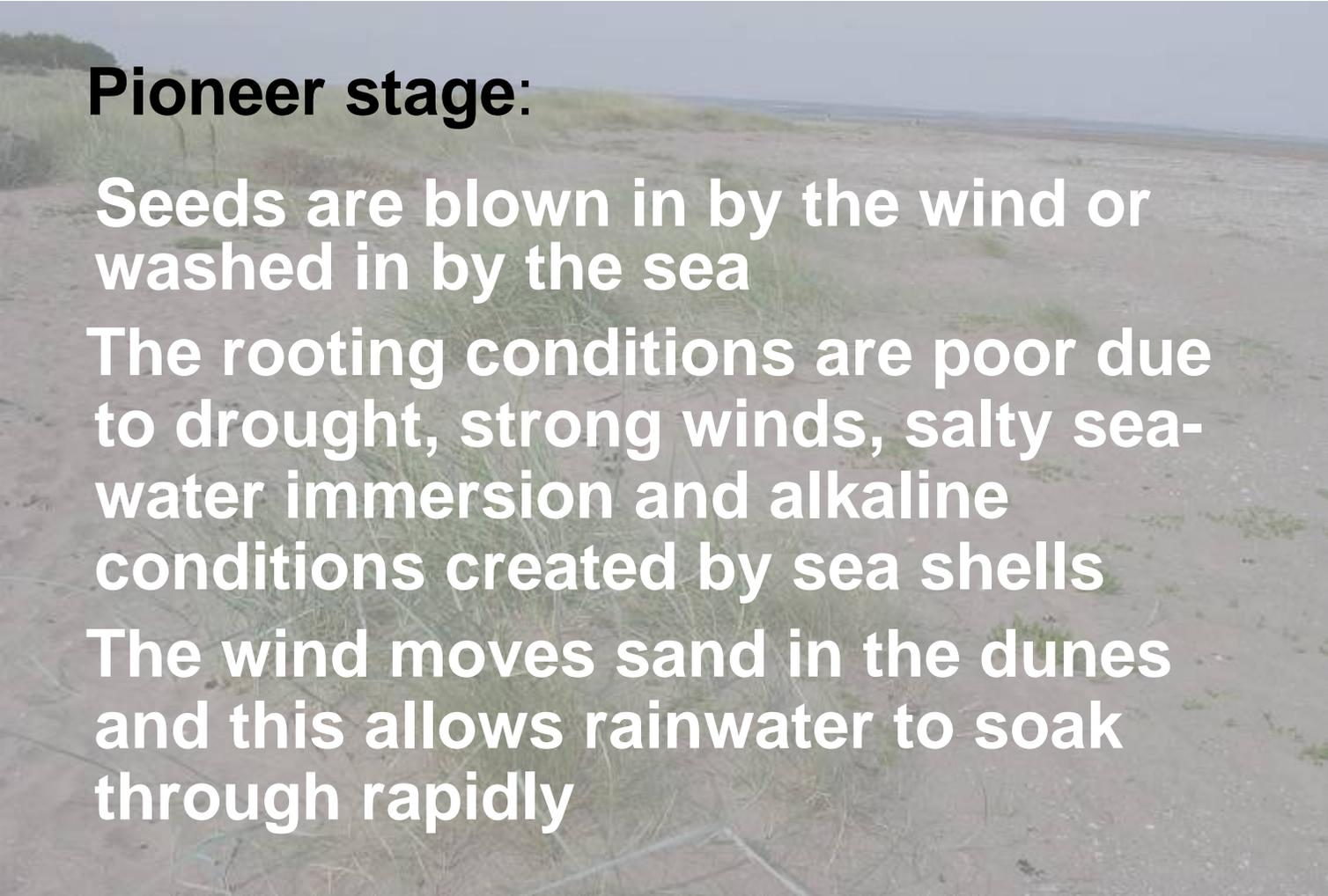
The development of a sand dune system requires:

- A plentiful supply of sand
- Strong winds to transport sand particles through saltation
- An obstacle to trap the sand e.g. a plant

Plants are therefore central to the formation, growth and character of sand dunes



Psammoseres: some definitions



Pioneer stage:

Seeds are blown in by the wind or washed in by the sea

The rooting conditions are poor due to drought, strong winds, salty seawater immersion and alkaline conditions created by sea shells

