Declining Seagrass Abundance

Why has seagrass abundance declined in some Oregon estuaries?

Overview

Photographic evidence collected over the past decade indicate that seagrass abundance at Valino Island in South Slough National Estuarine Research Reserve has declined over recent time. Is seagrass wasting disease the culprit, and what are the ecological impacts of reduced seagrass abundance?

Learning Goals

Students will learn the following:

- *Seagrass communities provide important ecosystem services.*
- *Researchers use quantitative methods to determine whether there are changes in seagrass abundance over time.*
- *Seagrass wasting disease is caused by a protist and is causing changes in seagrass abundance in at least one Oregon coastal estuary.*

Introduction

Seagrasses are flowering plants that have evolved to live in seawater, and estuarine seagrass communities are one of the most productive and dynamic ecosystems in the world. Eelgrass (*Zostera marina*) is the most prevalent type of seagrass found on the U.S. West Coast. While providing habitat and nursery grounds for many marine organisms, seagrasses also stabilize substrates, contribute organic matter to estuarine food webs, and filter or buffer nutrients and chemical inputs. The health of seagrass communities is widely considered to indicate the overall health of an estuary.

In recent years, seagrass researchers from Oregon State University's Hatfield Marine Science Center have noticed a decrease in seagrass abundance at their Valino Island study site in South Slough National Estuarine Research Reserve.

In this lesson, students will identify and explore the observed phenomenon of seagrass declines and determine potential factors which may be related.

Photos: Oregon Sea Grant

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Grade Level
9-12

Anchoring Phenomenon
Declining Seagrass Abundance

Driving Question
Why has seagrass abundance declined in some Oregon estuaries?

Time
Engage 15 min
Explore 45 min
Explain 20 min
Elaborate 45 min
Evaluate 20-60 min
Teacher Guide and Overview

Standards
Next Generation Science Standards
LS2.A: Interdependent Relationships in Ecosystems
LS2.C: Ecosystem Dynamics, Functioning, and Resilience

Common Core Math Standard
HSS.IC.B.3

Learning Objectives

Students will be able to:

1. *Describe basic seagrass biology and ecology, as well as threats faced by seagrasses;*
2. *Use quadrats to sample an ecosystem for species density;*
3. *Use quantitative reasoning to assess the incidence, magnitude, and impact of wasting disease on seagrasses in the South Slough National Estuarine Research Reserve;*
4. *Analyze data to make a conclusion about ecosystem health.*

A variety of factors can affect seagrass abundance. While seagrass beds are vulnerable to physical disturbances such as wind-driven waves and storms, the direct and indirect effects from human activities account for the majority of seagrass declines in recent decades. For example, overfishing can lead to imbalances in food webs and disrupt seagrass ecosystems. Increases in temperature, sediment, nutrients, or other changes in water quality can lead to seagrass losses. Disease has also devasted seagrasses. In the 1930s, large die-offs of eelgrass beds in North America was attributed to a "wasting disease" and was later determined to be caused by a slime mold-like protist, *Labyrinthula zosterae*. Seagrasses that are weakened or stressed by biotic and abiotic factors may be more susceptible to the disease.

Essential Questions

- *How is seagrass abundance measured?*
- *What factors could be contributing to seagrass declines at South Slough?*
- *Is seagrass wasting disease causing declines in seagrass abundance?*

Field Experiences for Students

- *Visit South Slough Reserve*
- *Visit Hatfield Marine Science Center*

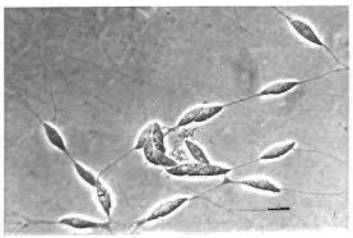


Image: L. zoterae (Muehlstein 1989)

Lesson Procedure

ENGAGE

Begin by asking students to view pictures of the *Seagrass Beds at Valino Island* in South Slough National Estuarine Research Reserve (SSNERR). Photographic data has been collected over the past decade. Students will brainstorm questions based on their observations of the phenomenon. Students will be asked, "Why should we care?" about potential seagrass decline.

