

## *Monitoring a Habitat*

### **Monitoring a Habitat**

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In this activity you will learn about ways that scientists monitor habitats in the marine environment of the Channel Islands National Marine Sanctuary and will be able to apply what they have learned to monitoring their own field study site.

#### **Introductory Discussion:**

Before beginning a monitoring project, or starting this lesson, you may want to discuss the following questions with your students.

- Why would you want to monitor a habitat?
- Where would you monitor?
- What would you measure?
- How often should you monitor the area? How often is realistic?
- What questions would you want answered through your project?

#### **Background:**

Long-term monitoring programs are often used to assess the ecological health of an area. Marine Sanctuary and Park managers and naturalists select and monitor a subset of species that is found in the area, because it would be impossible to count and track the presence of every species. The selected species represent a cross section of the ecological roles found in the area and a wide range of trophic (feeding) levels, from primary producers to herbivores, top-level carnivores to detritivores. Selected taxa are monitored regularly to learn more about population fluctuations and the impact of both natural and human-induced changes.

Monitoring programs are designed to detect changes spatially over time- changes in physical conditions, changes in distribution or abundance of organisms or changes caused by human actions or natural events. Physical factors such as temperature and salinity measured as baseline data can form the foundation of a monitoring program. So can the presence or absence of a species or age groups of a single species or entire groups of species. Habitats can be monitored to observe changes in structure, such as physical disturbance. In a monitoring project, observations are made or samples are taken- like "snapshots" of the habitat - on a regular basis, at various intervals depending on the type of information needed. Periodic reports of data compare snapshots against each other and against the baseline data. This information helps resource managers evaluate trends (systematic changes over time) or perturbations (sudden changes). Although the causes of the changes may not be apparent as a result of the monitoring, they alert managers and suggest ways of studying, in closer detail, the causes of change.

Scientists consider many factors when selecting a study site, including physical, geological and biological characteristics. Differences in temperature, substrate type, nutrient availability, degree of protection from winds or currents, depth or elevation, and many other factors can affect the diversity of species found in an area. Transition zones between biogeographic provinces are also interesting to survey because they display characteristics typical of both provinces. Around the northern Channel Islands, the Channel Island National Park Service, in cooperation with the Channel Islands National Marine Sanctuary and the California Department of Fish and Game, have established 16 permanent kelp forest monitoring sites and permanently affixed 100 meter transect lines to the seafloor at each site. These sites were selected because they represent different depths, locations (windward vs. leeward side of the islands), water temperature zones

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and areas with differing amounts of nutrients, currents, biodiversity and biogeographical provinces, and were accessible to monitor.

### **Survey Techniques**

Many different sampling techniques can be used depending upon the species being monitored and their unique characteristics. Often a monitoring program will use several different techniques. Common monitoring techniques and step-by-step directions for you to conduct your own monitoring projects are described below. As you begin to design your own monitoring projects, you can explore techniques and applications from the Channel Islands Kelp Forest Monitoring Project to help you decide which survey method is best for your purposes.

#### ▪ *Quadrat Survey*

Quadrat surveys are used to determine the abundance of sedentary or slow-moving organisms, such as different species of grasses herbaceous plants, or evidence of animal activity such as ant hills and spider webs. The size of the quadrat depends upon the species being sampled and their relative abundance. Common species may be sampled using smaller quadrats, while rarer, or clumped, organisms require a larger quadrat to be accurately sampled. For example, if you were sampling the types of shrubs found in a field, your quadrat would be larger than if you were sampling the types of grass or weeds in a field. If you live near a beach you may choose to sample organisms from the intertidal zone, such as barnacles, oysters, sea anemones and periwinkle snails.

During a quadrat study, a square area is marked off. All of the organisms being monitored within the survey area are identified and counted. The abundance of each species is determined by counting the individual organisms found within the study area. Larger organisms such as sea stars or sea urchins are counted individually, and the **density** of each species (number of individuals per square meter) is calculated. Smaller organisms, such as cup corals or algae, may be extremely difficult to count. **Percent cover** provides an alternative way to assess their abundance; as the name suggests, the amount of area that is "covered" by each species is determined as a percentage of the total area.