The wind moves sand in the dunes and this allows rainwater to soak through rapidly

Psammoseres: some definitions

Building stage:

Plants trap sand and grow with it, binding the sand together with their roots

The humus created by decaying pioneer plants creates more fertile growing conditions, and the soil becomes less alkaline as pioneer plants grow and trap rainwater

Less hardy plants can now grow and start to shade out the pioneers

As plants colonise the dunes, the sand disappears and the dunes change colour - from yellow to grey

Psammoseres: some definitions

Climax stage:

Taller plants (such as trees) and more complex plant species (like moorland heathers) can now grow

Plants from earlier stages die out because of competition for light and water

When the water table reaches, or nearly reaches the surface, dune slacks can occur
Plants which are specially adapted to be water-tolerant grow here

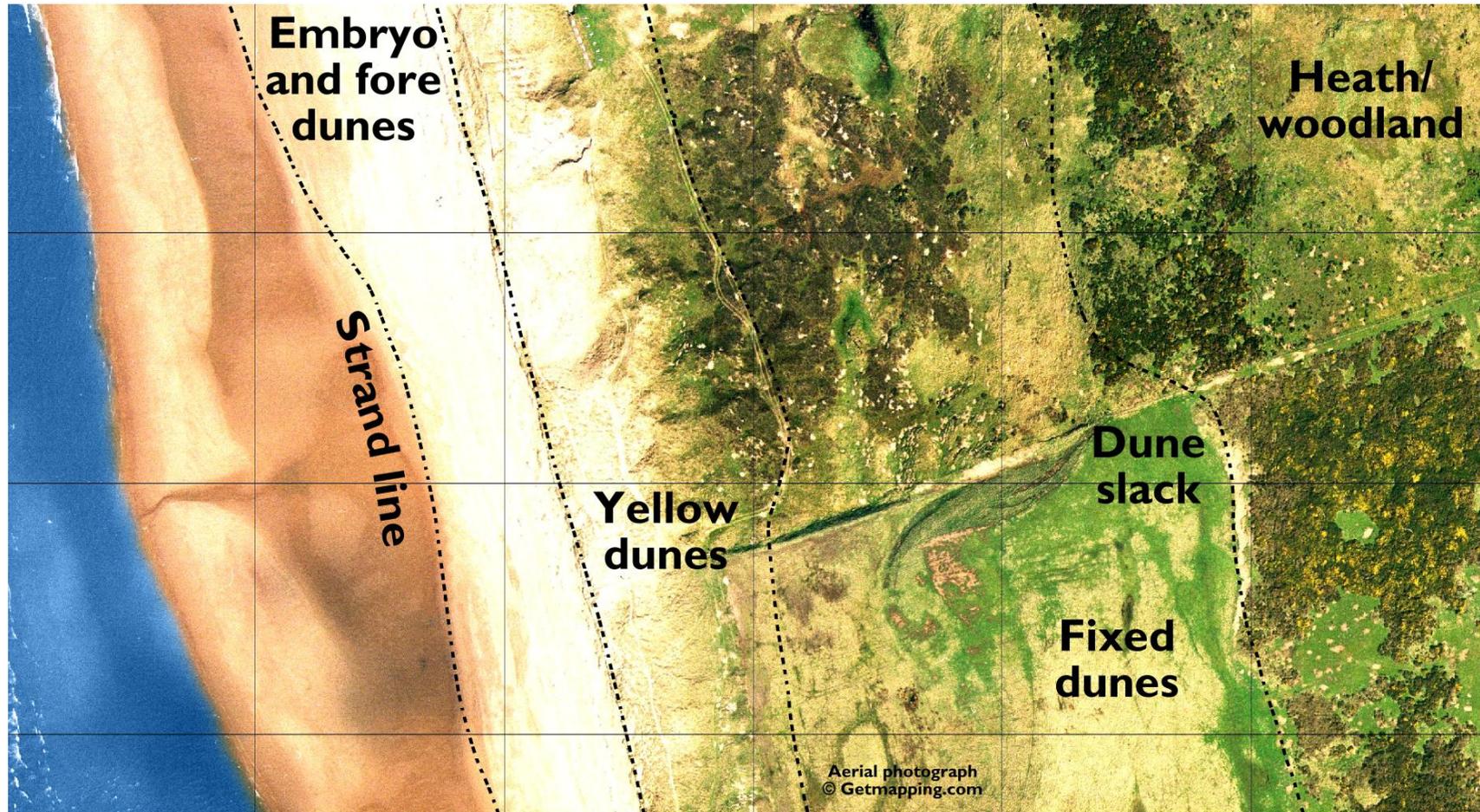


Sand dune systems develop seawards over time...

