



The Oregon Dunes, Florence. Source: Wikimedia Commons

The images below show the Oregon Dunes but only one represents a threat to the survival of the Oregon Dunes ecosystem. Which image would you choose and why?

The Oregon Dunes can be used as a Case Study OR an illustrative example for Ecosystems at Risk. There is detailed information available to cover all syllabus requirements for this topic.

This article is a taster, an introduction to the Oregon Dunes as an Ecosystem at Risk.

A document containing information about the Oregon Dunes for all syllabus dot points will accompany this edition of the Geography Bulletin on the GTA NSW & ACT website



Open dunes are a popular tourist attraction Shutterstock



European Beachgrass on the foredune L Chaffer

OREGON DUNES – AN OVERVIEW

'Our hike through the Oregon Dunes was a lesson in how man can screw up nature, wrecking perfectly functioning ecosystems, probably beyond repair.'

Judy Nichols - Hiking the Oregon Dunes: A lesson in ecosystem destruction (2019)
<https://www.newamericannomads.com/blog/hiking-the-oregon-dunes-a-lesson-in-ecosystem-destruction/>



Watch this short video clip for a 'big picture' summary of change over time to the Oregon Dunes and attempts to protect this unique ecosystem.

https://www.youtube.com/watch?time_continue=428&v=ZVx2dNTjyA&feature=emb_logo

ECOSYSTEMS AT RISK: OREGON DUNES

Spatial patterns and dimensions

Location: Altitude: Latitude: Size: Shape: Continuity

The Oregon Dunes stretch 87 km along the Pacific Coast of the US state of Oregon, stretching in a continuous band from Heceta Head north of Florence (44° N, 124° W) to Cape Arago south of Coos Bay (43° N Longitude: 124° W). The eastern boundary extends up to 4 kilometres inland. The dunes cover 162 square kilometres (40,000 acres /16,200 hectares) making them the largest dune system on the West Coast of North America (spatial continuity) and one of the largest temperate dunes systems in the world.

The dune system is over 100,000 years old with the youngest dunes nearest the shore forming in the last seven thousand years. The oldest and highest dunes further inland to the east, are up to 150 metres in altitude and formed between 20,000 years ago and 100,000 years ago (temporal continuity). The primary source of sand for these dunes are the Cascade and Coast Mountains and the Umpqua River, Siuslaw River and other smaller rivers flowing to the west.

Source: <https://www.mercurynews.com/2016/11/17/an-oregon-coast-getaway-waves-gems-and-plenty-of-charm/>

Figure 1: General location map



Figure 2: The Oregon Dunes morphology



The dunes: Nearest the beach the foredune is a 7 to 8 metre vegetated ridge running almost continuously along the shoreline. Inland lies a deflation plain, a low-lying area with seasonal ponds and low transverse dunes. Farther inland, oblique dunes shaped by prevailing winds in winter, stand 60 metres above sea level.



BIOPHYSICAL INTERACTIONS

Coastal dunes are dynamic aeolian landforms created by interactions between the atmosphere, hydrosphere and lithosphere. These biophysical interactions create the abiotic conditions for dune formation and continuity across time and space. In their natural state, the sands of the Oregon Dunes move continuously from day to day, storm to storm, and season to season, and life on the dunes (the biosphere) has evolved to cope with these changes.

Lithosphere, atmosphere and hydrosphere (Abiotic interactions)

In order for coastal dunes to form there must be:

- adequate sediment availability (sand 0.2 – 2.0mm in size)
- wind energy capable of transporting sand landward

Over 45 million years ago tectonic plate movements created the Cascade and Coast mountain Ranges. Weathered and eroded sediment was transported to the coast over thousands of years via the Siuslaw, Siltcoos, Tahkenitch, Umpqua, and Coos rivers. Sand accumulated on Oregon's broad continental shelf and a low coastal terrace of sedimentary rock. When sea levels fell, dry sand was moved by wind and when sea levels rose waves transported sand onto the coast. The flat coastal topography was the foundation on which the dunes were built and shaped by tides, wind and waves.

