TSIA Module 4
Biological Group

Task:
Characterize the species of an intertidal area

This packet contains:

Activity: Species Richness

Activity: Photoquadrats

Activity: Planning a biological survey of the coastal environment

Sample Data sheets:
- Transect
- Quadrat

Activity: Species Richness

Species richness is the number of species in an area. For example, if an area contains humpback whales, blue whales, and bottlenose dolphins, the species richness of that location is three. In this activity you will determine the number of species in your classroom by creating a **rarefaction curve**, a graph of the total number of species found versus the amount of time spent searching for species.

Materials
- Species cards
- Timer
- Two pens or pencils of different colors

Procedure

1. Imagine that your class is going on a field trip to do a survey of a habitat area. This area has been extremely well studied. Scientists estimate that there are 500 different species at the site. Some of these species are large, abundant, and obvious. However, most of the species are small, hidden, or rare. Answer the following questions:
   a. Your class goes to the study site to do a field survey, but you get a late start and only have half an hour at the site. Do you think your class can find all 500 species in 30 minutes?
   b. Your class returns to the same field site on a different day. This time your class has one hour to search the site. How do you think your list of species compiled on this day–searching for one hour–will compare with the first day when you only had 30 minutes?
   c. Your class returns a third time to the field site. This time your class has two hours at the site. How do you think your species list for the two hour survey will compare to the lists generated the first two field trips?

2. Make a prediction about the amount of time spent searching and the number of species that will be found. Graph your prediction in Figure 1.
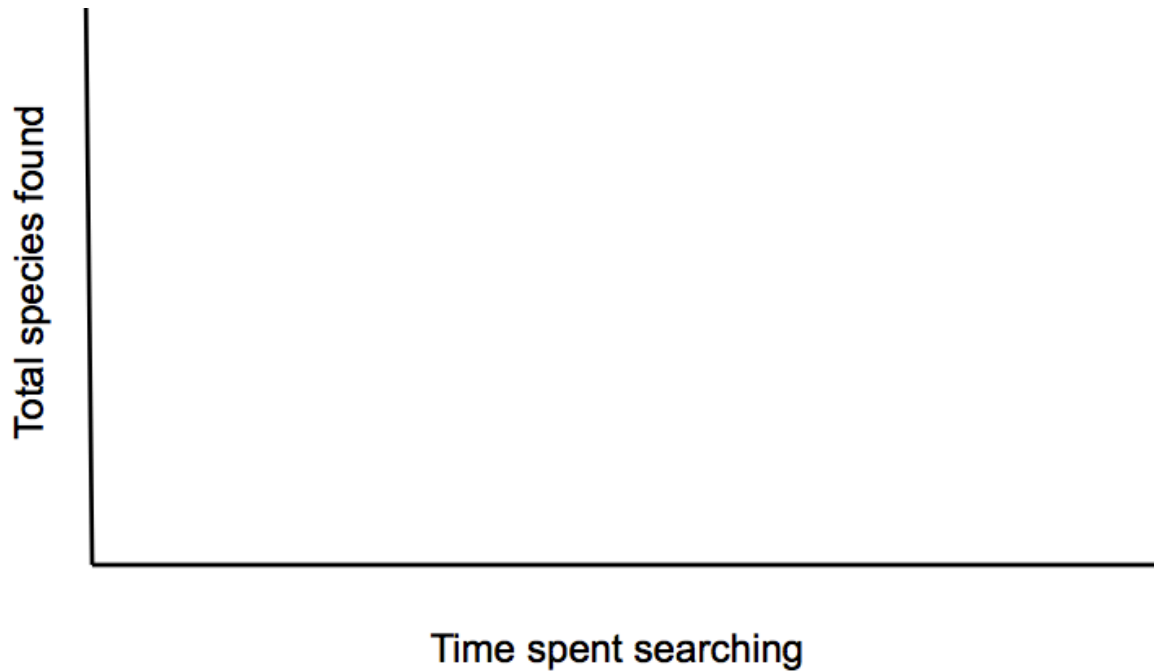
Figure 1. Prediction of the number of species that will be found over time

