LiMPETS Photo Quadrat Classroom Activity

Objectives

Students will a) learn rocky intertidal monitoring techniques used in LiMPETS (Long-term Monitoring Program and Experiential Training for Students) by practicing with life-sized photos, b) learn to identify intertidal algae and invertebrates, c) learn intertidal zonation using data generated by the class and d) discover the biodiversity of the rocky intertidal habitat by calculating the abundance of many species.

Grade level: 9th-12th (may be adapted for middle school)

CA State Content Standards for High School

Biology/Life Sciences 6.a. Ecology: Students will know the biodiversity of the rocky intertidal by determing the abundance of many species.

Investigation and Experimentation 1.a.d.k: Students will use appropriate tools to monitor the intertidal, will understand why long-term cumulative data is important, and will analyze results.

Materials

The following materials are available for loan within a 50-mile radius of a California National Marine Sanctuary office. Offices are located in San Francisco, Monterey, and Santa Barbara. Contact your local LiMPETS coordinator for more information, www.limpetsmonitoring.org. LiMPETS coordinators can also help you build and create your own set of materials.

- 7 photo quadrats (laminated life-sized photos of the intertidal)
- 7 quadrats (1/2m x 1/2m)
- Photo quadrat datasheet and answer key
- *Invertebrate and Algae Photo ID Guide*, www.limpetsmonitoring.org/ri_data.php
- Transect (marked rope or meter tape), 30m in length (optional)

Background

Scientific methods taught in the classroom take on new meaning when students see (and experience) how "real science" is done by biologists who monitor the environment. Monitoring the environment means taking repeated samples in the same way at the same locations over time. Long-term monitoring increases sample number and allows scientists to detect change over time.

One common monitoring unit that is used in rocky intertidal ecosystem studies is the quadrat. Quadrats are square or rectangular frames within which algae or animals are counted. Scientists can place quadrats randomly in an area OR quadrats may be placed at intervals along a transect line (Figure 1). Quadrats are used because it is impossible to count every living and non-living thing in an ecosystem.

In this activity, students use quadrats to monitor the abundance and distribution of key organisms along an imaginary vertical transect line. Collecting data along a vertical transect can demonstrate classic zonation patterns and is an instructive, hands-on lesson in intertidal ecology. This is good practice for students who plan to participate in LiMPETS or other monitoring studies at the rocky intertidal. By repeatedly collecting data along a transect line that reaches from the

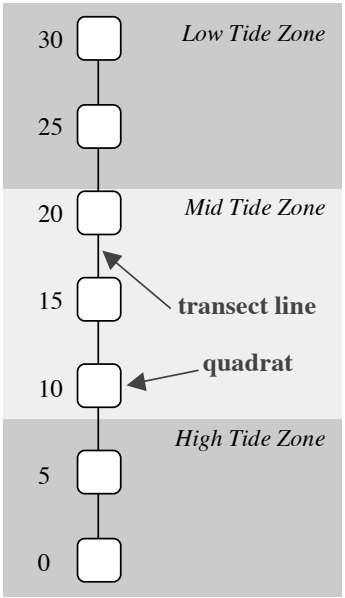


Figure 1: Transect schematic

high tide zone to the low tide zone, scientists can detect changes in the ecosystem over time. A major concern over the next several decades will be the effects of rising sea levels, as a consequence of global warming, on the biota of the rocky intertidal. Presumably, species will shift up in their vertical distribution as sea level rises. Will this really happen? Monitoring rocky intertidal areas can provide the answer.

Procedure

Introduction:

- Discuss the importance of long-term monitoring. Get students to think about what inferences can be made about environmental conditions by repeatedly counting the number of individuals in an area, by counting the number of species in an area, etc. *Long-term data that quantifies the number of individuals (species abundance) in an area gives us good information about what natural fluctuations occur in a population and helps us to identify changes that do not appear natural, like long-term declines in abundance. Long-term data that quantifies how MANY species in an area gives us information about biodiversity and changes to biodiversity in an ecosystem.*
- Discuss the importance of rocky intertidal ecosystems along our coast (good background information at www.mbnms-simon.org). Why would it be important to know how many animals and algae are found in these areas? Why would it be important to know about the distribution of organisms in the rocky intertidal? *Changes in abundance or distribution may reflect changes in the overall condition of the ecosystem.*
- What might a short-term changes in the abundance of one particular species indictate? *Might indicate natural or human-caused fluctuations in the population, like increase in predators, occurance of winter storms that can dislodge critters from their homes, or human-collection of certain species for food.*
- What might long-term changes indicate? *Might indicate that the health of the ecosystem is changing. Threats to the rocky intertidal include human trampling, collection of species for food, pollution, introduced speices, and global warming.*

Activity:

- Explain how species are monitored using transects and quadrats.
- Divide students into groups of three or four. Each group will need one quadrat, one life-sized photo, a datasheet and a Photo ID Guide. Students can work at their desks or you may wish to set up a mock transect by stretching a meter tape along the floor and placing photos over the transect location (in meters, written on the upper corner of the photos).
- Each group should choose one person to record the data on the datasheet. The other students in the group will be counting organisms within the quadrat.
- Students should place the quadrat directly over the photo. The center of the quadrat should be directly over the red dot on the photo. Once in place, the quadrat should not be moved.
- The student recording the data should fill out the top of the datasheet. This student also directs the others in the group by telling them what to count. The other students will need to decide how best to conduct counts systematically so that each species inside the quadrat is counted - and counted only once.
- There are two ways to conduct counts. The algae and invertebrates listed in the first box on the datasheet are discrete and easy to count; students should therefore count the total number of individuals that they can find within the quadrat. The organisms listed in the lower box on the datasheet are more difficult to count. They may grow in continuous sheets or may be clumped closely together (e.g .most algae, aggregating anemones, etc.). Therefore, scientists estimate percent cover (%) to express abundances of most algae and colonial invertebrates. Students will count the number of small squares within the large quadrat that contain any ATTACHED portion of the alga or animal (total # possible = 25). This second method provides a

relative abundance measurement.

