Oregon's Seagrass Beds

Monitoring Seagrass Beds Along Oregon's Coast

Timeframe

1 Fifty minute class period

Target Audience

Middle School (6-8) Life Science but easily adapted to Grades 4-12

Materials

Each Group Needs:

- Seagrass Worksheet (one per student, or can work as group)
- Seagrass Handout (one per group)
- Set of field pictures from one of the three bays (3)

Contact:
SMILE Program
smileprogram@oregonstate.edu
http://smile.oregonstate.edu/

Description

In this activity, students practice the technique of surveying seagrass beds in three localities along Oregon's coast from provided photos, and use data to make inferences about what causes spatial variation.

Objectives

- Students will learn about the importance of seagrass beds within Oregon's coastal ecosystem, and how seagrass beds vary along the coast.
- Students will practice using quadrats as a standard surveying technique to collect data and interpret variations in ecosystem health and biodiversity.

Teacher Background

Seagrasses are marine flowering plants that live in shallow areas colonizing the coastlines of nearly all continents. They form large underwater meadows that provide food, habitat and shelter to numerous species of animals and algae, including many species that humans care about for food, industry, or aesthetic reasons, such as shellfish (e.g. oysters, Dungeness crab), fish (e.g. rockfish, salmon), waterfowl, turtles and dugongs, amongst others. In addition, because of the physical structure they create, they trap particles and attenuate wave action, contributing to clean waters and coastal protection. Unfortunately, as a result of their coastal locations, which make them susceptible to numerous human disturbances, seagrasses are threatened and have suffered worldwide declines, and many species of seagrass are now protected.

A major cause of seagrass loss worldwide is the phenomena of **eutrophication** (i.e. nutrient pollution), which can result from agricultural runoff, sewage outlets, fish farms, and other industrial biproducts. This increase in nutrients can stimulate the growth of different species of algae (living freely or attached to seagrass leaves) that can overgrow the seagrass and cause its decline, disappearance, or death. However, **mesograzers** (i.e. little invertebrates such as snails) can help prevent the negative effect of eutrophication. By feeding on the **epiphytes** that would otherwise overgrow seagrass, these grazers can act as a **buffering mechanism** that helps seagrass survival. There are grazers that eat algae and seagrass, such as isopods and amphipods, but we focus here on sea slugs. **Sea Slugs** only eat the epiphytes and not the seagrass, and are large enough and abundant enough to maybe have an ecological effect on epiphyte abundance.

In addition to human-induced increases in nutrients, there are also natural processes that bring nutrients into a system; one that is very prominent along the Oregon coast is upwelling. **Upwelling** brings deeper colder nutrient-rich water up to the surface. In some Oregon estuaries, eelgrass (*Zostera marina*) beds are commonly found, the natural levels of nutrient loading can be the same or greater than loading in estuaries that are considered eutrophic elsewhere in the U.S. (e.g. East and Gulf coasts). Under such high natural nutrient levels the question arises of whether these seagrass beds can resist under higher nutrient loading scenarios, and what role mesograzers play in contributing to such resistance

This lesson focuses on seagrass beds from three bays along Oregon's coast: Netarts, Yaquina, and Coos. We are studying these estuaries because they harbor large areas of seagrass and are located along an upwelling gradient which causes their different nutrient levels. We are curious if the presence or absence of sea slugs has a measurable impact on seagrass bed health.

Activity

1. Use Powerpoint presentation to introduce seagrass, why it's important, eutrophication's impact on the coastal ecosystem, the relationship between epiphytes, seagrass beds, sea slugs, and nutrients, and the three bays we are studying.

Key Vocabulary

Quadrat: Typically a square frame placed directly on top of vegetation used to survey biodiversity

Seagrass: Marine flowering plants that colonize intertidal and subtidal coastal areas

Upwelling: oceanographic process by which deep cold water rises towards the surface of the ocean

Macroalgae: Large seaweed

Epiphytes: Small seaweed that grows on seagrass.

Mesograzers: Small invertebrates such as snails that eat epiphytes.