- New dunes develop on the foreshore and here the psammosere is in its pioneer stage
- Landwards of this, on the older, more sheltered dunes, the psammosere is in its building stage
- Furthest inland, on the oldest dunes, the psammosere will reach its climax stage

A sand dune system may take hundreds of years to develop but the process can be seen within a few hundred metres of the shoreline

An aerial view of a sand dune system

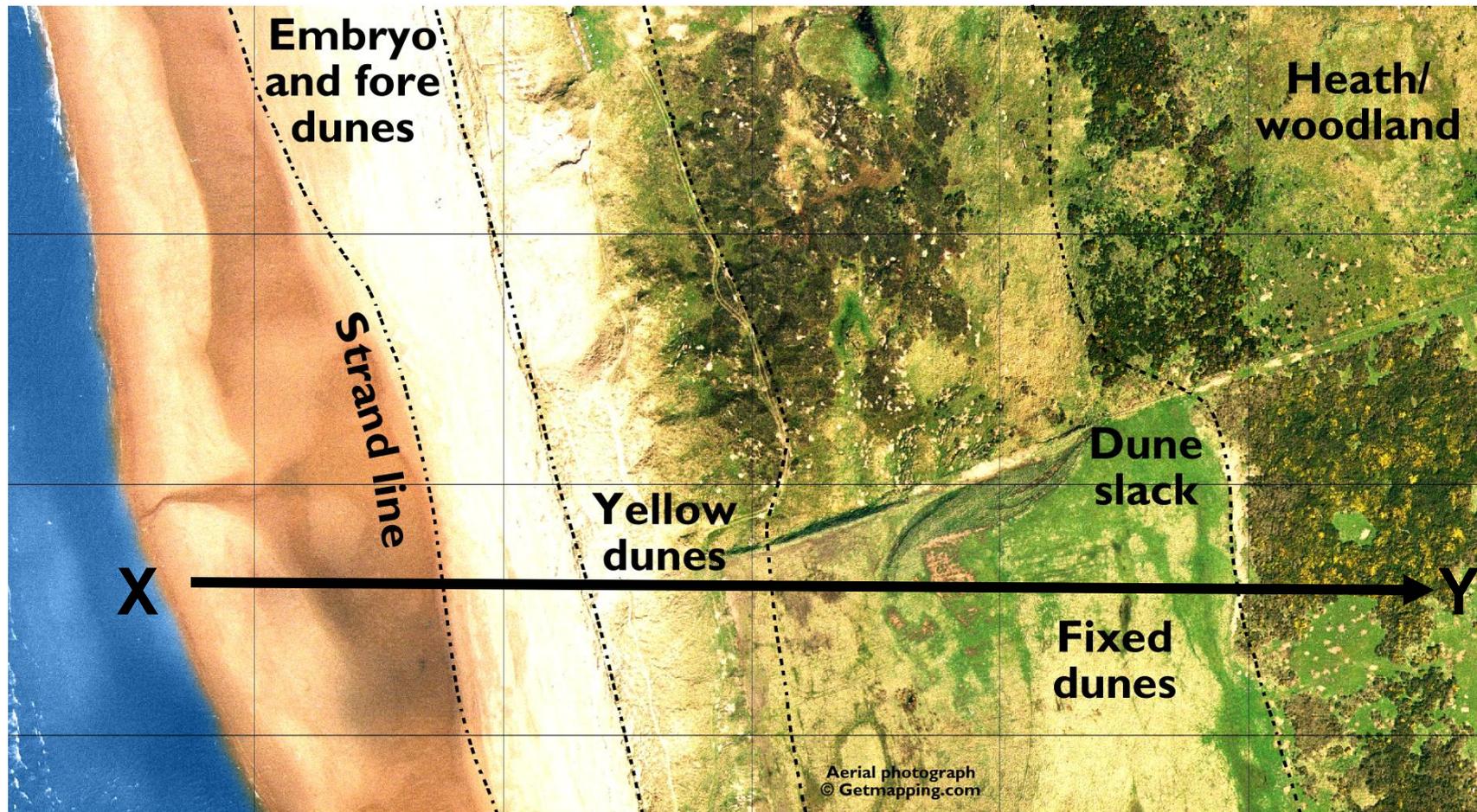


youngest
dunes



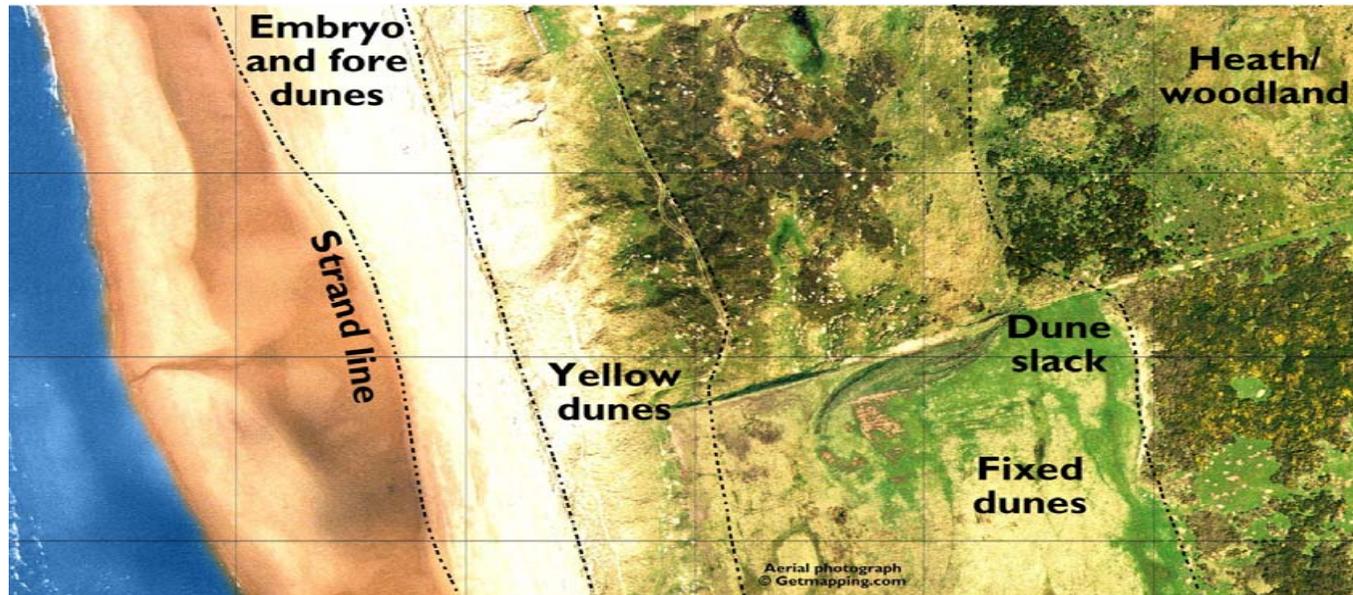
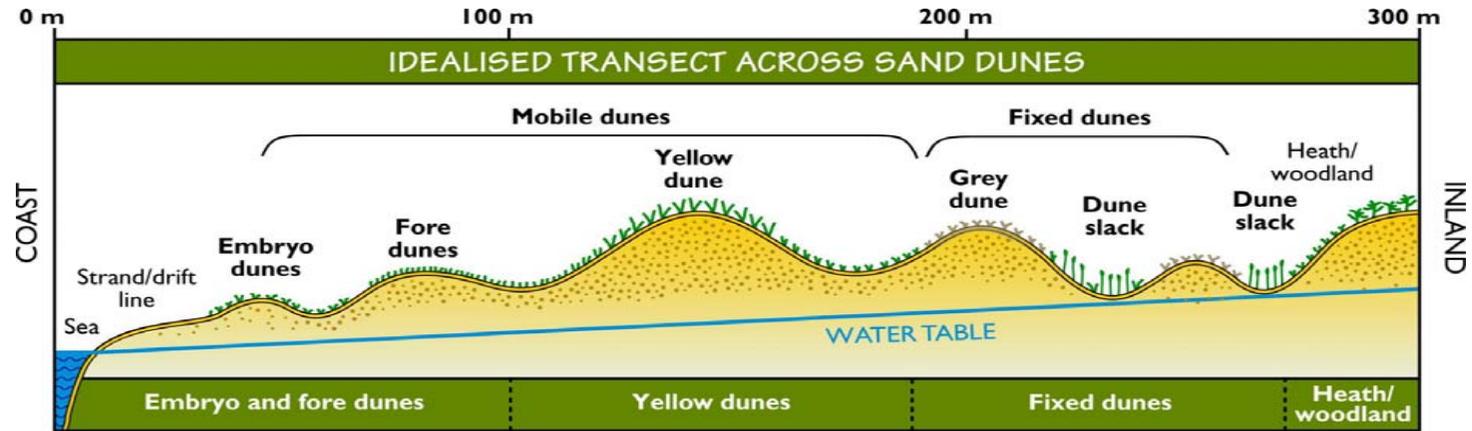
oldest
dunes