3. You will test your prediction using a card model. The classroom will represent the habitat study site, and the cards will represent the species in the habitat area. Some members of the class (the searchers) will leave the room. While they are gone, other members of the class (the hiders) will hide species cards around the room. Here are some tips for hiding the species cards:
   a. Some of the places in your classroom are unsafe and will be prohibited by your teacher. Have your teacher share any hiding and searching rules, or develop a safe hiding/searching procedure as a class.
   b. The most basic rule in searching for species in the field, and classroom, is not to destroy the habitat. For example, if you roll a rock over to look underneath it, you must put it back exactly the way it was. In the classroom, if you lift up an object to look underneath it, you must put it back.
   c. The searchers should leave the room. The remaining members of the class (the hiders) should hide species cards around the room according to the classroom hiding rules. *This step may have already been done by your teacher.*

4. The searchers can come back in the room when all of the species cards are hidden. Searchers are allowed to search the classroom for 30 seconds. Do not

help the searchers find species cards! In nature you would not know where species are located; by not helping the searchers this model is more realistic.

5. At the end of 30 seconds, record the number of species found, the number of new species found, and the total (cumulative) number of species found in the area over time. (Table 1).

6. Repeat 30-second search intervals at least five more times. Fill in Table 1.

7. *Optional*. Continue your search for an additional two intervals if you feel you can find more species in the classroom.

Table 1: Number of card species hidden in the classroom

Interval	Cumulative Time (seconds)	Number of Species found	Number of *New* species found	Total (cumulative) number of species found
0	0			
1	30			
2	60			
3	90			
4	120			
5	150			
6	180			
7 *(optional)*	210			
8 *(optional)*	240			

8. Make a line graph of the total species found against the amount of time spent searching (Fig. 2). This is called a **rarefaction curve**.
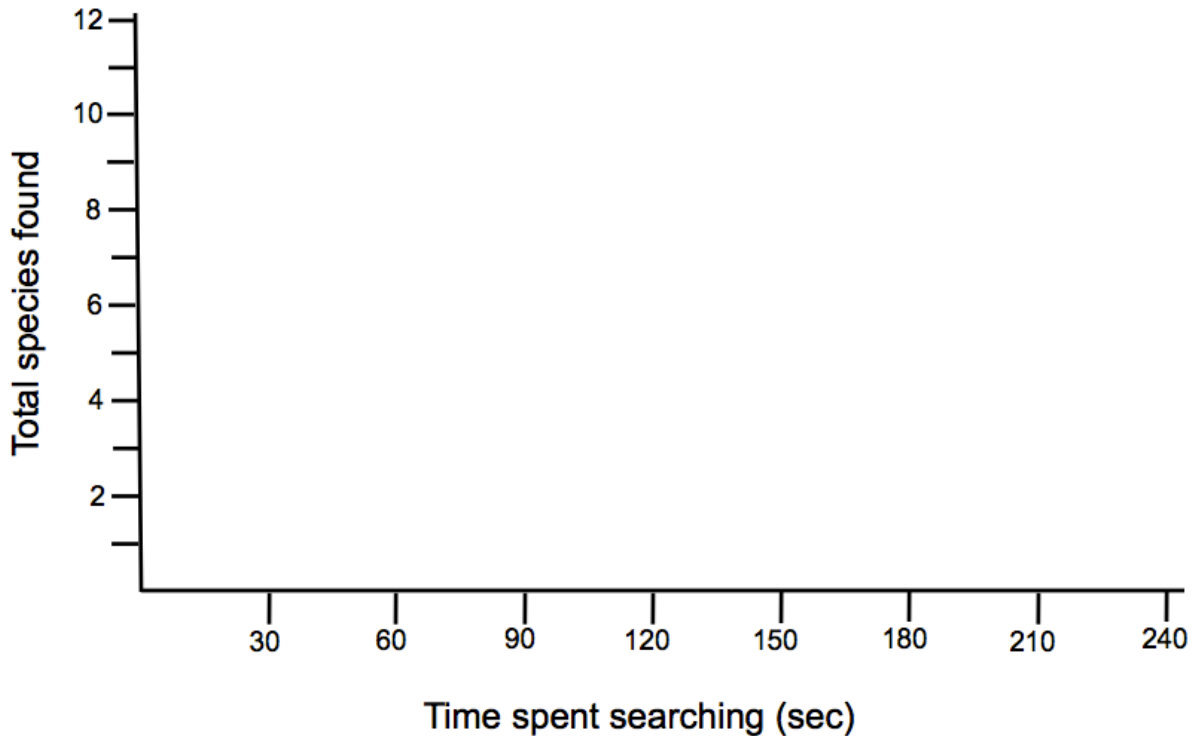