Guiding Questions

- How do you think scientists monitor biodiversity in the field?
- Do you think it's practical to try to count every single organism in an area? Why not?
- Why do you think scientists need a standardized method of sampling?
- How is seagrass important to the ecology of the ocean? How could it be affected by eutrophication?
- Why do you think there is variation in the amount of sea slugs and available nutrients within the three bays? How could this affect seagrass beds?

2. Introduce quadrats and proper random sampling technique.
3. Divide students into groups of three or four. Each group will need 3 photos from one of three localities (Coos Bay, Yaquina Bay, or Netarts Bay), each student needs a Seagrass Worksheet and pencil.
4. Introduce the datasheet, the importance of recording data in a standardized fashion, and the procedure used for each photo.
5. Students record the locality and Quadrat # on their worksheet.
6. **Data Collection:** Each student group starts with one photo. Lay the quadrat on top of the photo. Students will estimate percent coverage by seagrass, percent coverage by macroalgae, and percent of seagrass covered by epiphytes and record information in Table 1 on their worksheet.
7. Repeat for remaining two photos.
8. Compile the class' data in Table 2.
9. Have students make bar graphs of percent coverage by seagrass. They should have one bar for each locality (average percent coverage), with error bars to show the variation within the three photos.
10. Have students decide what two variables to plot in the graphing section provided. Make sure they are specifying the three localities.

Phyllaplysia taylori

Sea slug on seagrass!

Activity Wrap-Up: Discussion Questions

1. What was the greatest coverage by seagrass measured? Which locality was it from? *Q7 from Coos Bay (100% seagrass cover)*
2. What was the average coverage by seagrass? *~70%*
3. What did you notice about the distribution of epiphytes? *Epiphyte coverage is much higher in Yaquina Bay (75-80%) than others (30-50%)*
4. How much variation is there within each locality in terms of percent coverage by seagrass? *(50-100%)* Epiphytes? *(30-80%)* Macroalgae? *(0-30%)*
5. How do you think the distinction in sea slug population at

each locality affects the seagrass coverage? Epiphyte coverage? *Epiphyte coverage is highest in Yaquina Bay, where there aren't sea slugs, likely because sea slugs are eating epiphytes.*

6. How do you think the amount of nutrients at each locality affects the seagrass coverage? Epiphyte coverage? Macroalgae?
7. How do you think the percent coverage by macroalgae affects the seagrass coverage? Epiphyte coverage?
8. Why do you think the sea slug populations and available nutrients vary so much between these three bays? How does upwelling affect the greater coastal ecosystem?

Table 1. Estuary Characteristics

Estuary	Nutrient Abundance	Sea Slug Population	Characteristics
Netarts	N	SS	mid-low epiphytes (due to lower nutrient and presence of slugs), mid seagrass (due to less nutrients)
Yaquina	NN	0	mid-high epiphytes (due to no slugs and mid nutrient), mid seagrass (due to mid-high nutrients but high epiphytes)
Coos	NNN	SS	mid-high epi (due to high nut but also slugs), mid-high seagrass (due to high nutrient and mid epiphytes)

9. What else could potentially be affecting this seagrass population? *E.g. abundances of other mesograzers, water quality, other pollutants*
10. Why would percent cover not be the best data for understanding seagrass' role in the ecosystem? *Percent coverage is an estimate and it does not tell you how thick the coverage is.*
11. What other information about seagrass beds could we collect in the field that would help us understand the ecosystem and the relationships between these species?

Table 2. Quadrat Data (Sampling Answers)

Estuary	Quadrat #	Epiphyte % cover	Mean	StdDev	SErr	Eelgrass %	Mean	StdDev	serr	Macroalgae %	Mean	StdDev	serr
Netarts	**1**	40	**35**	5.0	2.9	55	**60**	5.0	2.9	10	**10.0**	10.0	5.8
	2	35				60				20			
	3	30				65				0			
Yaquina	**4**	80	**60**	30.4	17.6	65	**60**	8.7	5.0	30	**18.3**	10.4	6.0
	5	25				50				15			
	6	75				65				10			
Coos	**7**	50	**47**	5.8	3.3	100	**88**	12.6	7.3	0	**8.3**	7.6	4.4
	8	50				90				10			
	9	40				75				15			

Next Generation Science Standards

DISCIPLINARY CORE IDEAS:
LS4.D: Biodiversity and Humans

COMMON CORE STANDARDS:
6.RP.A.3: Use ratio and rate reasoning to solve real-world and mathematical problems.
6.SP.B.5: Summarize numerical data sets in relation to their context.
7.RP.A.2: Recognize and represent proportional relationships between quantities.

