Hybrid Beachgrass Discovery

How does a newly-discovered beachgrass hybrid affect coastal ecosystems?

Overview

Invasive beachgrasses on Oregon coastal dunes produce tradeoffs: They build dunes that protect the coastline from climate change-induced extreme storms and sea level rise (positive), but these grasses also outcompete native species (negative). Researchers have discovered a hybrid beachgrass that has different traits than its parents and has the potential to build taller dunes, which will impact the ways that humans interact with beachgrasses and dunes. In this lesson, students will investigate how the hybrid differs from its parents, how that may impact ecosystem services, and will more broadly learn about human-environment interactions.

Essential Questions

1. *What ecosystem services do beachgrasses and dunes provide?*
2. *How do we identify and measure beachgrasses?*
3. *How does vegetation influence dune shape, and how does dune shape affect protection from climate change impacts?*
4. *How do hybrids form, and why are they important?*

Learning Goals

Students will learn the following:

- *In human-environment interactions, some are positive and some are negative, and these interactions can affect the numbers and types of organisms in an ecosystem.*
- *Beachgrass traits affect dune formation.*
- *Beachgrasses, dunes and humans interact on the Oregon coasts, and these relationships pose both challenges and tradeoffs.*
- *Anyone can contribute to science with their own skill set, such as through citizen (community) science projects.*

Learning Objectives

Students will be able to:

- *identify and measure beachgrasses using quadrats, and potentially measure dune shape using unmanned aerial vehicles.*
- *explain why hybrids, beachgrasses, and dunes are important to coastal communities and how humans interact with them.*

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Grade Level

9-12

Anchoring Phenomenon

Hybrid Beachgrass Discovery

Driving Question

How does a newly-discovered beachgrass hybrid affect coastal ecosytems?

Standards

Next Generation Science Standards

LS2.C – Ecosystem Dynamics, Functioning, and Resilience

Common Core Math Standards

HSS-ID.A.1
HSS-IC.A.1
HSS-IC.B.6

Hybrid beachgrass (L) next to American beachgrass (R)

- *engage directly with the scientific method through primary data gathering and/or analysis.*
- *evaluate claims, evidence and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem (in this case, for example, whether beachgrass is present on dunes).*

Researcher counts beachgrass stems

Introduction

One hundred years ago, Oregon dunes were shifting environments and mostly bare of vegetation (think of the desert planet in the movie *Dune*!). Then, invasive beachgrasses were introduced by humans and these grasses stabilized the sand by forming large dunes - some over 30 feet tall. These large dunes help protect against sea level rise and extreme storms, which are increasing due to climate change, but the beachgrasses also outcompete native species. Therefore, these beachgrasses represent tradeoffs in ecosystem services, which are the benefits humans get from their environment.

In the last decade, a hybrid beachgrass was discovered by researchers. The hybrid was formed through the accidental breeding of its parent beachgrasses. While little is known about the hybrid beachgrass, research shows that it has certain traits, such as stem height and density, that are often greater than its parent species. Because taller and denser beachgrasses are associated with taller dunes, the hybrid has the potential to form larger dunes that protect better against sea level rise and storms. However, the hybrid may continue to outcompete native dune species and drive their decline. This hybrid represents the ways that humans can influence their environment and how the environment then affects us, often in ways that are unexpected and rarely straightforward.

Hybrid - *An organism produced by the breeding of two different parent species (in the case of the beachgrasses), or of genetically distinct populations within a species.*

Nehalem Bay, OR

Lesson Procedure

ENGAGE

New scientific knowledge is always being generated. For example, a list of 12 recent *coolest scientific discoveries* touch on a range of scientific disciplines, from medical slime robots to the merging of black holes.

In this lesson, students will focus on the discovery and implications of a new organism on the Oregon coast. The discovery of hybrid beachgrass is less than a decade old and its existence was never expected when humans planted its parents over a century ago.

Activity: Discovering New Organisms

To begin, introduce students to examples of hybrid organisms using the *Discovering New Organisms* presentation. Define what is meant by the term hybrid, and ask students to speculate what happens when something unexpected is found in an ecosystem. The last slide in the presentation shows three different grasses. What do students notice about these three organisms? What observations can be made about them, individually or as a group?

Connect back to Essential Question 4: How do hybrids form, and why are they important?

> First, hybrids form through the breeding of two organisms. In the case of beachgrasses, pollen from one beachgrass species is blown by wind and lands on the other species, giving rise to a seed that eventually becomes a hybrid beachgrass.
>
> Second, hybrids represent the creation of new genotypes and lead to different organism phenotypes. Many hybrids display a phenomenon known as "hybrid vigor", in which they are more physically fit than their parents. In plants, hybridization has been shown to be a catalyst of invasiveness.