• Count only live algae and invertebrates attached within the quadrat. These include those attached to the substrate as well as those attached to other SESSILE organisms attached to the substrate. For example, students should count barnacles that are attached to mussels but should not count barnacles attached to snails or other motile critters.

• Remind the recorder that zero is a number too. Don't forget to record zeros on datasheets when species are absent from inside the quadrat.

Drawing Conclusions:

• When students are finished and have completed their datasheets, they can use the data from the entire class to make conclusions about a) the vertical zonation of algae or invertebrates or b) the biodiversity of the rocky intertidal.

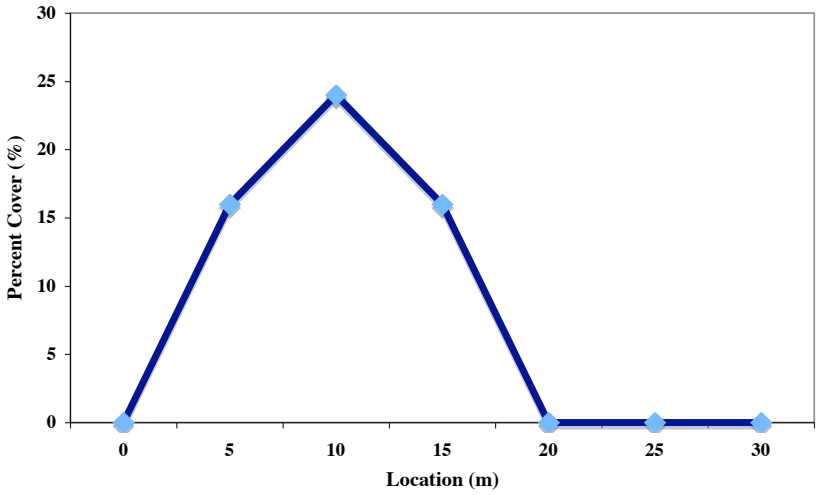
• For example, the class might choose a few species that are of interest to them (i.e. mussels, limpets, rockweed). Each group of students would calculate the abundance or percent cover of these taxa in their quadrat. Percent cover equals the total # of squares/25 * 100. Total abundance (for species in the first box of the datasheets) equals total # of individuals/1/4m^2. Students can record their transect location and abundance calculations on the board. See table below.

• Finally, each group should plot abundance (#/m^2) or percent cover (%) vs. distribution (meters). See figure below. What does the data tell us? In what zone are individual species most common? What causes this type of zonation in the rocky intertidal? *Mussels are often indicators of the mid tide zone. They are filter feeders and must be submerged in water to eat. Limpets are common in the high intertidal zone. They graze algae off of rocks and can withstand long periods out of the water.*

Table: Flattened Rockweed Abundance along Vertical Transect

Location (m)	Percent Cover (%)
0	0
5	16
10	24
15	16
20	0
25	0
30	0

Figure: Flattened Rockweed Vertical Distribution in Rocky Intertidal



LiMPETS Photo Quadrat Datasheet

Vertical Transect

Date: School/Leader:

Names:

	meters	meters
1. Record the location of the quadrat along the transect →		

2. Record the # of individuals within the large quadrat	# individuals	# individuals
Feather boa kelp (holdfast) - *Egregia menziesii*		
Sunburst anemone (>5cm) - Anthopleura sola		
Giant green anemone - *Anthopleura xanthogrammica*		
Unidentified large, solitary anemone - closed and covered with sand		
Chitons - *Mopalia* spp./*Nuttallina californica/Lepidochitona* spp./others		
Whelks - *Acanthinucella* spp./*Nucella* spp.		
Turban snails -*Tegula brunnea/funebralis*		
Hermit crabs - *Pagurus* spp.		
Purple sea urchin - *Strongylocentrotus purpuratus*		

3. Record the # small squares where individuals are present	# squares	# squares
Green pin-cushion alga - *Cladophora columbiana*		
Dead man's fingers - *Codium fragile*		
Sea lettuces - *Ulva* spp.		
Surfgrasses (attached in square) - *Phyllospadix scouleri/torreyi*		
Flattened rockweeds - *Fucus gardneri/Hesperophycus californicus*		
Slender rockweeds - *Pelvetiopsis limitata/Silvetia compressa*		
Tar spot algae - *Mastocarpus* spp./*Ralfsia* spp. and others		
Encrusting coralline algae (on rocks) - many species		
Upright coralline algae - *Bossiella* spp./*Calliarthron* spp./*Corallina* spp.		
Scouring-pad alga - *Endocladia muricata*		
Stunted turkish towel - Mastocarpus spp./Mazzaella affinis		
Lawn alga - *Chondracanthus canaliculatus*		
Nori - *Porphyra* spp.		
Sea sacks - *Halosaccion glandiforme*		
Iridescent algae - *Mazzaella flaccida/splendens*		
Aggregating anemone (<5 cm) - *Anthopleura elegantissima*		
Honeycomb tube worm - *Phragmatopoma californica*		
Limpets - *Lottia* spp.(0.5 - 2.5 cm)		
Sea mussel - *Mytilus californianus*		
Leaf barnacle - *Pollicipes polymerus*		
Common acorn barnacles - *Balanus/Chthamalus* spp.		
Pink acorn barnacle - *Tetraclita rubescens*		
Bare rock		
Loose sand		