A transect across a sand dune system

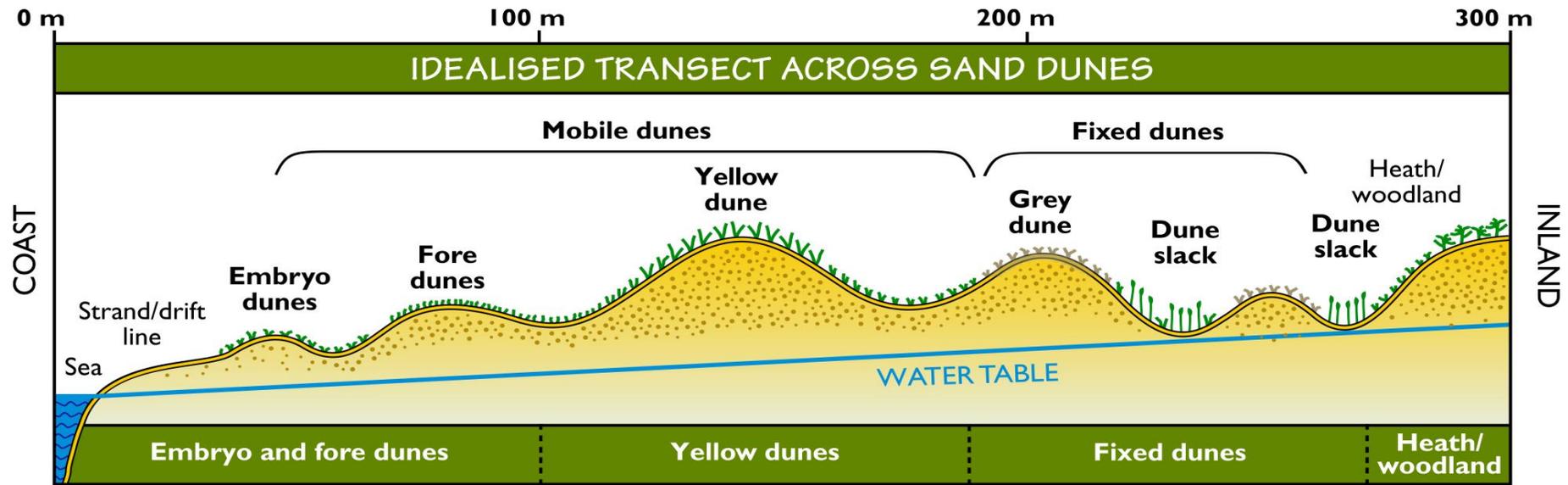


Reveals variations in relief and vegetation

A transect across a sand dune system



A transect across a sand dune system



The transect above has hidden 'hotspots'. Move your mouse over the diagram and these will be revealed. Progress across the transect using these hot spots.