The size of the quadrat also varies, depending upon the organisms being sampled. Less common or clumped organisms require a larger study area to accurately sample their numbers. In the Channel Islands, a 1 meter<sup>2</sup> quadrat protocol is used to assess the abundance of common sedentary or slow moving species, including wavy turban snails, sea urchins, bat stars, sea cucumbers, giant kelp, sea palms and gobies (a territorial bottom dwelling fish). For the classroom below, ¼ meter square quadrats will be used.

### **Quadrat Classroom Activity Materials**

- Approx 400 Multi-colored paper clips in 7 different colors  
Each color represents a different species. For example:  
Sea Urchins – Red Paper Clips – 165 paperclips  
Wavy Turban Snails – 100 – yellow paperclips  
Kellet's Whelk - 70 – pink paperclips  
Knobby Sea Star – 30- blue paperclips  
Keyhole Limpet – 20 – white paperclips  
Gorgonian Sea Fans – 10 – green paperclips  
Abalone – 5 – black paperclips

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(Don't show the students the ratio of the animals until they have completed their counts)

- 10M transect tape
- Four ¼ meter square PVC quadrats
- Clipboard
- Pencil
- Data Sheet
- Chalk Board or Dry Erase Board with species names and ratio of paperclips (don't show this to students until the end).
- Kelp Forest Monitoring Video and or photos and shells of organisms listed above

### **Quadrat Classroom Demonstration Procedure:**

1. Lay the transect tape along floor.
2. Randomly sprinkle paper clips along **one** side the transect line (within ¼ m or so of the line)
3. (NOTE: For the classroom demonstration we are just going to use one side of the transect line to simplify the procedure. When you go out into the field, you will conduct counts on both sides of the transect line).
4. Write the numbers 0-10 on a piece of paper, cut them out, turn them over and mix them up.
5. Choose four numbers from the pile and place a quadrat next to each number (with the bottom edge alongside the transect line).
6. Have students break up into groups and count the number and color of each paper clip that is found within their quadrat.
7. Tally the totals.
8. Show students photos or shells of the different organisms and give them some information about the natural history and abundance of these animals and have them guess which paperclip is represented by which species.
9. How do their quadrat totals relate to the total number of each species along the transect?
10. Discuss some of the limitations of quadrat sampling (if animals are very mobile they may move out of quadrats. If species are rare (such as the black abalone), they may not be found in quadrats even though they are found within the study area).

### **Field Survey Techniques:**

#### *Conducting a Quadrat Study*

##### **Materials:**

Per group:

- 1 clipboard
- 2 data sheets
- 1 meter square quadrat, made from PVC pipe, or other material
- list of species to identify/look for
- field guide if necessary

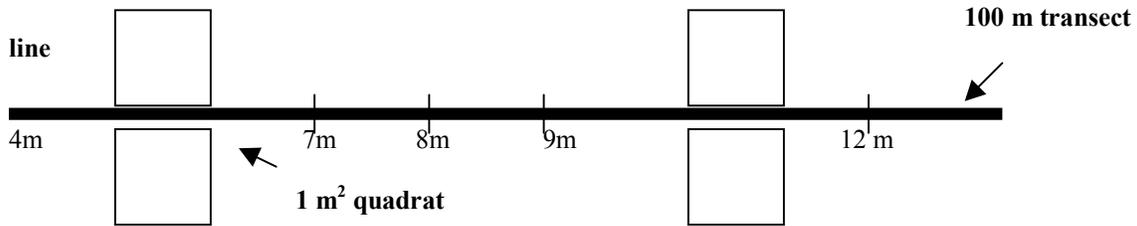
Per class:

100 meter transect tape 2 stakes

##### **Method:**

**1 m<sup>2</sup> quadrat**

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1. Select a study site.
2. Determine what species you will be sampling. Be sure you can identify each of these species.
3. Randomly pick a number between 1-8.
4. Run a 100 meter transect tape in a straight line through your study site. Place the tape so it accurately reflects the surrounding area.
5. Secure the tape down at both ends with stakes.
6. Beginning at your randomly selected number, place the 1-meter quadrat so that one edge lines up with the transect tape.
7. Record the names and abundance of all species found within the quadrat.
8. Flip the quadrat over to the opposite side of the transect tape and repeat the procedure. Record the species name and abundance codes in a new data table.
9. Continuing sampling at 10 meter intervals. You will have twenty separate 1-meter quadrat surveys when you are done surveying your study site.
10. Return to class and examine your data. Create an overall species list (a list of all species encountered during the survey project). Then, calculate the average density of each species.

$$\text{Average density of species } a = \frac{\text{Total number of species } a \text{ found in all plots}}{\text{per quadrat} \quad (\text{size of quadrat}) (\# \text{ of plots sampled})}$$

note: If you are using a 5-meter<sup>2</sup> quadrat, you will survey an area 1 meter wide, by 5 meters long. The 5 meter length of the transect line will run along the transect tape. You will start at the beginning of the tape. Each study site will be adjacent to each other.

### Questions:

1. What is a quadrat study? What type of organisms can be studied using quadrats? Why do researchers and park managers use them?
2. Describe your study site; include physical and biological characteristics, the species sampled and quadrat size. Explain why you selected your study site, target species, and quadrat size.
3. Why did you sample so many quadrats instead of just one?
4. Determine a species list for study site. List all the species encountered in any of the surveys in alphabetical order.
5. Calculate the average density for each species.
6. Describe any changes in species density that you observe.

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7. Are some species generally seen in smaller groups? If so, give examples. Are other species generally found in larger groups? If so, give examples. How might a large group size be an advantage? a disadvantage? Suggest reasons to explain the differences.

### Conducting a Band Transect

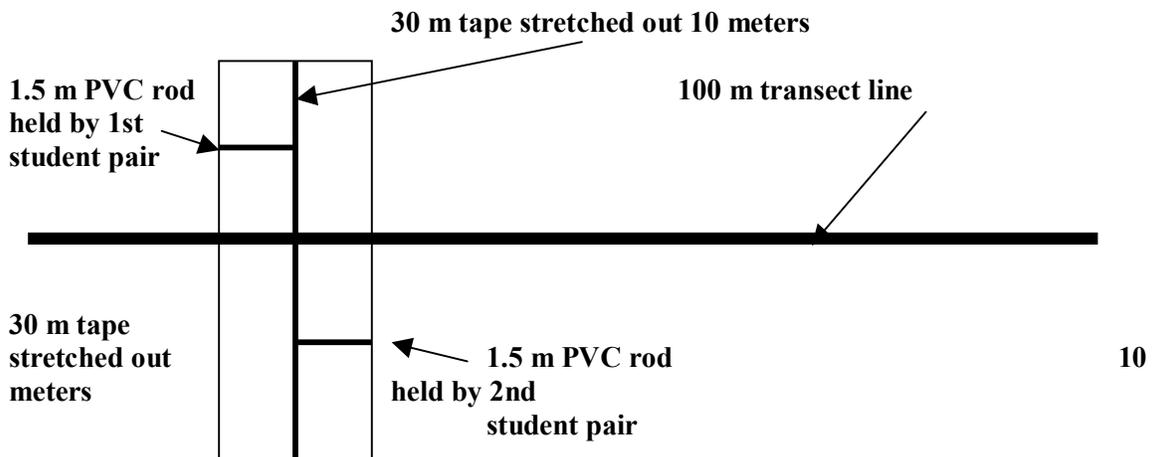
During a band transect, a larger rectangular area is sampled. In the Channel Islands kelp forests, divers conducting a band transect connect a transect tape to the 100 meter transect line and swim the tape out perpendicular to the transect line for 10 meters on both sides. All of the organisms found within a specified distance (1.5 meters) on either side of the second, shorter transect tape are counted and identified. Band transects are done at random intervals along the 100 meter transect line. Band transects are used to sample organisms that are less common, more mobile, are clumped, or may not be accurately sampled using a quadrat survey. In the Channel Islands, band transects extend for 3 x 10 meter area on each side of the transect line, covering a total of 60 meters<sup>2</sup>. Band transects are commonly used to survey orange puff ball sponges, gorgonians, abalone, sunflower sea stars, rock scallops and California spiny lobsters.

