Name____ Lab Section__________________

Objectives:

- Understand the problems intertidal organisms face in their struggle to survive and reproduce in their environment.
- Perform basic field techniques in collecting samples from the environment.

Background material may be found in

• Chapter: 34
• Chapter: 37

Biology: Concepts & Connections, 8th ed.

Introduction

Between the high and low tide marks lies a strip of shoreline that is regularly covered and uncovered by the daily ebb and flow of the tides. This meeting ground between the land and the sea is called the **intertidal** and is home to some of the most beautiful and diverse habitats on our planet. Intertidal communities occur on sandy beaches, in bays and estuaries, on wharf pilings, and along rocky shorelines.

The plants and animals that inhabit the intertidal are hardy and adaptable. They must be able to withstand periodic exposure to air and the force of the pounding surf. In addition, the substrate in which the animals live plays an important role in determining the types of organisms found in an intertidal community. **Because sand is constantly moving and shifting, sandy beaches are a much more unstable habitat than rocky shores.** As a result, there tend to be fewer species adapted to live on sandy beaches. Furthermore, among those that live there, some prefer wetter areas (areas exposed to air only during low tides) while others prefer drier areas (are only under water during high tides).

In today's lab, we will determine the distribution and abundance of animals along a sandy beach in Santa Barbara, California by identifying observed organisms, counting individuals, and looking for patterns in the distribution of the different species. You will learn how to make a **transect**, collect samples along that transect, and tabulate the data. You will also calculate species richness and evenness, tools commonly used to measure biodiversity.

Procedure

The class will be divided into teams. **Each team should have one shovel, one bucket, one screen, one plastic measuring cup, one transect line, and many flags.**

1. Look at the beach. Note the berm, intertidal area (low tide), and the area of the most recent high tide.
2. Lay out the transect line beginning at the berm crest and go straight out to sea as far as possible. The **berm crest** marks the point of the biggest recent tide, and is usually seen as a shelf or rounded border.
3. Put a flag in the sand at each meter as you move toward the water. Roll up your transect line, cleaning it off as you go so it won't get clogged up with sand.
4. Beginning at the berm crest, take a small shovel of sand and dump it on the screen. **Be careful not to touch the screen with the shovel, as it can damage the screen**. Fill the measuring cup with water from the bucket, and use it to rinse the sand through the screen with water. This will wash all the sand away and leave the animals. Count and record the number and types of animals left on the screen. This will be sample #1 from station #1.
5. Repeat the procedure at the rest of the stations.

Data Collection

Table 12.1: Organisms found during transect sampling.

	Annelids		**Arthropods**			**Other**
Station	**Blood worms** Number found (n)	**Clam worms** Number found (n)	**Sand crabs** Number found (n)	**Beach Pillbugs (Isopods)** Number found (n)	**Beach hoppers** Number found (n)	List name & number found
1 (berm)						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20 (water line)						
Total (n)*						

Record any other species you see at the beach (e.g., birds, kelp flies) and the approximate number of individuals.

Table 12.2: Organisms seen during transect sampling.

Species	**Number of Individuals (n)**

Distribution of Organisms

1. Examine your data. How many different species did you see?

2. Did you find all the different types of animals at each station you sampled?

3. Were some types more abundant at some stations and less abundant at others?

   Explain why or why not. (Your answer should be in terms of community and ecosystem structure, e.g. role of abiotic and biotic environment, effects of species interactions, etc.)

4. What adaptations do you think are necessary to allow an organism to be successful in the sandy beach habitat?

Data Analyses - Calculating Biodiversity

Species diversity is a characteristic unique to the community level of biological organization. Higher species diversity is generally thought to indicate a more complex and healthier community because a greater variety of species allows for more species interactions (hence greater system stability), and indicates good environmental conditions. A uniform population of a single species adapted to a specific environment is more at risk if environmental changes occur. A more diverse community consisting of many species has a better chance of including individuals that might be able to adjust to changes in the environment. **Therefore, the question of how many different species exist in a particular environment is central to understanding why it is important to promote and preserve species diversity.**

Scientists use several different diversity measures to describe the species diversity within a community and to compare diversity among communities. The simplest way to measure biodiversity is to count the number of different species at a site or in a community. This number gives scientists a measurement of **species richness**.

Transfer the values from the bottom line of Table 12.1 for each species **and any additional species** to Table 12.3 below, and then complete the table with calculations of n(n-1), and sums of each column.

Table 12.3: Organisms found during transect sampling.

Species	Total Found (n)*	n(n-1)
Blood Worms		
Clam Worms		
Sand Crabs		
Beach Pillbugs (Isopods)		
Beach Hoppers		
Kelp Flies		
Other Species #1 -		
Other Species #2 -		
Total number of species (R) =	**$\sum$ n = N =**	**$\sum$ n(n-1) =**

Species Richness

This value is determined by counting the **total number of species** found in the community. This value is R in Table 12.3. Record the species richness of your Sandy Beach community here.

