

TEACHER GUIDE

Extension Activity: Ecological Data

Time Required: About 3 hours plus any travel time. This activity is largely intended for science projects or special classes.

Structure: This extension activity will help students to draw meaningful comparisons among multiple plankton tows. Students learn to obtain basic qualitative and quantitative environmental data that will help them to understand how planktonic organisms are affected by their environment. Students also learn to quantify their sampling effort and sample yields to aid in comparisons of bulk trends among plankton tows. Finally, students learn to quantify the composition of their plankton samples to help in recognizing trends in the diversity and abundance of certain planktonic organisms. This extension activity is suggested to be used as a follow up to the students' initial plankton tow observations.

Materials Included:

1. **STUDENT HANDOUT – Beaufort Wind Scale**
2. **STUDENT WORKSHEETS – Extension: Ecological Data**
 - a. **Environmental Data**
 - b. **Sampling Data**
3. Petri dishes
4. Plastic droppers
5. Dissecting needles
6. Motic digital dissecting microscope
7. Plankton sieve
8. Squeeze bottle

Materials Needed for Extension Activity:

1. Compass
2. Watch
3. Local tide / lunar chart
4. 2 – 3 gal bucket with rope affixed to handle (length long enough to safely retrieve water sample from sampling vessel/location)
5. Thermometer
6. Salinity meter (e.g., refractometer, salinity probe, aquarium hydrometer, etc.)
7. Tape measure
8. Calculator
9. 5 ml graduated cylinder

Advance Preparation:

1. Make copies of student handout and worksheets.
2. Have students collect background information of sampling location, such as mean weather conditions, 24-hour precipitation data and anthropogenic / historical influences on how area has

changed over time. Local precipitation data can be found on National Weather Service and US Geological Survey websites, such as <http://www.prh.noaa.gov/hnl/pages/hydrology.php> and <http://hi.water.usgs.gov/> for Hawaii locations. Teachers should familiarize themselves and their students with the location and of any potential hazards, such as rip currents, reefs, water quality, etc.

3. Go over instructional procedures with students using mock exercises, so that operations go smoothly in the field.

Instructional Procedures:

1. Environmental Data worksheet:

- 1) Have the students sketch a map of their sampling location, noting any prominent features (i.e., stream mouths, coves, points, reefs, etc.). Ensure that students use a compass to indicate direction on their map. Students should also include a scale bar that provides some rough estimation of distance. Have students plot their sampling transect.
- 2) Have the students write a brief habitat description of their sampling location. Share with your students any applicable background information on the area, such as mean weather conditions, anthropogenic influences and any other historical factors.
- 3) Have the students fill in the table of environmental data based on observations made as a class or group. Ensure that units are included where applicable.
 - i. Date & Time – use watch
 - ii. Wind speed – refer to Beaufort Wind Scale handout
 1. Include gust speed if applicable
 - iii. Wind direction – use compass to determine direction that wind is blowing from. Releasing light weight and low-impact debris, such as leaves, into the wind may assist observations.
 - iv. Air temperature – Make sure thermometer bulb is DRY when measuring. (Wet bulbs will usually give a lower reading due to evaporative cooling and are used to calculate humidity, not air temperature).
 - v. Past 24-hour precipitation – inform students of this value that you obtained in advance (if available)
 - vi. Fetch a sample of water representative of the sampling transect using the bucket and affixed rope, for salinity and water temperature data – use hydrometer with thermometer
 - vii. Time/height of nearest low/high tide – use local tide chart
 - viii. Date/phase of last/next lunar quarter – use lunar (tide) chart

2. Sampling Data worksheet:

- 1) Community Structure – The goal here is to describe the composition of the plankton community in terms of relative abundances.

- i. Have students take a small subsample of the plankton and randomly observe microscopically. Students should identify as many organisms into the listed categories as time allows and calculate their relative abundances.
 - ii. Save all subsamples when done – do not discard! Will use for biovolume measurement below.
 - iii. You may also wish to combine class data to increase the statistical strength of estimates.
- 2) Sampling Effort – The goal here is to calculate the volume of seawater sampled in the plankton tow. Explain to students how the formula is based upon the geometric volume of a cylinder, in which the area of the plankton net represents the bases and the towing distance represents the height. Guide students along in filling out the table.
- 1. Measure the radius of the net opening in meters.
 - 2. Calculate the area of the net opening, given $area = \pi r^2$. Answer will be in meters squared.
 - 3. Measure the total distance towed in meters.
 - a. If towing offshore on a boat where distance is hard to measure, distance can be calculated by multiplying towing speed with towing duration.
 - i. Towing speed can be calculated by marking and measuring a distance along the length of the boat. At towing speed, drop environmentally friendly debris (e.g., leaves, flowers, etc.) at the forward mark and time how long it takes to reach the back mark. Convert value to meters per minute.
 - ii. Time the total duration of plankton tow in minutes.
 - iii. Multiply towing speed with towing duration to obtain towing distance. Answer should be in meters.
 - 4. Multiply the area of the net opening with the total distance towed. Answer will be in cubic meters.
 - 5. Convert value to liters, given that 1 cubic meter = 1000 L.
- 3) Plankton Biovolume – The goal here is to determine the biovolume of the plankton sample and to relate it to the volume of seawater sampled. Guide students with the following steps to fill in the table.
- i. Have students place their plankton subsample into a sieve with the rest of the sample, using a squeeze bottle filled with seawater to assist the transfer. Sieve out as much water as possible from the plankton.
 - ii. Add 2.5 ml of water to a graduated cylinder (volume water).
 - iii. Slowly add plankton to the graduated cylinder and measure the new volume (volume water + plankton). If the new volume exceeds 5 ml, remove some