PRACTICES:
- Asking Questions and Defining Problems
- Analyzing and Interpreting Data

CROSSCUTTING CONCEPTS:
- Patterns
- Stability and change
- Scale, Proportion, & Quantity

LESSON EXTENSION:

Looking for more lessons using quadrats? Check out SMILE's **Schoolyard Quadrats** lesson, another great introduction to field sampling - in your own yard!
http://smile.oregonstate.edu/lesson/schoolyard-quadrats

POTENTIAL EXTENSION ACTIVITIES:

This lesson serves as a great introduction to using quadrats and sampling seagrass. The next step is to visit Hatfield Marine Science Center with your students, or plan a research project studying seagrasses near you! To test this in the field, contact **StreamWebs@oregonstate.edu** or visit the StreamWebs Website: http://www.streamwebs.org/

To relate StreamWebs to your students, check out these **Eutrophication Lessons**:

- http://earthecho.org/uploads/files/lesson-plans/Dead_Zones_For_Dinner_Lesson_Plan.pdf
- http://ei.cornell.edu/watersheds/Eutrophication_Experiments.pdf

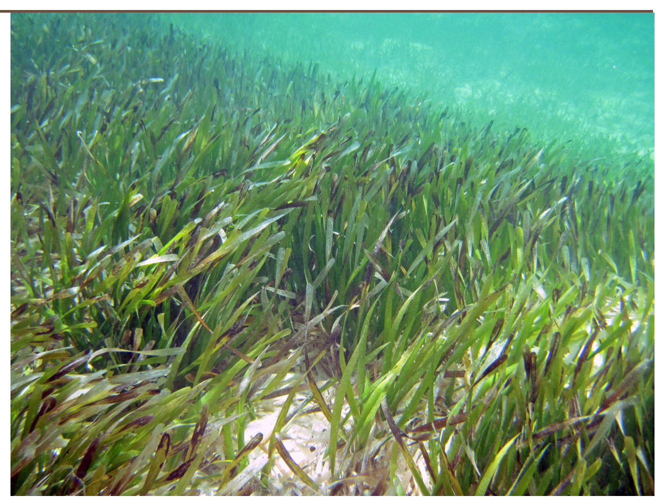
Background Information on **Upwelling, Eutrophication & Hypoxia** in the Pacific Northwest:

- http://oceanservice.noaa.gov/facts/upwelling.html
- http://www.piscoweb.org/files/hypoxia_general%20low-res.pdf
- http://www.piscoweb.org/files/Hypoxia_FAQ_06_09.pdf

Resources:

Dr. Fiona Nash's Lab:
https://tomasnashlab.wordpress.com/

Information about Seagrass:
http://ocean.si.edu/seagrass-and-seagrass-beds



Phyllaplysia taylori, or Eelgrass Sea Hare, a sea slug native to the Pacific Coast that eats epiphytes off of seagrass.

Oregon Seagrass: Student Worksheet

Name: ____________________ Date:_____________

Table 1. Quadrat Photo Data
Percent coverage of seagrass, epiphytes and macroalgae.

From Bay: _____________

Quadrat #	% Seagrass Cover	% Epiphytes Cover	% Macroalgae Cover
Mean			

Table 2. Class Data
Percent coverage of seagrass, epiphytes and macroalgae.

Location	Quadrat #	% Seagrass Cover	% Epiphytes Cover	% Macroalgae Cover
Mean				
Mean				

Graph 1. Bar Plot of Mean Seagrass Coverage

Create one bar for each bay with the mean percent seagrass coverage. Use error bars to show the distribution in each bay.

Graph 2. Scatter Plot

Create a scatter plot to look for a relationship between two data points you measured: percent seagrass cover, percent epiphyte cover, and/or percent macroalgae cover. You can also plot location vs. a variable.