The Oregon Dunes contain many lakes such as the Siltcoos, Tahkenitch, and Tenmile Lakes formed when moving dunes dammed streams flowing from the mountains. Today, some of these lakes drain through creeks to the Pacific Ocean while inter-dune lakes such as Lily Lake and Horsfall Lakes are intermittent and rely on seasonal rainfall.

Biosphere (Biotic interactions)

After the initial formation of the dune field, a positive sediment budget meant that sand continued to accumulate. Finally, the dunes were stabilised by groundwater (wet sand is not moved by wind) and the growth of vegetation that trapped the sand and stabilized the ground. A vegetation succession developed across the dunes. Pioneer species facilitated the establishment of other native species and biodiversity increased. There is a diversity of ecoregions within the Oregon Dunes including areas of moving sand, wetlands, bushland, woodland and forest – each adapted to the environment of a location. Figure 2 illustrates the changing topography and vegetation succession found in the Oregon Dunes today.

Much of the flora and fauna that has colonised the dunes over time has adapted to the shifting sands and ever-changing abiotic environment. Complex food webs and food chains transfer energy and nutrients and support high levels of biodiversity. Plant species are highly dependent on moving sand and wildlife feed in different areas of the dunes. The Western Snowy Plover forage for insects in the wrack (ocean debris) and dunes and Lupine, Wild Pea, and Sand Verbena grow in close proximity. When sand stops moving, some plant communities become permanent, however other native species disappear from the ecosystem. Native species impacted by changes to the lithosphere can be seen in Figure 3.

A unique ecosystem at risk of disappearing forever.

The Oregon Dunes are quite different today than they were 100 years ago. The introduction of European Beachgrass has changed the dune morphology and ecosystem dramatically. The loss of sand for dune formation and invasion of exotic species of plants and animals has caused irreversible change to much of the ecosystem ... as far inland as the forests on the highest dunes. Only a few places exhibit features of the original ecosystem.

'There are few places where humanity's hand is as evident as it is on the dunes ecosystem. We have a responsibility to preserve what is left and restore what we can so the amazing natural processes and unique plants and wildlife of the dunes can thrive there once more.'

Chandra LeGue, Oregon Dunes Restoration Collaborative

The introduced European Beachgrass seen in the opening image of this article threatens the survival of the entire Oregon Dunes ecosystem. The beachgrass forms dense mats and hummocks with roots as deep as 10 metres extending to the groundwater below and rhizomes that spread long distances across the dunes. The dense grass prevents the seasonal movements of sand and has created a large stable foredune that blocks the wind, preventing the inland transfer of sand needed to replenish the dunes. Behind the vegetated foredune a large deflation plain, robbed of sand and no longer replenished by new supplies is now a wetland dominated by non-native bushland species and shrubs. See Figure 3 It has been calculated that 5 metres of dunes are being lost each year as these species take over and hundreds of metres of dunes have been lost over the last 80 years.

ECOSYSTEMS AT RISK: OREGON DUNES

Figure 3: Biodiversity and change

Native plant species and communities in decline

<p>PINK SAND VERBENA</p>  <p>Only growing on open sand, this once common wildflower is a federal species of concern and hard to find on the dunes.</p>	<p>GREY BEACH PEA</p>  <p>Adapted for life on the sand, this woolly-leaved legume is increasingly uncommon on the dunes.</p>	<p>SEASHORE BLUEGRASS - SAND FESCUE</p>  <p>Together, these plants grow only on unstabilized sand. Only a few sites remain in the dunes where this pair is found together.</p>	<p>SHORE PINE - BEARBERRY</p>  <p>The individual species are common, yet grow together only on the dunes. Without blowing sand, once transient woodlands now mature into forests, and young woodland communities like this disappear.</p>
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Dunes invaders – non-native plant species