You can return to this diagram at any time by using the return button



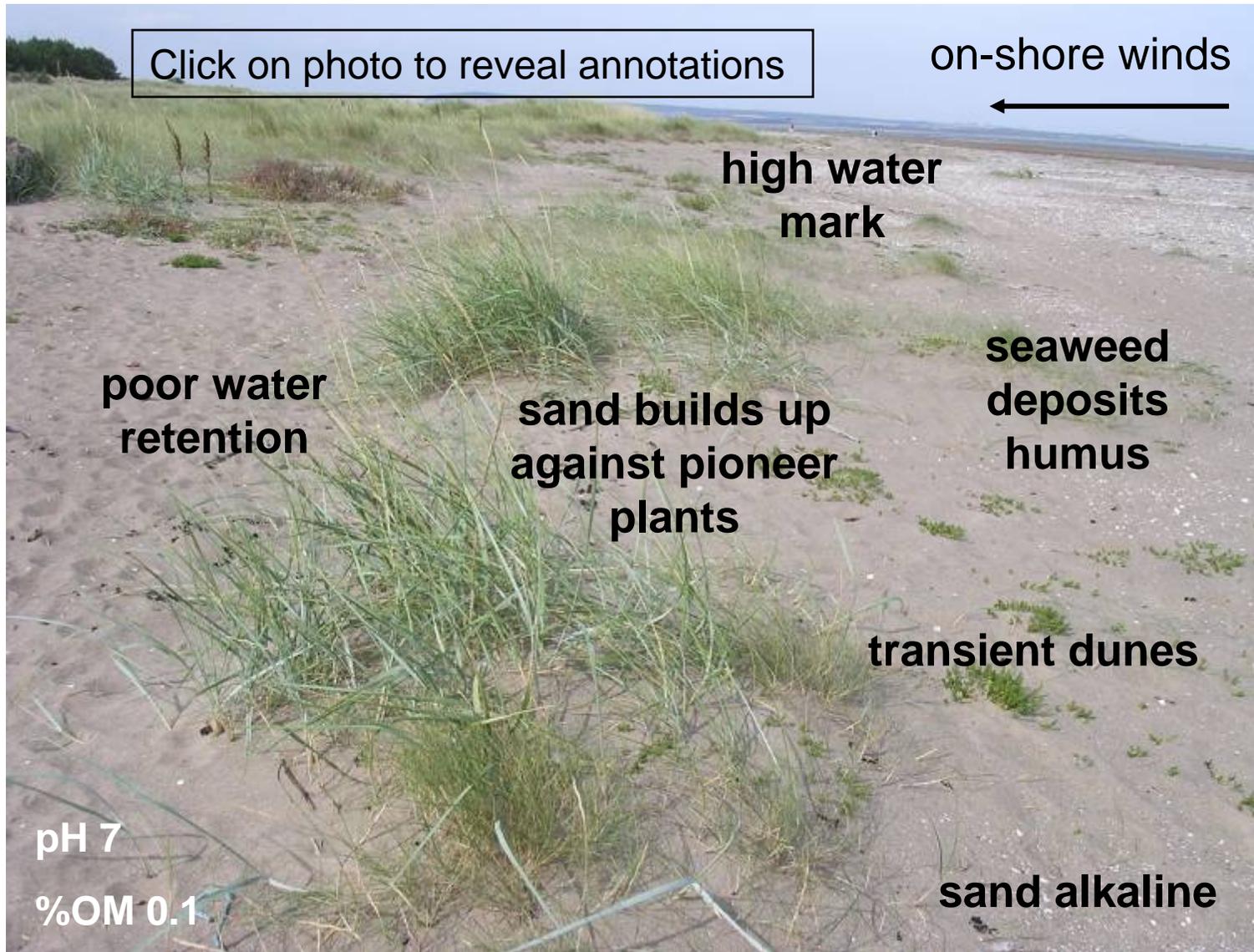
You can advance quickly from one slide to the next by using this button



You can go from this slide to the revision materials by using this button



Embryo and Fore Dunes: the environment



Embryo and Fore Dunes: the plants

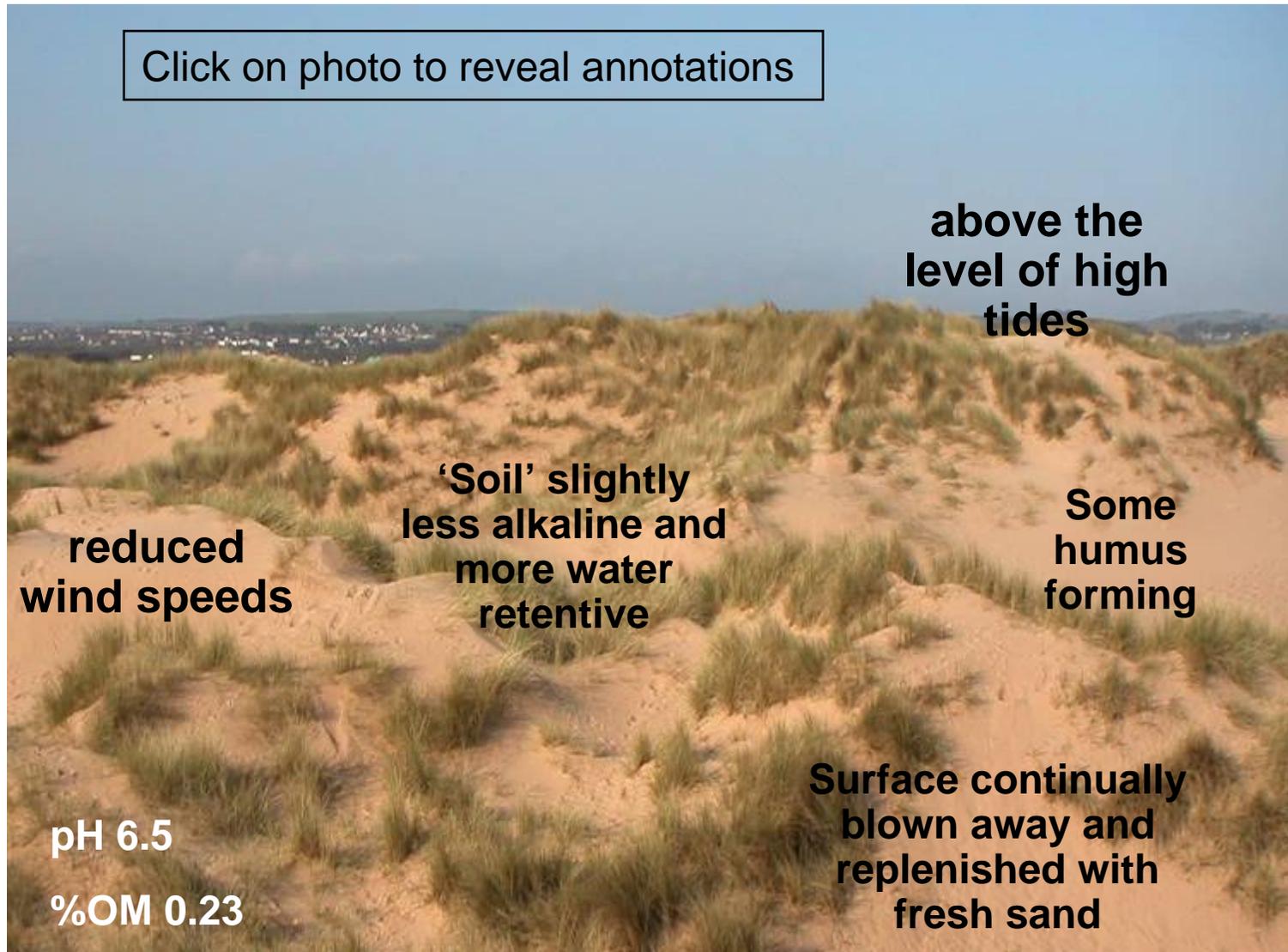
The plants which grow here have adaptations which allow them to grow in a difficult environment :

- waxy leaves to retain moisture and withstand winds
- prostrate (low) habit to avoid strong winds
- deep tap roots to obtain available moisture
- high salt tolerance



Yellow Dunes: the environment

Click on photo to reveal annotations



above the
level of high
tides

reduced
wind speeds

'Soil' slightly
less alkaline and
more water
retentive

Some
humus
forming

pH 6.5

%OM 0.23

Surface continually
blown away and
replenished with
fresh sand



Yellow Dunes: the plants

The dominant plant species is
Marram grass:

- Salt tolerant
- Thrives on being buried by sand
- Inrolled leaves to reduce moisture loss
- Long tap roots
- Underground rhizomes stabilise the sand



Other plants such as Ragwort, Red fescue and Sand sedge begin to appear



Grey Dunes: the environment

Click on photo to reveal annotations

sheltered by higher,
seaward dunes

lower pH

little mobile
sand

sand no longer
accumulating

higher humus
content

a more closed vegetation
community in which
marram grass is no longer
able to compete

pH 5 - 6

%OM 1.0



Grey Dunes: the plants



- higher species diversity
- mainly perennials
- marram becomes more sparse
- surface lichens give 'grey' appearance



Older grey dunes may have extensive covering of lichens and heather

Dune Slacks: the environment

Click on photo to reveal annotations

occur in low lying hollows
between dune ridges

soil acidic

relief
intersects the
water table

pH 4 - 5

%OM 8.5

water table high –
especially in winter



Dune Slacks: the plants

The community which develops here comprises moisture-loving plants commonly found in many fresh water wetland areas e.g.



Dune Heath/Woodland: the environment

Click on photo to reveal annotations

**well sheltered
from winds**

**maritime influence
is minimal**

acidic soil

nutrient rich

pH 4

**soil has high organic
matter content**

% OM 12.1



Dune Heath / Woodland: the plants



Human interference means that true mixed woodland climax vegetation is rarely seen on dune systems in the UK

Most dune systems develop into a community of heathland, woody perennials (often spinous) and scattered trees



Revision materials



Psammosere: summary of stages

Stage in dune succession

		Mobile dunes		Fixed dunes		
		Embryo and fore dunes	Yellow dunes	Grey dunes	Dune slack	Heath/ woodland
Dune characteristics		<ul style="list-style-type: none"> On-shore winds Seaweed (humus build up) Sand building up Transient Alkaline sand 	<ul style="list-style-type: none"> Surface continually blown away and replenished by fresh sand Reduced wind speed Top of dunes above high tide level 	<ul style="list-style-type: none"> Increased humus content Surface lichens Sand no longer accumulating Marram grass not able to compete well 	<ul style="list-style-type: none"> Damp, low lying hollows High water table in winter Soil acidic and pH variable 	<ul style="list-style-type: none"> Acid soil and increased organic matter content Nutrient rich Shelter developed
	Plant characteristics	<ul style="list-style-type: none"> Scattered individuals Low growing prostrate habitat Waxy leaves Salt tolerant 	<ul style="list-style-type: none"> Salt tolerant Thrives on being buried by sand Inrolled leaves Long tap roots Underground rhizomes to stabilise sand 	<ul style="list-style-type: none"> Many plants now co-existing Mainly perennials Stabilising plants liking increased organic matter content 	<ul style="list-style-type: none"> Moisture loving plants 	<ul style="list-style-type: none"> Acid loving plants co-existing Woody perennials plus understory species
Example plant		 <p>Photo courtesy of Carl Farmer</p> <p>e.g. Sandwort</p>	 <p>e.g. Marram grass</p>	 <p>e.g. Grey lichen and heather</p>	 <p>e.g. Rushes</p>	 <p>e.g. Heather and woodland</p>



“A Question of Psammoseres”

The nine number question board which follows is adapted from a template made available by :

www.sln.org.uk/geography

Click on a number to link to a question

Click the back button to link back to the question board



Once selected, numbers will change colour



“A Question of Psammoseres”

1

2

3

4

5

6

7

8

9

Use 'end show'
command to exit
presentation



What type of dunes are forming in the foreground of this photograph?



2



This photo shows ground cover somewhere within a dune system. What stage of the psammosere is it associated with?

Can you name any of the plants growing in the photo?





What is the dominant species in this photograph? At which stage of the psammosere would you expect to find it?

How is this plant adapted to its environment?





4



This photo shows ground cover somewhere within a dune system. What stage of the psammosere is it associated with?

What is the dominant species? Why is the other plant also able to grow here?



5



In which stage of the dune succession would plants like these be found?

How are they adapted to the environment there?

Can you name either of the species shown?





6



What name is given to areas of open water such as this which are found within dune systems?

Name some of the plants which you might expect to find growing there





7



This photo shows ground cover somewhere within a dune system

What stage of the psammosere is it associated with?

Can you name any of the plants growing in the photo?



8



The climax vegetation of a dune succession would look similar to this photo

What is meant by the term 'climax vegetation'?

Why is a community of plants like this one rarely found in dune systems in the UK?



9



The photo shows a dense community of foreshore plants
Name some of the plants you would expect to find here and
explain how they are able to survive in this environment