Figure 2. Classroom rarefaction curve

Rarefaction Curves
Scientists examine the shape of rarefaction curves to determine when a species search can reasonably be terminated. Although there may still be species left to be found, when the curve flattens out, the majority have probably been discovered and the relationship between additional time spent searching and number of new species found is likely to be minimal.

9. Label, with a star, the point on your rarefaction curve where you would call off a search because the rarefaction curve has flattened out. At this point you are assuming that:
    a. The majority of species in an area had been found
    b. If the cards were hidden again in a similar way, and if similar students searched the area again, the search could be stopped at a similar time and a similar number of species would have been found.

10. Replicate the game at least one more time with different searchers and hiders. Record your results in Table 1 and Figure 2 using a different colored pen or pencil.

Activity Questions

1. How can you know if you found all the species in a given area?

2. Why are some species harder to find? Did you find all of the species cards in the classroom? Why or why not?

3. What would happen if the searchers got help from the hiders? How would this affect the shape of the rarefaction curve?

4. How did your results compare with your prediction?

5. One of your friends has been searching for species in the same area for one hour every day for 17 days and has graphed the rarefaction curve shown in Figure 3. You are going to search for species in the same area as your friend using the same search technique, one hour a day every day. Looking at Fig. 3, what is the fewest number of days you can search and find almost all of the species in the area?
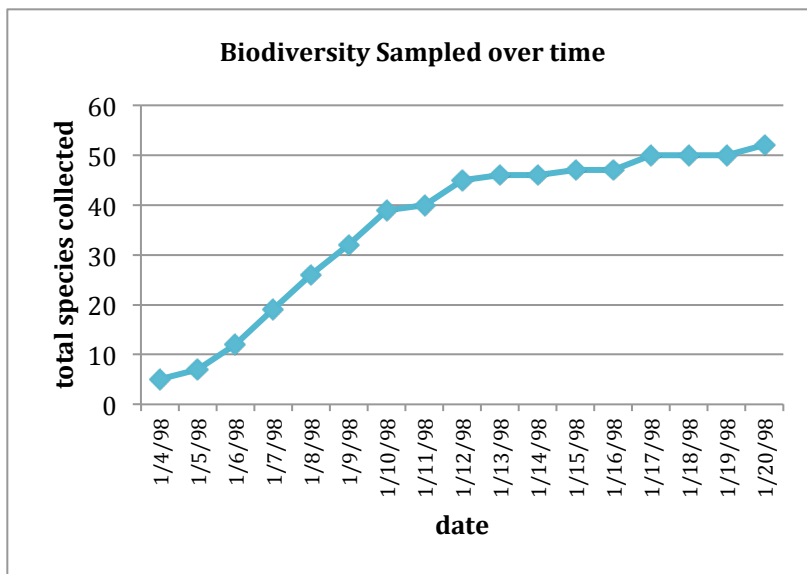
Figure 3: Rarefaction curve showing total number of species found over the span over approximately 16 days of sampling in the field.

6. How similar or different were your classroom results, in terms of number of species found and the shape of your rarefaction curve, when you repeated the game?

7. What would happen if two different areas were searched for different amounts of time, or with different numbers of people? Could the results be compared?

8. How can you modify your data so comparisons can be made between areas searched for different amounts of time or with different numbers of people?

9. What are the limitations of a list of species? (Hint: think about how you would count the number of species when it is difficult to determine what an individual organism is, for example, sponges or some algal species.)

Activity: Photoquadrats

Photoquadrats are life-sized photographs sized to fit the dimensions of a quadrat. Photoquadrats allow you to compare quadrat data collection methods and practice identifying organisms.

