Part over Whole: Calculating Benthic Cover on Coral Reefs

FOCUS
Coral Reef Ecology, Mathematics (percentages)

GRADE LEVEL
Primary (UK); 3-5 (US)

FOCUS QUESTION
How can you calculate benthic cover of organisms on Bermuda’s coral reefs?

LEARNING OBJECTIVES
Students will be introduced to different categories of benthic cover on Bermuda’s reefs. They will understand the advantages of using random sampling in scientific surveys and techniques. Students will become familiar with the Random Dot Technique and calculate percentages of benthic cover.

MATERIALS
10 photos of reefscape photos (attached)
10 random dots (dice or other small object)
10 trays (large enough to hold an 8.5 x 11 photo). Cardboard trays work well, shoebox covers, baking trays
Cards with Benthic Categories (attached)
Data Sheet for Analysis (attached)

**AUDIO VISUAL MATERIALS**

Power Point of Benthic Categories

**TEACHING TIME**

One 45-minute class period

**SEATING ARRANGEMENT**

Groups of two to four students, divide per total photos (10)

**KEY WORDS**

*Ecology*: the science by which we study how organisms (animals, plants, and microbes) interact in and with the natural world

*Ecosystem*: Groups of organisms together with their physical and chemical environments.

*Coral Reef*: A structure of living coral, coral skeletons and calcium deposits from other marine organisms, such as calcareous algae and mollusks. Coral reefs grow upward from the seafloor as new corals cement themselves to the skeletons of dead coral and other organisms. Coral reefs serve as habitat for a number of fish and other sea life.

*Coral*: a spineless animal with one or more rings of tentacles that surround a central mouth. Each animal is considered a polyp and these polyps typically form colonies; over time, the calcium carbonate skeletons of these colonies create reefs. Most corals have photosynthetic algae, called zooxanthellae, that live in their tissues. The algae use energy from the sun to make nutrients for the coral animals; in return, the coral skeleton provides a “house” for the algae. This is an example of a “symbiotic relationship.”

*Algae*: a photosynthetic organism that occurs in most habitats. Their sizes range from single celled to complex multicellular forms.

*Benthic*: refers to animals or plants that live on the bottom of the ocean.

**BACKGROUND INFORMATION**

At BIOS, the Marine Environmental Program Sub Program 2 concentrates on the ecological surveys of Bermuda’s coral reef platform. A number of techniques are used, one being the Long-Term Video Monitoring Program (LTVMP). In this program, scientists use a video camera to record permanent transects that are 30 meters in length at each of the sites in the map below (Figure 1). They use 5 replicates at each site to film the reef, 10 per location.
Once the videos are processed, still images (photographs) of the coral reef are obtained. With these pictures, the scientists use a random dot survey to help them calculate how much of the seafloor is covered by different marine organisms, as well as non-living cover like sand and rock.
Random Dot Survey: A random point/dot survey uses randomly selected points in a study area to characterize a site. It is considered an unbiased method because the points are randomly placed (usually by a computer) instead of selected by a scientist or observer. In science, unbiased sampling techniques, like the random dot survey, are considered to be better because there is less chance of human influence over the results.

Figure 3: Screenshot example with point overlay of screen. The red “plus signs” are the randomly placed points.
Scientists use a computer program to place random points over each picture of the reef. They then look at each point and identify what type of marine organism (example: coral or algae) or bottom type (example: rock or sand) is directly under the point. Using fractions or percentages, the scientists can estimate the total cover of each category and get a quick snapshot of the benthic community of the reef.

Now it is the students’ turn to become the scientists and begin to calculate benthic cover!

LEARNING PROCEDURE:

1. Teacher shows Powerpoint slides of the benthic categories: hard coral, soft coral, algae, sand, bare rock, other. Briefly discuss with students the characteristics of each category to help them with identification in the photos.
2. Each group will obtain a data sheet with benthic categories with a location for each of the 10 photos.
3. Each group will be given 1 of 10 photos, these photos will be passed around until all photos are completed.
4. The first photo will be placed on the coral reef board and all 10 dice will be shaken and tossed onto the board.
5. Students will then be responsible for recording what is under each of the dice by category and reporting this information to the data collector.
6. One student should be in charge of recording on the data sheet what category each of the dice falls on.
7. Students will repeat this procedure for all 10 photos, rotating roles. Everyone should have the opportunity to be the data collector.
8. Using the formulas provided on the sample data sheet, students can then calculate the percentages of each benthic category on the reef.

QUESTIONS:

Why would you want to look at benthic cover on a coral reef?

- Get a baseline survey so you can observe long term changes
- Be able to quantify what is there
- Get an idea of the species assemblages at different sites
- Look at the health of coral and algae at a given reef site
- Use for comparison to other sites

Compare your benthic cover results with other groups. How are the reefs the same? How are they different?
What would happen to your results if you increased the number of random points? Would this make your cover estimates more accurate or less accurate? (As an extension for secondary students, groups could be tasked with selecting one photo and obtaining cover estimates using 20 or 40 points—multiple throws of 10 dice—and comparing their results)

FURTHER READING

http://www.bios.edu/research/mep/index.html
http://www.coral.noaa.gov/
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<th>Benthic Cover Data Sheet</th>
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<td>Other</td>
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<td>Totals</td>
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NOTES
Each Total along the bottom should be 10 (for 10 total dice)
The final column will be a total of the entire tow
# Reef Analysis

Transect analysis by:

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<td><strong>Totals</strong></td>
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**NOTES:** The Totals from the Columns should be 100

To Calculate the percent you will put PART over WHOLE (x 100)

Whole = 100 which is the TOTAL amount of dots surveyed

Example: If there were 10 dots that fell on Bare Rock the it would be 10/100=.10

.10x100=10% of our Reef is Bare Rock!
Benthic Categories
Hard Coral
Soft Coral
Bare Rock

Notes: There will be very LITTLE BARE ROCK on the reef, many of these rocks, pictured here are covered with turf algae and would be marked as algae!!