In your own field study, band transects are used to determine the abundance and distribution of rare and clumped organisms that are not adequately sampled by quadrats. You might use them to sample trees or shrubs in a forested area, large cacti found in a desert, or sea stars along a rocky intertidal area.

### Materials:

Per group:	2 clipboards	2 1.5-meter PVC rods
	2 30-meter tapes	2 data sheets
Per class:	100 meter transect tape	appropriate field guides
	2 stakes	

### Method:



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**Band Transect Procedure:** Together Team 1 (4 students) samples the entire area (60 m<sup>2</sup>); one pair samples the top half, the other pair samples the bottom half. Their results are added together to create a single band transect data set.

1. Select a study site.
2. Determine what species you will be sampling. Be sure you can identify each of these species.
3. Randomly pick a number between 1-8.
4. Run a 100 meter transect tape in a straight line through your study site. Place the tape so it accurately reflects the surrounding area.
5. Secure the tape down at both ends with stakes.
6. Beginning at your randomly selected number, run a second transect line perpendicular to your original transect line. The second transect line should extend for 10 meters on both sides of your main transect line.
7. Begin on one side of the main transect line. Walk along the left side of the 10-meter transect, from the outer edge, towards your main 100-meter transect line. Actively search for your species. Count and record all species that you encounter.
8. When you reach the main 100-meter transect line, turn around and sample the opposite side of the secondary 10-meter transect line, walking back to the outer edge of the 10-meter transect tape. You have just sampled a 3 meter x 10 meter rectangular area, or 30 m<sup>2</sup>.
9. Repeat steps 7 & 8 on the opposite side of the 100-meter transect line. Add your data from the opposite side to the data you just collected. The final size of each band transect is a rectangular area measuring 3 meter x 20 meter, or 60 m<sup>2</sup>.
10. Pick up the 10-meter transect tape.
11. Move 8 meters down the main transect line and repeat the procedure.
12. When you have finished, you should have sampled twelve 60 m<sup>2</sup> rectangular areas.

### Questions:

1. What is a band transect survey? What types of organisms can be studied using this method? Why do researchers and park managers use this method?
2. Describe your study site; include physical and biological characteristics, the species sampled and band transect size. Explain why you selected your study site and target species.
3. Why did you sample so many areas instead of just a single band transect?
4. Determine a species list for your study site. List all the species encountered in any of the surveys in alphabetical order.
5. Calculate the average density for each species.
$$\text{average density of species } a = \frac{\text{total \# of organisms of species } a \text{ in all transects}}{(\# \text{ of transects}) \times (\text{size of transect in m}^2)} \text{ per m}^2$$
6. Describe any changes in species density that you observe. Suggest reasons to explain the differences.

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7. Are some species generally seen in smaller groups? If so, give examples. Are other species generally found in larger groups? If so, give examples. How might a large group size be an advantage? A disadvantage?

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### ***Conducting a Roving Survey***

During a roving fish survey, SCUBA divers enter the water near the transect line and record all the fish species they see within 10 meters of either side of the 100 meter transect tape. Using an underwater slate, divers record the relative abundance of each species (S= single fish, F=Few 2-10 fishes, M=Many 11-100 fish, and A=Abundant more than 100 fish). Divers actively explore the area looking among the kelp fronds, under rocky ledges, along sandy bottoms, and at different levels within the water column in order to survey all of the fish species in the area.