Slide from "Discovering New Organisms" showing three types of beachgrasses

Activity: Life Imitating Art

Students can learn how the introduction and unexpected consequences of the beachgrasses in Oregon parallels plotlines from the book and movie *Dune*, which was inspired by dunes in Florence, Oregon. Read about these connections and "life imitating art … imitating life" in this *article* which features an interview with OSU beachgrass researcher Rebecca Mostow.

LESSON RESOURCES

Discoveries

- *Coolest scientific discoveries, April 2022*

Key Vocabulary

- *Dunes and beachgrasses (pdf)*

Discovering New Organisms

- *Presentation: Discovering new organisms (ppt)(pdf)*

Life Imitating Art

- *Reading: How the 'dune' science fiction saga parallels the real science of Oregon's dunes*

EXPLORE

Activity: Dunes and Ecology

Use the *Dunes and Ecology* presentation to help students become familiar with sand dunes and learn how the dunes and the organisms that live on them are important to coastal ecosystems.

Teachers can have students research recent news articles about dunes (to learn about losing dune habitat worldwide, why they are important, and what ecosystem services they provide, etc.) and then have a discussion about dune pros and cons from different perspectives. Pre-discussion research can be focused on questions such as:

- What is a dune?
- What are the parts and shapes of dunes?
- What plant and animal species live on dunes?
- Why are beachgrasses important for humans and ecosystems?

Connect back to Essential Question 1: What ecosystem services do beachgrasses and dunes provide? With students, brainstorm some of the potential *positive and negative impacts* of beachgrasses and dune formation.

Positive: Beachgrasses build dunes that protect against sea level rise and storms, which are becoming more frequent/intense due to climate change; Dunes provide habitat for native species, such as the endangered Western snowy plover; Beachgrasses and dunes store carbon, which can help mitigate the effects of climate change; Dunes provide recreation areas for humans.

Negative: Beachgrasses outcompete and reduce habitat for native and endangered dune species; The dunes that beachgrasses build often block views for homes on the coast (many of these homes, such as at Pacific City, are vacation or second homes)

Dunes and Ecology

- *Presentation: Dunes and Ecology (ppt)(pdf)*
- *Positive and negative impacts (pdf)(doc)*

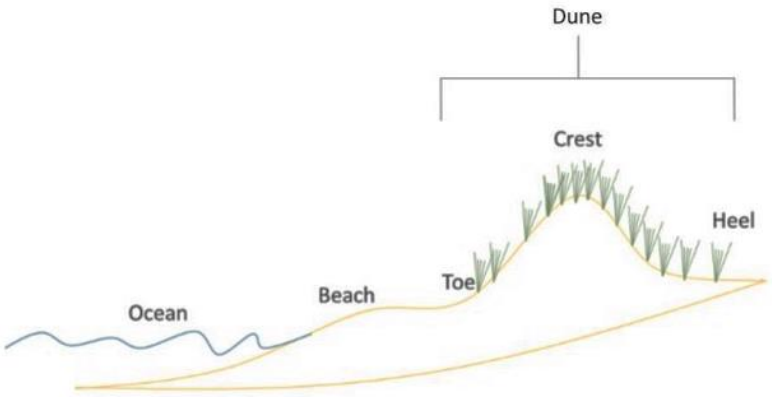
Key Concepts & Big Ideas

Human-environment interactions go two ways; we influence our environment and our environment influences us, sometimes in unexpected ways (like through hybridization!)

Invasive/non-native species are not always evil, but can have benefits, too. Ecosystem services have tradeoffs and may not benefit or harm all groups equally.

What is a "natural" ecosystem, and is it possible or desirable to restore an ecosystem to its "natural" state?

How do these concepts connect to Traditional Ecological Knowledge and Indigenous practices of land stewardship?



Structure of a dune.
Figure adapted from John Stepanek

EXPLAIN

Activity: Hybrid Beachgrass Discovery

To learn more about the discovery of hybrid beachgrass in Oregon, show students a 10 minute presentation *A Wild Grass Chase* that OSU researcher Rebecca Mostow gave at the 2020 State of the Coast conference. After viewing the presentation, discuss with students how hybrid beachgrasses may affect dune ecology.

Next, students use Mostow's *A Guide to Beachgrasses of the Pacific Northwest* to gain background information about how to identify the four dune grasses, including the hybrid beachgrasses. If needed, return to the *Dunes and Beachgrasses* vocabulary list for clarification about key terms, and use the *Dunes and Ecology* presentation to review the parts of a dune and interactions between humans and dunes.

As students gain more information, have them add to and update their list of potential *positive and negative impacts* provided by dunes and beachgrasses.

ELABORATE

Activity: Beachgrass Field or Classroom Experience

If possible, take a field trip to coastal dunes to see many of these concepts in action and interact with beachgrasses in person. The *Beachgrass Project Field Guide* contains visuals and information about some of the species that students may encounter on a dune.