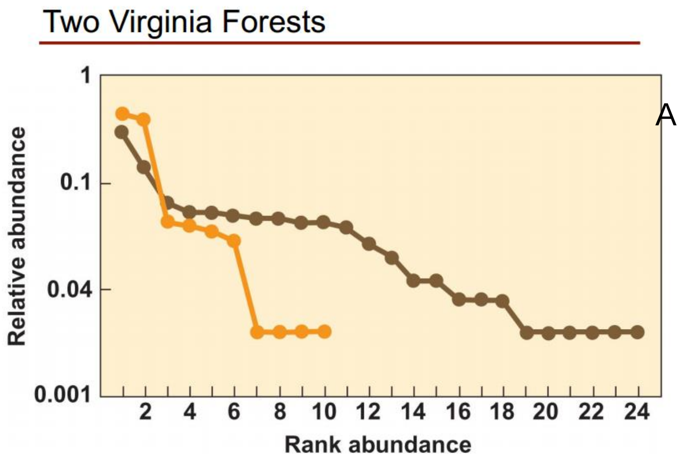
R = ___________________

By comparing species richness at two sites or communities, scientists learn something about biodiversity. But a simple survey of species richness does not necessarily give a complete picture of biodiversity in a community because it does not place any importance on **relative abundance** of each species. A community is said to have high species diversity if many nearly equally abundant species are present. ***If a community has only a few species or if only a few species are very abundant, then species diversity is low.***

Relative Abundance/Evenness

Rank-abundance curve

Relative abundance is best shown by creating a rank-abundance curve. This is done by plotting the proportion of each species' abundance vs. its rank (from most abundant to least abundant). The greater the slope of the resulting line, the less diverse (less "even") the sample, and the flatter the slope, the more diverse or "even" the sample. For example, rank-abundance curves were constructed using data from two forests in Virginia. You can see the line for forest "B" is flatter than that of forest "A", indicating that forest "B" is more "even" and diverse than forest "A".



A B

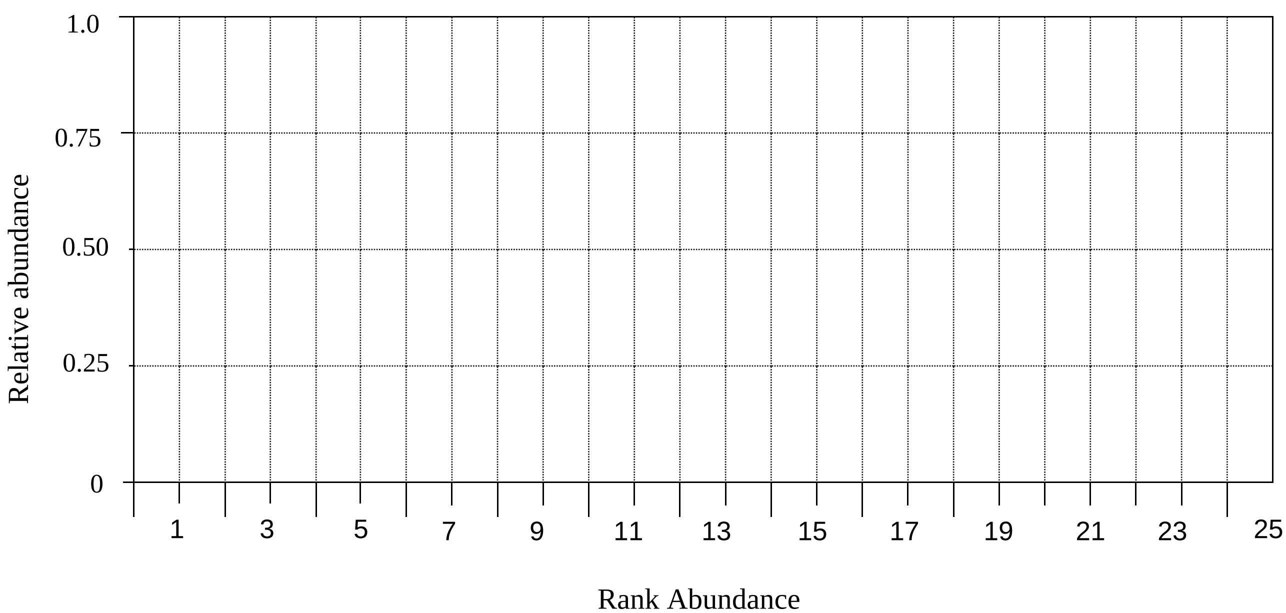
To determine the evenness of the Sandy Beach community you are going make a rank-abundance curve with your data.

1. Transcribe your data from Table 12.3, to Table 12.4, listing each species in order from most abundant to least abundant.
2. Calculate ∑ n for all species combined by adding up the total number of individuals you found.
3. Calculate the relative abundance of each species by dividing the number of individuals of each species (n) by ∑ n. Put this value in the last column on Table 2.
4. Plot the relative abundance vs the rank abundance of each species on Figure 12.1.

Table 12.4: Rank abundance

Rank	**Species/Name of Organism**	**Number Found (n)**	**Relative abundance ($n/\sum n$)**
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
	$N = \sum n =$		

Figure 14.1: Rank Abundance Curve



Examine your rank-abundance curve to determine how "even" your area is. A line with a relatively flat slope indicates your area is more even and more diverse. A line with a steep slope indicates your area is less even and less diverse.

5. What does this curve tell you about the diversity of your area?

Simpson's Index of Diversity

The Simpson's Index of Diversity is one method for estimating diversity that takes into account both species richness and the relative abundance (evenness) of each species. This index will range from 0 to 1, where a value closer to 0 indicates less diversity and a value closer to 1 indicates more diversity.

To calculate this index, use the numbers from table 12.3 and plug into the formula:

$$D = \frac{\sum n(n-1)}{N(N-1)}$$

Simpson's Index of Diversity = 1 – D

=

6. What does this value tell you about the diversity of your area?

LABORATORY NOTES: