

Corals and Climate Change

Photoquadrats on a Transect: Teacher Lesson Plan

Overview:

Students use photographs of reef sample areas, called photoquadrats, to determine the health of a reef.

Grade level:

7th – 12th

Materials:

For each group of 3 to 5 students:

- 1 set of 4 photoquadrats, see Appendix 1
- Student Guide
- Organism ID Guide, see Appendix 2
- Graph paper for each student, or computers with Microsoft Excel

Time required:

45 minutes



National Park Service
www.nps.gov/index.htm



Pacific Island Network Inventory & Monitoring Program
National Park Service
www.science.nature.nps.gov/im/units/pacn/



Integration & Application Network (IAN)
University of Maryland Center for Environmental Science
www.ian.umces.edu

Objectives

- Students will use scientific research methods to gather data about a photoquadrat of a reef.
- Students will analyze the data and draw conclusions based on their analysis.

National Science Education Standards

9-12 Standard A: Science as Inquiry

- Abilities Necessary to do Scientific Inquiry
- Understandings about Scientific Inquiry

9-12 Standard F: Science in Personal and Social Perspectives

- Environmental Quality
- Natural and Human Induced Hazards

Procedure

Opening Questions: (Have the students write answers to these questions and/or discuss as a class.)

- Why do scientists study coral reefs?
- Do scientists count every plant and animal on the reef? Why or why not?
- How can scientists collect enough information about the reef without taking too much time?

Introduction

1. Print out and laminate one set of photoquadrat cards for each group of students.
2. Have students watch the photoquadrat video by the National Park Service http://science.nature.nps.gov/im/units/pacn/videos/MP4_Videos/benthic.mov
3. Explain to students that scientists who want to learn about coral reefs have to collect data about the plants and animals found on a reef. One way they do this in by taking pictures of a specific area of the reef, called a photoquadrat, at several places along a line, called a transect. Scientists examine the photos to identify the plant or animal species, record this information, then analyze their results to determine the overall health of the reef. For more information on sampling techniques and photoquadrats see the OPIHI Project website: http://www.hawaii.edu/gk-12/opihi/classroom_home.shtml

Activity

1. To simulate a transect, you can set the pictures out in a line along the floor with each picture 1 meter from the next. If there is not enough room to create transects students may look at the photographs on a table.
2. Demonstrate to the students how to identify species in the photoquadrats, and how to use photoquadrats to determine percent cover (see below for example; detailed instructions are in the “Student Guide” below).

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3. Divide students into groups and give each group a set of photos and data sheets.
4. Have students work together to first identify what species appears under each dot. Each time a species is observed under a dot, students should put a check mark in the “Times Observed” column of their data sheet.
5. Next, students should add up the check marks for each species and record this number in the “Total Times Observed” column, then calculate % cover for each species by dividing the total times observed by the total number of dots in the photo and multiplying by 100.
6. The students should then total the percent cover of live coral points (those containing any living coral) and dead coral points (those containing dead coral or dead coral covered with algae) for each photoquadrat.
7. Have students answer the analysis and conclusion questions listed in the “Student Guide” below.

Graphing

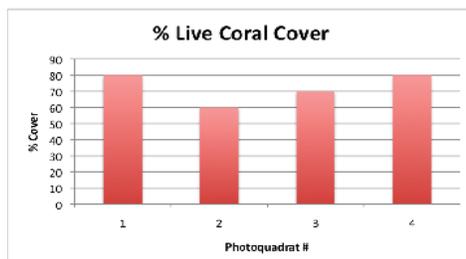
1. Have students make a data table displaying total live percent cover in each photoquadrat.
2. Next have students make a bar graph displaying percent live cover in each photoquadrat, making sure to number and label the X and Y axes and title the graph.
3. Have students answer the conclusion questions listed in the “Student Guide” below.

Example

Species	Times observed	Total times observed	Percent cover (total times observed ÷ total dots × 100)
Antler coral	√√√√√√√	7	$7/24 \times 100 = 29\%$
Cauliflower coral	√√√√	4	$4/24 \times 100 = 17\%$
Lobe coral	√√	2	$2/24 \times 100 = 8\%$
Blue soft coral	0	0	0%
Turf algae	0	0	0%
Encrusting algae	0	0	0%
Dead coral	√√√√√√√√√√	11	$10/24 \times 100 = 46\%$
Percent live cover		13	$13/24 \times 100 = 54\%$
Percent dead cover		11	$11/24 \times 100 = 46\%$



Photoquadrat #	% Live Cover
1	80
2	60
3	70
4	80



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Photoquadrats on a Transect: Student Guide

When scientists want to learn about the health of a coral reef, they have to collect data on the plants and animals found on a reef. One way to do this is by taking pictures of a specific area of the reef, called a photoquadrat, at several places along a line, called a transect. Scientists examine the pictures to identify the plant or animal species, record this information, and interpret their findings to estimate the overall health of the reef. In this exercise, you will use the photoquadrat technique to learn about the health of a Hawaiian coral reef.

Step 1: Identify the Species

Each photoquadrat photo contains an overlying grid of dots. First, identify the coral, algae or invertebrate under each dot. Use the Coral Reef Identification Guide (Appendix 2) to identify each type of organism.

Step 2: Record the Species

After identifying what type of organism is under each dot, put a check mark in the “Times Observed” column on your data sheet each time you observe an organism under a dot. Next, add up all of your check marks for each type of organism and record this number in the “Total Times Observed” column of your data sheet.

Step 3: Calculate Percent Cover

Calculate the percent cover for each species. Record this on your data sheet in the “Percent Cover” column on your data sheet.
Percent cover = (Number of points under which organism is observed) ÷ (Total number of points) × 100

Step 4: Identify Healthy and Unhealthy Points

Add up percent live coral cover. Next add up percent cover for all dead coral points (areas with any dead coral, which looks like a rock, or dead coral covered with algae).

Step 5: Analyze the Data

After filling in the data table for each photoquadrat, compare the photoquadrats along your transect and answer the following questions:

1. What photoquadrat had the highest percent live coral points? _____
2. What photoquadrat had the highest percent of percent dead coral points? _____

Step 6: Graph data

1. Make a data table that displays total live percent cover in each photoquadrat.
2. Next, use the data table to make a bar graph that illustrates live percent cover of each photoquadrat. Make sure to number and label the X and Y axes of your graph and include a title.

Step 7: Draw conclusions

Answer the following questions:

1. Based on your data is one photoquadrat healthier than all the others? Write 2 or 3 sentences that explain why.

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Photoquadrats on a Transect: Student Guide

3. What is the average percent live and percent dead coral cover for all of the photoquadrats on the transect?

Average % live: _____

Average % dead: _____

4. Based on your data is the overall reef healthy? Write 2 or 3 sentences that explain why or why not.

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Photoquadrats on a Transect: Data Sheets

Photoquadrat 1

Species	Times observed (place a check mark in this column every time you observe each species)	Total times observed (add up check marks for each species)	Percent cover (percent cover = total times observed ÷ total dots × 100)
Antler coral			
Cauliflower coral			
Lobe coral			
Blue soft coral			
Turf algae			
Encrusting algae			
Dead coral			
Percent live cover			
Percent dead cover			

Photoquadrat 2

Species	Times observed (place a check mark in this column every time you observe each species)	Total times observed (add up check marks for each species)	Percent cover (percent cover = total times observed ÷ total dots × 100)
Antler coral			
Cauliflower coral			
Lobe coral			
Blue soft coral			
Turf algae			
Encrusting algae			
Dead coral			
Percent live cover			
Percent dead cover			

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Photoquadrats on a Transect: Data Sheets

Photoquadrat 3

Species	Times observed (place a check mark in this column every time you observe each species)	Total times observed (add up check marks for each species)	Percent cover (percent cover = total times observed ÷ total dots × 100)
Antler coral			
Cauliflower coral			
Lobe coral			
Blue soft coral			
Turf algae			
Encrusting algae			
Dead coral			
Percent live cover			
Percent dead cover			

Photoquadrat 4

Species	Times observed (place a check mark in this column every time you observe each species)	Total times observed (add up check marks for each species)	Percent cover (percent cover = total times observed ÷ total dots × 100)
Antler coral			
Cauliflower coral			
Lobe coral			
Blue soft coral			
Turf algae			
Encrusting algae			
Dead coral			
Percent live cover			
Percent dead cover			

Photoquadrats on a Transect: Appendix 1 Photoquadrat Images

Photoquadrat 1



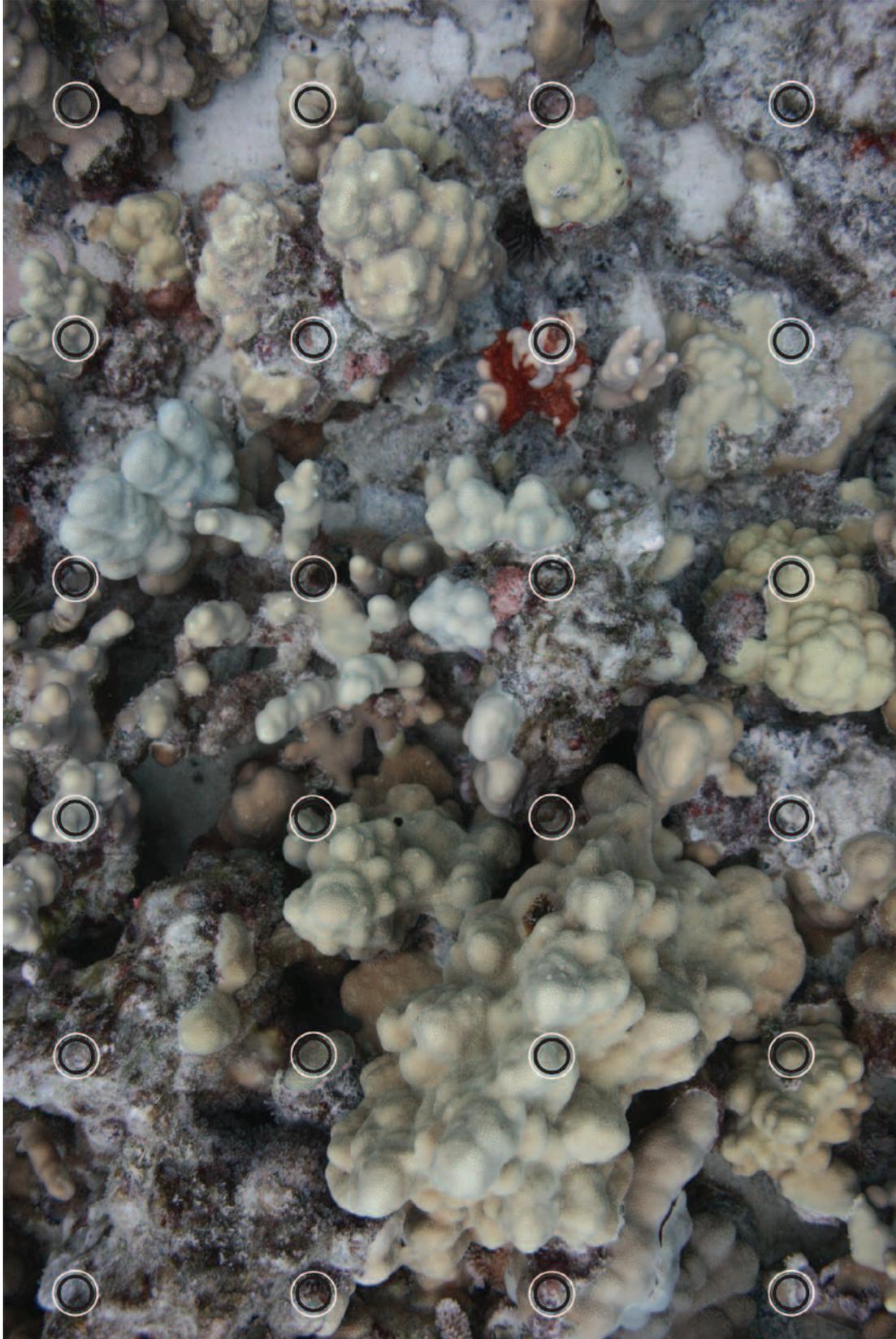
Photoquadrats on a Transect: Appendix 1 Photoquadrat Images

Photoquadrat 2



Photoquadrats on a Transect: Appendix 1 Photoquadrat Images

Photoquadrat 3



Photoquadrats on a Transect: Appendix 1 Photoquadrat Images

Photoquadrat 4



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Photoquadrats on a Transect: Appendix 2 Organism Identification Guide

Corals



ANTLER CORAL - a branching live stony coral. Photo: NPS



LOBE CORAL - a bumpy looking live stony coral. Photo: NPS



BLUE SOFT CORAL - a coral that does not make a calcium carbonate skeleton. Photo: IAN/UMCES



CAULIFLOWER CORAL - a live stony coral with elaborate bends. Photo: IAN/UMCES



DEAD CORAL - rocky substrate with no living coral polyps. Photo: NPS

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Photoquadrats on a Transect: Appendix 2 Organism Identification Guide

Algae



TURF ALGAE - short filamentous algae that may grow on live coral, dead coral, or other substrates. Photo: NOAA



ENCRUSTING ALGAE - pink to dark burgandy algae crust that grows on hard substrates. Photo: NOAA

Invertebrates



SEA URCHIN - can have short or long spines and attach to hard substrate. Photo: NOAA