Materials

- Quadrat
- Photoquadrat
- Photoquadrat Data Sheet
- Pencil
- Skewer
- Reference materials

Note on species identification

The photoquadrat data sheet lists most of the species found in the TSI photoquadrat pictures. These pictures were taken in the Hawaiian intertidal. However, not all of the species on the pictures are easily found in reference materials. For example, blennies and gobies, two types of fish depicted on the photoquadrats, are not included very often in Hawaiian fish identification guides. When identification guides have pictures of these types of fish, they often do not include species that are common in the intertidal (the ones on the TSI photoquadrat pictures). However, you can still look at reference materials to get a general idea of the morphology of each of these types of fish and identify them to genus. In general, blennies have narrow bodies and are often seen peering from holes in the reef. They have a characteristic alert, curious expression. Intertidal gobies are small and very well-camouflaged. Gobies have compressed bodies and are blunt-headed.

Algae can also be difficult to identify in photos. Only three species of algae are listed to genus on the data sheets because the characteristics that are used to identify algae are often too small to clearly see in a photoquadrat. If you cannot identify something, you should describe it in as much detail as possible and list it in one of the blank species lines on the data sheet. Then, if you come across it again, you can include it on the same line.

Procedure

1. Center the quadrat over the photoquadrat.

2. Collect both point count and quadrat percent cover data (Table 1, columns "point count" and "percent cover"). You can also choose to do the quadrat percent squares modification and still record data in "percent cover" column. Use a skewer to assist in determining what organism or substrate is directly below a quadrat intercept.

3. Determine total percent cover of each organism and substrate category so the two quadrat methods can be compared.
   a. Determine the percent cover of the point counts (column "Point Count Percent (%) Cover")
   b. *Only if you did the percent cover squares modification*, determine the percent cover (column "Squares Precent (%) Cover")

4. *Optional:* Analyze another photoquadrat.

Activity Questions
1. Compare the quadrat point intercept and quadrat percent cover data. What are the similarities and differences in the data?

2. In this activity, what were the pros and cons of each quadrat method? Which method did you think was best suited to the task? Explain.

3. If a photoquadrat has been analyzed multiple times by different group, compare data. Why are there differences between groups when the picture was the same?

Table 1. Photoquadrat Data Sheet
Point Counts-Count the species directly underneath each point where the strings cross; make a hatch mark for each point corresponding to category. You should have **25** points total.
Percent Cover-Estimate how much cover each category represents. Percentages should add up to **100.** If using the squares modification, the number should add up to the number of squares in your quadrat.

		Point Count	Point Count Percent (%) Cover	Percent Cover	Squares Percent (%) Cover *(only if did squares modification)*
Algae	*Padina sp.*				
	Turbinaria ornata				
	Sargassum sp.				
Other algae (write in)					
Cnidarians	*Aiptasia pulchella*				
Echinoderms	*Tripneutes gratilla*				
	Echinometra mathaei				
	Echinometra oblonga				
	Holothuria hilla				
	Holothuria cinerascens				
	Actinopyga obsesa				
	Actinopyga mauritiana				
	Ophiocoma erinaceus				
Molluscs	*Conus abbreviatus*				
	Conus flavidus				
	Turbo sandwicensis				
	Cypraea schilderorum				
	Nerita picea				
	Littoraria pintado				
	Aplysia dactylomela				
Arthropods	*Platypodia eydouxii*				
	Calappa gallus				
Other inverts (write in):					
Fish	*Gymnothorax eurostus*				
	Cirripectes sp.				
	Bathygobius sp.				
Other fish (write in):					
Substrate	Sand				
	Bare Rock				
Other substrate (write in):					
	QUADRAT TOTAL				

Activity: Planning a biological survey of the coastal environment
Species richness (Part A) and species abundance (Part B) are both important components of species diversity. Survey the biology of a coastal area using transects and/or quadrats to describe one or both of these biological parameters.

Procedure
You are going to identify species in an area that may not be familiar to you.
a. How will you describe and identify species in the field and on your data sheet? Consider how males and females of the same species may look different, and how juveniles and adults may look different.
b. How will you ensure that these species will only be counted once, even if multiple people describe them?