plankton so that the new volume is less than 5 ml. Repeat for the rest of the plankton sample, recording all volumes.

- iv. Subtract the original volume(s) (2.5 ml) from the new volume(s) to obtain the plankton biovolume.
 - v. Convert plankton biovolume to liters, given $1000 \text{ ml} = 1 \text{ L}$.
 - vi. Divide the plankton biovolume by the sampling volume and multiply by 100. This is the percentage of the sampled seawater that is composed of plankton, on a volume per volume basis. In other words, this is the concentration of planktonic organisms in the sampled seawater.
3. Suggest follow up ideas or experiments that STUDENTS can do (and students can do them!).

STUDENT HANDOUT – Beaufort Wind Scale

Developed in 1805 by Sir Francis Beaufort of England

Force	Wind (Knots)	WMO Classification	Appearance of Wind Effects	
			On the Water	On Land
0	Less than 1	Calm	Sea surface smooth and mirror-like	Calm, smoke rises vertically
1	1-3	Light Air	Scaly ripples, no foam crests	Smoke drift indicates wind direction, still wind vanes
2	4-6	Light Breeze	Small wavelets, crests glassy, no breaking	Wind felt on face, leaves rustle, vanes begin to move
3	7-10	Gentle Breeze	Large wavelets, crests begin to break, scattered whitecaps	Leaves and small twigs constantly moving, light flags extended
4	11-16	Moderate Breeze	Small waves 1-4 ft. becoming longer, numerous whitecaps	Dust, leaves, and loose paper lifted, small tree branches move
5	17-21	Fresh Breeze	Moderate waves 4-8 ft taking longer form, many whitecaps, some spray	Small trees in leaf begin to sway
6	22-27	Strong Breeze	Larger waves 8-13 ft, whitecaps common, more spray	Larger tree branches moving, whistling in wires
7	28-33	Near Gale	Sea heaps up, waves 13-19 ft, white foam streaks off breakers	Whole trees moving, resistance felt walking against wind
8	34-40	Gale	Moderately high (18-25 ft) waves of greater length, edges of crests begin to break into spindrift, foam blown in streaks	Twigs breaking off trees, generally impedes progress
9	41-47	Strong Gale	High waves (23-32 ft), sea begins to roll, dense streaks of foam, spray may reduce visibility	Slight structural damage occurs, slate blows off roofs
10	48-55	Storm	Very high waves (29-41 ft) with overhanging crests, sea white with densely blown foam, heavy rolling, lowered visibility	Seldom experienced on land, trees broken or uprooted, "considerable structural damage"
11	56-63	Violent Storm	Exceptionally high (37-52 ft) waves, foam patches cover sea, visibility more reduced	
12	64+	Hurricane	Air filled with foam, waves over 45 ft, sea completely white with driving spray, visibility greatly reduced	

Source: <http://www.spc.noaa.gov/faq/tornado/beaufort.html>

**STUDENT WORKSHEET – Extension: Ecological Data
Environmental Data**

Sketch a map of your sampling location noting prominent features, such as stream mouths, embayments, reefs, etc. Be sure to use a compass to indicate direction on your map. Plot your towing track on the map.

Briefly describe this habitat. Is it open ocean or coastal? If coastal, specify habitat type (i.e., estuarine, coral reef, exposed, protected, etc.). Is the shoreline developed or vegetated?

Fill in the following table:

Date:	Time:
Wind speed:	Wind direction:
Air temperature:	24 h-Precipitation:
Water temperature:	Salinity:
Time/height of nearest low tide:	Time/height of nearest high tide:
Tide phase (flood, slack, ebb):	Tow depth:
Date/phase of last lunar quarter:	Date/phase of next lunar quarter:
General weather description:	

Sampling Effort

Net radius (m) (Radius = 0.5diameter)	
Net area (m ²) (Area = πr^2)	
Towing distance (m)	
Volume sampled (m ³) (Vol = Area x Distance)	
Volume sampled (L) (1 m ³ = 1000 L)	

Plankton Biovolume

Volume water (ml)	
Volume water + plankton (ml)	
Volume plankton (ml) (Vol. plankton+water - Vol. water)	
Volume plankton (L) (1000 ml = 1 L)	
% Plankton in Seawater (Vol. plankton/Vol. sampled X 100)	