See the *Teacher Field Trip Guide* which has resources and suggestions for educators about activities and materials. On the field trip, students can use resources and questions in the *Hybrid Beachgrass Workbook: Field Trip Edition* (which has field trip and non-field trip activities) to observe differences in beachgrass taxa, and brainstorm why these differences may be important.

If a field trip is not possible, use the parallel *Hybrid Beachgrass Workbook: Class Edition* with students and associated *Beachgrass Traits data*.

Connect back to Essential Question 2: How do we identify and measure beachgrasses?

Identify their ligule (a thin piece of tissue at the base of their leaves), which differs in length among beachgrass species. Leaf blade width differs among beachgrass species as well, but is less obvious.

Measure density (by counting stems or visually assessing perfect cover) and height, using a quadrat to designate area.

Hybrid Beachgrass Discovery

- *Video: A Wild Grass Chase SOTC presentation[10:32]*
- *A Guide to Beachgrasses of the PNW (pdf)*

Beachgrass Project – Field

- *Beachgrass Project Field Guide (pdf)*
- *Teacher Field Trip Guide (pdf)*
- *Student Hybrid Beachgrass workbook: Field trip edition (pdf)(doc)*

Beachgrass Project – Classroom

- *Student Hybrid Beachgrass workbook: Class Edition (pdf)(doc)*
- *Beachgrass Traits data (xls)*

Students collect data during a field trip

Activity: Career Connections

The data shared in this lesson was collected by researcher *Risa Askerooth* at Oregon State University. Classes could invite a scientist or graduate student to the classroom or a beachgrass field trip, and students could have conversations with them about questions such as:

- What does it mean to be a graduate student?
- How do you get there- school, degrees, applying?
- Who pays for it?
- What is the process for picking a subject/professor/place to study?
- What skills do you have to possess?
- What happens after grad school? What other careers can you do?

Additional career connection opportunities include this *Careers in Science* lesson plan from PBS, which highlights different science careers with profiles of Alaska Native scientists, and discusses the different lenses of western science and Alaska Native ways of knowing that can be used to understand the world.

EVALUATE

Activity: Visualizing Data

After students have learned about or interacted with different beachgrass taxa and the relationship between vegetation characteristics and dune shape, they will be ready to visualize field data that either they have collected on their field trip, or the dataset that was collected by field scientists. To help explain the importance and implications of dune management by humans, students can use a *Dune Profile student worksheet* and associated *data* that directs them to compare and contrast dune profiles with and without vegetation. See the *Teacher Notes* for setting up the activity.

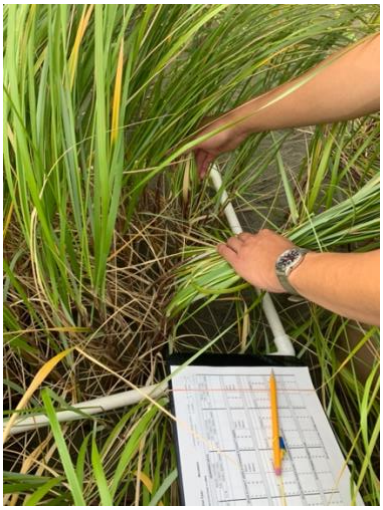
Connect back to Essential Question 3: How does vegetation influence dune shape, and how does dune shape affect protection from climate change impacts?

> Beachgrasses trap sand and build dunes through a series of feedbacks between beachgrass traits and sand supply. Taller and denser beachgrasses are positively associated with taller dunes.
>
> Taller dunes prov ide better protection against flooding and erosion from storms and sea level rise.

Career Conections

- *Risa Askerooth, OSU bio (pdf)*
- *Careers in Science lesson from Teachers' Domain on PBS*

Risa and her colleagues discover a patch of hybrid beachgrass.



Counting beachgrass stems

Visualizing Data

- *Dune Profile student worksheet (pdf)(doc)*
- *Dune profile data (xls)*
- *Teacher Notes (pdf)*
- *Beach profiling method*

Studying beachgrasses in Pacific City, OR

Next Generation Science Standards

Performance Expectation:
HS-LS2-6: Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

Science & Engineering Practice:
Engaging in Argument from Evidence

Disciplinary Core Idea:
LS2.C – Ecosystem Dynamics, Functioning, and Resilience

Crosscutting Concept:
Stability and Change

Common Core Math Standards

Math Practice:
MP.2 - Reason abstractly and quantitatively

Math Standards:
HSS-ID.A.1 – Represent data with plots on the real number line
HSS-IC.A.1 – Understand statistics as a process for making inferences about population parameters based on a random sample from that population.
HSS-IC.B.6 – Evaluate reports based on data

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See more lessons on the ORSEA webpage: oregoncoaststem.oregonstate.edu/orsea