Part A – Species Richness
1. Based on your prior knowledge about the field site, make a prediction about the amount of time spent searching and the total number of species that will be found. Graph your prediction in Figure 1.
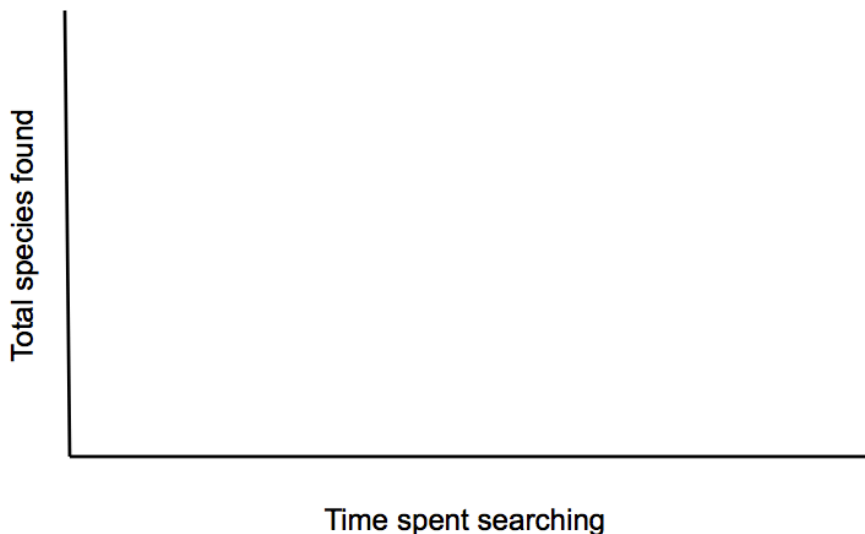
Figure 1. Prediction of the total number of species that will be found over time

2. Based on the time you will be spending in the field and the size of your study site, determine appropriate time intervals for searching for species. If you will only spend one day at the site, this may be as short as a few minutes. If you will return to the site multiple times, your time intervals may be longer.

Part B – Species Abundance
1. Based on your prior knowledge, predict if the field study site will show zonation. Write a hypothesis based on your prediction.

2. Write down any other study questions. What data do you need to collect to complete your analysis?

3. Based on the information your teacher gives you about your study site and the amount of time you will spend on your study site, plan your survey. The following prompts are designed to help you. Depending on your study questions, you may not need to answer all of the following prompts.

   Determine:
   a. The number of transects
   b. How to lay transects in the field
   c. How far apart the transects should be from each other
   d. How many point intercept data points to take for each transect
   e. The distance between each transect point-intercept
   f. How many quadrats per transect
   g. The number of times at what distances along the transect to place quadrats
   h. How to lay your quadrats in reference to your transect line
   i. Quadrat method(s) to use

Both Part A and B
1. Create data tables to record data in the field. You can create your own or modify the sample data sheets.

2. Collecting data in the field can be fraught with errors.
   a. Determine at least three errors that might occur during data collection.
   b. How do you plan to collect data in a way that will lesson the effects of each of these errors?

3. Decide how your group will divide and share tasks in the field.

4. Consider possible environmental and organism hazards. How will your team stay safe?

5. Based on your plan, create a packing list for your field study.

Activity Questions
1. Explain your planned study questions.

2. Once collected, how will you analyze and represent your data? What sort of graphs and/or tables will you use?

3. Scientists often collaborate to build a bigger picture about the field site they are working in. How will you share the information you learn with the 'physical' and 'chemical' teams?

4. What might cause you to adapt to your study plan in the field? How might any adaptations affect your planned data collection?

Sample Field Data Sheets

Transect Data Sheet
The information at the top of the sheet (location, date, start and end time) is important when comparing species abundances between sites. The transect line number refers to the group's transect placement in relation to all other groups. Transect line number information will become important when analyzing your data and looking at any zonation.

You should take transect point intercept data at least every meter. It is unlikely that your site matches the number of rows in this example data sheet. Modify the sheet to reflect your field transect length by adding or deleting rows to the data table.

Quadrat Data Sheet
These data sheets list the most common species that have been found in the past at these intertidal sites. Additional species can be written in the blank spaces of the first column. The general data sheets can be used for other locations.

If you are collecting data using multiple quadrat methods, print separate sheets and clearly label which sheet is for point counts and which is for percent cover. If you are collecting quadrat data from more than five locations print additional sheets, you should aim for a minimum of ten quadrats per transect.