EXPLORE

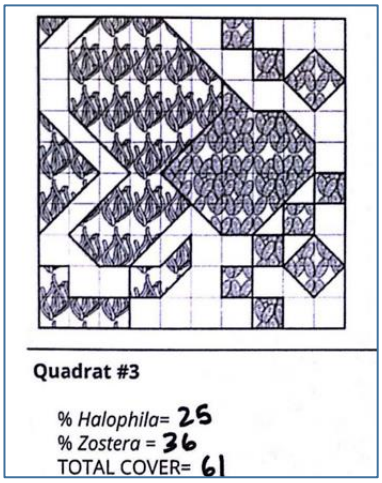
Activity: Reading Comprehension

Students will complete the *Seagrass Reading and Comprehension Questions* worksheet. This ecology reading gives background information on what seagrasses are, what function they serve in the ecosystem, and what threats may be causing their decline. It also introduces the scientists whose data the students will be analyzing later. The comprehension questions span a range of levels of Blooms Taxonomy and ask students to go beyond just recalling what they read.

EXPLAIN

Activity: Quadrat Sampling

Students will complete the paper & pencil *Quadrat Sampling Worksheet.* This activity introduces Dr. Nash & Dr. Mueller's study sites as well as the techniques (quadrat & transect) that they used to sample them. Given sample quadrats, students measure the percentage of two types of seagrass species and add them together to find the total cover.



ELABORATE

Activity: Quadrat Sampling at Home

Students will apply what they learned about quadrat sampling to sample their own lawns for weeds using the *Quadrat Sampling at Home* worksheet. They will make their own quadrat out of simple materials they have at home.

LESSON RESOURCES

Presentation:

- *Seagrass Beds at Valino Island*

Reading Comprehension

- *Seagrass Reading*
- *Comprehension Questions*
- *Comprehension Answer Key*

Quadrat Sampling:

Student Worksheet
Worksheet Answer Key
Quadrat Sampling at Home

Dr. Ryan Mueller, OSU

Dr. Fiona Thomas-Nash, OSU

Activity: Data Analysis
Students will analyze data gathered by Dr. Fiona Nash in the field and assess the relative health of four seagrass beds. All students are asked to answer the question, "*Which area has seagrass beds that are in the most danger of dying off?*"

Three versions of the *Data Analysis Activity* are provided to accommodate students at varying math levels. At the basic level, students interpret graphs. At the intermediate level, students calculate average and standard deviation by programming them in Google Sheets with the assistance of how-to videos. They make two graphs of the data and use these graphs to write their conclusion. The more advanced students not only create graphs, but also conduct statistical tests on the data in Google Sheets.

EVALUATE

Students will be successful when they understand the link between the protist *Labyrinthula zosterae* and the seagrass wasting disease. Through the reading activity, students will realize that the protist is just part of the problem-- habitat destruction and global climate change are turning a pathogen that seagrasses can usually fight off to one that they can barely keep at bay. Through the data analysis activity, students will make the connection that the eelgrass bed with the lowest stem density was also the one with the most *Labyrinthula*. We further hope that students will have a deeper understanding of the process of science and feel as though they participated in it in some small way.

Aerial view of South Slough which forms the southern end of the Coos Estuary in southwestern Oregon.

Image: South Slough National Estuarine Research Reserve

Data Analysis Activity
Basic Level
Data Analysis - Level One

Intermediate Level
Data Analysis - Level Two
Eelgrass Data - Level Two

Advanced Level
Data Analysis - Level Three
Eelgrass Data - Level Three

Vocabulary
- *estuary*
- *quadrat*
- *transect*

Next Generation Science Standards

Performance Expectation(s):
HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

Science & Engineering Practice:
Using mathematical & computational reasoning

Disciplinary Core Ideas:
LS2.A: Interdependent Relationships in Ecosystems
LS2.C: Ecosystem Dynamics, Functioning, and Resilience

Crosscutting Concept:
Scale, proportion, & quantity

Math Practices:
Reason abstractly & quantitatively

CC Math Standards:
CCSS.MATH.CONTENT.HSS.IC.B.3
Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.

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