<p>EUROPEAN BEACHGRASS</p>  <p>Infamous for its ability to spread, take advantage of limited resources, and crowd out other species, this was originally planted to stabilize the sand to protect built infrastructure. It has drastically altered the dunes landscape. Due to its deep and spreading root system, removal requires years of effort and maintenance.</p>	<p>SCOTCH / SCOT'S BROOM</p>  <p>Its beauty when flowering belies its presence on the dunes as a seed-factory menace. Widespread and well-adapted to the dunes, it's a tough competitor with native species. Many volunteer hours have gone into pulling this weed.</p>	<p>GORSE</p>  <p>With yellow blooms similar to scotch broom, gorse was introduced a century ago and is now widespread. Its seeds can live in the sand for several decades before germinating. The plant itself can re-sprout when cut, making it a tough one to remove.</p>
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Wildlife of the dunes

Some of these native species have suffered as a result of habitat loss. From bears to beetles, the dunes support many fascinating animals.

<p>SIUSLAW HAIRY-NECKED TIGER BEETLE</p>  <p>This fast-moving predatory beetle that inhabits sandy areas where freshwater flows into the ocean once ranged from California to Washington. Habitat loss has drastically decreased their numbers.</p>	<p>INSULAR BLUE BUTTERFLY</p>  <p>Relying on beach clover for food and shelter, this delicate butterfly is declining, along with its host plant, due to the loss of open sand.</p>	<p>WESTERN SNOWY PLOVER</p>  <p>Threatened throughout its range, this small shorebird has been impacted by the loss of open sand and disturbance by people. Restoration of the dunes is critical to the recovery of this species.</p>
<p>HUMBOLDT MARTEN</p>  <p>Recently found to be inhabiting shrubby areas of the dunes, this typically forest dwelling animal eats small mammals and berries. A lucky visitor may find them warming in the sun following a storm.</p>	<p>BLACK BEAR</p>  <p>Not what most people would expect to see lumbering across a sand dune, black bears find berries, nuts, small mammals, and other tasty treats among the shrublands of the dunes.</p>	<p>PORCUPINE</p>  <p>Typically considered a forest dweller, but now rare in many parts of Oregon, it is a special experience to find a porcupine waddling across the sand in search of salty, succulent dunes plants.</p>

Moving in

Human-caused changes to the dunes have made the landscape more attractive to some animals than before. Adaptable and impressive animals in their own right, they are unwittingly impacting the ecology of the dunes.

<p>CROWS, JAYS, RAVENS</p>  <p>Collectively called corvids, these birds are smart, resourceful scavengers. Attracted to food scraps left by people, they often turn their attention to eggs and chicks of snowy plovers and other native birds.</p>	<p>OPOSSUMS, RACCOONS</p>  <p>Opossums were introduced a century ago. Along with raccoons, they are savvy scavengers who will feast upon many things they come across, including fruit, nuts, carrion, birds, and eggs.</p>	<p>COYOTES</p>  <p>Always a resident of the dunes, the number of these adaptable hunters is increasing as they find more prey among the European beachgrass. Plover and marten are a delicacy for these wily animals as well.</p>
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See these images in greater detail and read a concise summary of the Oregon Dunes ecosystem at risk in the PDF document titled 'Restoring Oregon's Dunes' at https://www.saveoregondunes.org/wp-content/uploads/2019/06/Siuslaw_Dunes-Restoration-Strategy_WEB.pdf

ECOSYSTEMS AT RISK: OREGON DUNES

The ecological changes to the Oregon Dunes are destroying the very features that attract locals and tourists to the dunes each year. The loss of intrinsic, heritage and utility values of the dunes is significant. See Figure 4.

'Without sand moving across the open landscape, plants that have evolved with blowing sand disappear, and plants that require an unmoving surface, moisture, and soil invade the dunes and a new succession of non- native species has taken hold.'

'If the foredune was mobile the open sand would cover the naturally occurring deflation plains and move inward and the natural processes would work as they should.'