Indicate the designated transect points your class will place their quadrats in the top row of the columns. The transect points can be any standard distance (e.g. every 0.5m, 1m, 2m, 5m, etc.) depending on the size of your study site.

Transect Data Sheet

Name(s):_____Date:_____

Location: _____Transect Line #: ____Start time: _____ End Time: _____

Point-Intercept Transect
Record the single organism or substrate category directly underneath each transect point.

Transect Point (m)	Organism / Substrate

Quadrat Data Sheet – Diamond Head Beach, Oahu

Name(s):_____Date:_____

Location: _____Transect Line #: _____Start time: _____ End Time: _____

	Quadrat Placement					
Algae	*Acanthophora spicifera*					
	Blue-green algae (Lyngbya)					
	Cladophoropsis/ Cladophora					
	Crustose Coralline (looks like pink rock)					
	Dictyosphaeria cavernosa					
	Dictyota acutiloba					
	Dictyota sandvicensis					
	Dictyopteris spp.					
	Gracilaria salicornia					
	Halimeda discoidea					
	Hypnea musciformis					
	Laurencia spp.					
	Microdictyon setchellianum					
	Padina spp.					
	Sargassum spp.					
	Turbinaria ornata					
	Turf (mix of 1-2 cm tall species)					
Other algae (write in)						
Invertebrates	*Anthopleura nigrescens*					
	Brachidontes crebristriatus					
	Cypreae caputserpentis					
	Dendropoma gregaria					
	Holothuria atra					
	Isognomon californicum					
	Littoraria pintado					
	Nerita picea					
	Nesochthamalus intertextus					
	Nodilittorina hawaiiensis					
	Peasiella tantilla					
	Siphonaria normalis					
Other inverts (write in)						
Substrate	Bare Rock					
	Sand					
Other substrate (write in)						
	Quadrat Totals					

Quadrat Data Sheet - Waipuilani Beach, Maui

Name(s):_____Date:_____

Location: _____Transect Line #: _____Start time: _____ End Time: _____

	Quadrat Placement					
Algae						
	Acanthophora spicifera					
	Blue-green algae (Lyngbya)					
	Bryopsis pennata					
	Cladophora sericea					
	Colpomenia sinuosa					
	Crustose coralline (looks like pink rock)					
	Hypnea musciformis					
	Laurencia spp.					
	Padina spp.					
	Sargassum echinocarpum					
	Ulva fasciata					
	Ulva reticulata					
	Turf (mix of 1-2 cm tall species)					
Other algae (write in)						
Invertebrates	*Morula granulata*					
	Nerita picea					
	Ophicoma erinaceus					
	Porites compressa					
Other inverts (write in)						
Substrate	Bare Rock					
	Sand					
Other substrate (write in)						
	Quadrat Totals					

Quadrat Data Sheet - Hilo, Big Island

Name(s):_____Date:_____

Location: _____Transect Line #: _____Start time: _____ End Time: _____

		Quadrat Placement				
Algae	*Acanthophora spicifera*					
	Blue-green algae (Lyngbya)					
	Brown-Colored Crust					
	Cladophoropsis/Cladophora					
	Codium edule					
	Crustose coralline (looks like pink rock)					
	Dictyosphaeria cavernosa					
	Dictyota acutiloba					
	Galaxaura spp./Liagora					
	Gracilaria salicornia					
	Laurencia spp.					
	Padina spp.					
	Pterocladiella capillacea					
	Sargassum spp.					
	Turbinaria ornata					
	Ulva fasciata					
	Turf (mix of 1-2 cm tall species)					
Other algae (write in)						
Invertebrates	*Actinopyga mauritiana*					
	Anthopleura nigrescens					
	Barnacles					
	Brachidontes crebbristriatus					
	Echinometra mathaei					
	Echinometra oblonga					
	Holothuria atra					
	Isognomon spp.					
Other inverts (write in)						
Substrate	Bare Rock					
	Sand					
Other substrate (write in)						
	Quadrat Totals					

Quadrat Data Sheet – General

Name(s):_____Date:_____

Location: _____Transect Line #: ____Start time: _____ End Time: _____

	Quadrat Placement					
Algae (write in)						
Invertebrates (write in)						
Substrate	Bare Rock					
	Sand					
Other substrate (write in)						
	Quadrat Totals					