The "Great Annual Fish Count" (GAFC) is an event coordinated by the Reef Environmental Education Foundation (REEF) that mobilizes and trains volunteer divers and snorkelers in roving fish survey techniques identify and document fish diversity and population trends in marine sanctuaries and coastal areas. This annual event takes place the month of July, and serves both to introduce and inspire recreational divers and snorkelers to: participate in REEF's year-round volunteer monitoring programs; raise awareness among both the diving community and public-at-large regarding marine habitats and trends in fish populations; and provide researchers, marine resource managers and policy makers with this useful information that would otherwise be unavailable. To learn more about REEF, visit [www.reef.org](http://www.reef.org). To find out about the GAFC, visit <http://www.fishcount.org/>

While some individuals may be fortunate enough to be SCUBA certified and participate in a local fish count event sponsored by the Great American Fish Count, REEF, or another non-profit organization, many of us probably will not have the opportunity, at least as middle or high school students. We can learn about the Roving Diver Fish Count technique and modify to meet our terrestrial needs. Birds are abundant, easily identified, and occupy a diverse range of ecological niches. Furthermore, they exist within a three dimensional space, using ground cover to tree tops. With care, we can get close enough to birds species to identify them by sight.

#### **Materials:**

clip board	data sheet (1 per group)
field guides	4 colored stakes
stop watch or timer	

#### **Procedure:**

1. Select a study site. *Depending upon where your school is located and if it is rural or urban, your study site will vary; your study site may include a wooded area, an area adjacent to a creek, a nearby wetlands, a desert area, a rocky intertidal area, or the school ball field.*
2. Using field guides, learn to identify the common birds found in your area by sight and sound.
3. Mark off the boundaries of your study site, using colored stakes or other markers.
4. Quietly approach your study site.
5. Record the names of all species of birds you see in your study area. Actively search for as many bird species as possible--look on the ground, in tree branches or on top of buildings or telephone wires. Each person should keep their own species list; do not share data or point bird species out to your classmates. Next to each species mark an "X" in the appropriate abundance column.

S = Single (1)  
F = Few (2-10)

M = Many (11-100)  
A = Abundant (100+)

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6. Continue to record the names of bird species that you encounter for 20 minutes. If you see a species that has already been listed, adjust your "X" in the abundance column to include the newer sightings. For instance, if you saw one sparrow when you began your survey, and two more sparrows ten minutes later, add an "X" in the "Few" column next to "Sparrow".
7. Return to class and compile your data. Determine the % sightings for each species.

### **Questions:**

1. What is a roving count survey? What types of organisms can be studied using this method? Why do researchers and park managers use this method?
2. Describe your study site; include physical and biological characteristics, the species sampled and quadrat size. Explain why you selected your study site and target species.
3. Surveys of this type can be very variable. The bird species seen and the abundance of each species will vary throughout the day simply due to chance. Even so, a great deal of information can be learned by studying trends in species distribution and abundance. What other factors might effect the number and types of bird species seen?
4. Determine a species list for study site. List all the bird species encountered in any of the surveys in alphabetical order.
5. Calculate the percent sighting for each species. List the species in order from the greatest to smallest percent sighting. Which species were seen the most often and were the most abundant? Which were the least?  
$$\frac{\% \text{ sighting for species a}}{\# \text{ of surveys}} = \frac{\# \text{ of surveys species was seen in}}{\# \text{ of surveys}}$$
6. Which bird species were most abundant? Did they occur in large flocks, in smaller groupings, or by themselves?

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**Data Table for Band Transect or Quadrat Study**

Team Members: \_\_\_\_\_  
\_\_\_\_\_

Type of Survey: \_\_\_\_\_

Location of Survey: \_\_\_\_\_

Began at \_\_\_\_m on 100m Transect Line

Species	Number Counted	Ave. Density per meter <sup>2</sup>

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**Data Table for Roving Bird Count**

Name: \_\_\_\_\_

Location of Survey: \_\_\_\_\_ Date of Survey: \_\_\_\_\_

Time Survey Began: \_\_\_\_\_ Time Survey Ended: \_\_\_\_\_

<b>Name of Species</b>	<b>Single (1)</b>	<b>Few (2-10)</b>	<b>Many (11-100)</b>	<b>Common (over 100)</b>	<b>% Sighting</b>