Figure 3: Human induced change

Foredune with European Beachgrass and other exotic species



Deflation plain and wetland behind the foredune



Photos L Chaffer

It has been accepted that most of the change to the Oregon Dunes ecosystem is irreversible. Management is now focused on maintaining the values of the existing dune ecosystems for people and the environment and efforts to restore the original ecosystem and its unique biodiversity to areas in the healthiest natural condition. See Figure 5

Figure 5: Goals of dune restoration



Map source: https://www.saveoregondunes.org/wp-content/uploads/2019/06/Siuslaw_Dunes-Restoration-Strategy_WEB.pdf

Figure 4: Ecological change

'Over the course of the last century, people who love the dunes began to see a shift – first subtle, later more pronounced – in the palette of this special place. The expanse of sand – the speckled tan, the pink-purple-yellow – was fading to grey-green, beachgrass green. And over time, an unusual succession was taking place. Where once the wind-driven sand kept the landscape, and the vegetation, in constant flux, the movement had stopped or slowed, and permanent wetlands and woodlands were taking the place of what had once been open sand.'

Life on the dunes felt this shift as well. Snowy plovers were finding fewer and narrower areas of open sand to raise their young. Predators like coyote were finding it easier to catch dinner on the dunes, the dense vegetation providing cover for them as they hunted and more habitat for their prey; their numbers increased. Wetlands emerged and persisted as larger grass-covered dunes altered how wind touched the land, changing the very structure of the landscape. And new forests cropped up as beachgrass-covered sand provided a new solid foundation on which trees could take hold. Once transient and minor features of the landscape were now prominent, the mosaic altered and now static.'

An early resident or settler of the Oregon dunes, visiting today, would find a vastly changed landscape, one where the delicate balance of wind, sand, plants, and animals has been thrown of kilter, where the motion of the dunes has been replaced by the march of beachgrass across the landscape, the unintended consequence of a century-old decision.'

Restoring Oregon Dunes. The bid to save a national treasure. <https://www.saveoregondunes.org/wp-content/uploads/2018/02/Dunes-Restoration-Strategy.pdf>

ECOSYSTEMS AT RISK: OREGON DUNES



New wetland vegetation community on the deflation plain Photo: L Chaffer



Educational signs explain the changes happening to the dunes. Photo: L Chaffer



Management of the Oregon Dunes includes controlling tourist access and use as well as protecting breeding sites for endangered species such as the plover. L Chaffer



OREGON DUNES RESOURCES

- Save Oregon Dunes (PDF) <https://www.saveoregondunes.org/wp-content/uploads/2018/02/Dunes-Restoration-Strategy.pdf>
- Save Oregon Dunes website <https://www.saveoregondunes.org>
- Pavlis, Dina. *Secrets of the Oregon Dunes*. Florence, Ore: Windy Acres Enterprises, 2008. Book review <http://alottasand.com/als-home.aspx>
- Saving One of Oregon's Most Unique Landscapes <https://www.coastexplorermagazine.com/features/saving-oregon-dunes-national-recreation-area>
- The Secret World of Sand <https://oregoncoastmagazine.com/2015/11/15/the-secret-world-of-sand/>
- Oregon Dunes https://oregonencyclopedia.org/articles/oregon_dunes/#.XaBoSi1L1N3
- Oregon Dunes National Recreation Area https://en.m.wikipedia.org/wiki/Oregon_Dunes_National_Recreation_Area
- Oregon Dunes Restoration <https://www.outdoorproject.com/articles/oregon-dunes-restoration>
- Geology of the dunes https://www.fs.usda.gov/detailfull/siuslaw/learning/nature-science/?cid=fsbdev7_007155
- Oregon State Parks https://www.stateparks.com/oregon_dunes_national_recreation_area_in_oregon.html YouTube: Buggies in the dunes (Tourism) <https://www.youtube.com/watch?v=aqnvVjb3gw>

A DOCUMENT SUMMARISING KEY INFORMATION ABOUT THE OREGON DUNES TO COVER ALL SYLLABUS DOT POINTS WILL ACCOMPANY THIS EDITION ON THE GTA NSW & ACT WEBSITE