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Lesson 2.1: Different measures for different needs.

Purpose

Scientists have developed multiple measures to evaluate the biodiversity of a particular site. To understand why scientists use different methods to evaluate biodiversity we will develop our own methods to evaluate the diversity of an everyday object: the cell-phone.

The review below rates each cell phone company from very good (score of 5), good (score of 4), fair (score of 3), poor (score of 2), and very poor (score of 1) on several categories.

Rating Category	Company A	Company B	Company C
Cost of phone	$100	$60	$90
Call Quality and Reliability	5	3	4
Number of free minutes	5	4	4
Available features (call waiting, redial when busy)	5	4	4
Phones are easy to use	4	4	4
Coverage area	5	4	5
Other media (phones play music and videos)	Not Available	4	5
Downloadable Games	Not Available	4	3
Thickness/Size of Phones	4	1	3
Average Score	**4.70**	**3.50**	**4.0**
Total Number of Plan Features	**6**	**8**	**8**

1. Based upon the data in the table, which cell-phone company's plan would you buy? Why? What were the factors that most influenced your decision?

Students' responses here will vary. For example - They could choose Company A, because it has the highest average score. They could choose Company C, because it has all of the possible features and they all score at least "fair". They could choose Company B because it is the cheapest. Or they could focus on one other specific category like reliability.

2. Do you think your classmates will agree with you that Company _____ is the best? Why or why not?

Again, the responses will vary. Hopefully, they can provide some reasoning for why another individual may pick a different plan.

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Lesson 2.3: Examining Biodiversity measures

Purpose

In the previous lesson, you examined three different urban sites and discussed which one you felt had the greatest biodiversity. In this activity, you are going to revisit those sites, examining specific bird data and using different measures of biodiversity.

Prediction

Look at the data in the table below. Which of the three sites do you think will have the greatest biodiversity using the Simpson and Shannon-Weaver indices? Why?

Students' responses will vary. They will most likely choose either Site 2 or Site 3, because the two sites have more individual birds.

Procedure

1. For each site record the species richness in the data table on the next page.
2. Describe the species evenness for each site in the table (e.g. even number of each species, a couple of dominant species with high numbers and the rest are low.)
3. Open the spreadsheet ***biodiversity_measures.xls***. The data for the three sites is recorded in the table below. You will need to add the data from one site at a time to calculate the Simpson and Shannon-Weaver indices.
4. Start with Site #1. Species #1 will be the Rock Dove so change the species number to 32. Repeat this with all 10 species. After adding all of the data, record the final Simpson and Shannon-Weaver Indices in the data table on the next page.
5. Repeat the procedure for Site #2 and then Site #3.

	# of individuals counted at site		
Species of Bird	**Site #1**	**Site #2**	**Site #3**
Rock Dove (pigeon)	32	44	20
Black Capped Chickadee	4	22	23
European Starling	43	47	25
House Sparrow	15	42	25
Song Sparrow	1	6	20
House Finch	23	45	24
Dark-eyed Junco	0	0	20
American Crow	4	4	20
Common Grackle	0	5	23
American Robin	0	4	20
Total Number	122	219	220

Results:
Record below the species richness. Then use the excel sheet to calculate the Shannon Weaver and Simpsons indices for both sites. Record both indices below.

Site	Species Richness	Species Evenness	Simpsons	Shannon-Weaver
Site 1	*7*	*Uneven distribution – 3 dominant species*	*0.76*	*1.55*
Site 2	*9*	*Uneven distribution – 4 dominant species*	*0.83*	*1.86*
Site 3	*10*	*Even distribution – no dominant species*	*0.90*	*2.30*

Conclusion
1. Which of the three sites had the greatest biodiversity? Explain why it has the highest biodiversity.

Site three has the greatest biodiversity. The Simpsons and Shannon-Weaver indices are the highest for site 3, because it has the most species (high species richness) and there is an even distribution of the number of individuals for each species (species evenness).

Further Exploration
1. What do you think will happen to the Simpsons and Shannon-Weaver index if there is only one species? Will it be high, in the middle or low? First make a prediction. Then use the spreadsheet to test your idea and then record your results.

Prediction – Students' responses will vary. Example -both indices will be low.

Both the Simpsons index and the Shannon-Weaver index = 0.

2. What do you think will happen if you have 10 species but one very dominant one? Again, make a prediction, then use the spreadsheet to test your idea and record your results below.

Prediction – Students' responses will vary. Example – The numbers will be in the middle, like .5 for Simpsons and 1 for Shannon-Weaver.

Results – Students' responses will vary. Example – I put species 1 had 100 individuals and the other 9 species had 5 individuals. My Simpsons Index was 0.52 and my Shannon-Weaver Index was 1.30.

3. Using the spreadsheet, try to make the Simpsons and Shannon-Weaver index as high as possible. What conditions lead to the two indices being high?

To make both indices high, I included a high number of all species. Both the species richness and the species evenness were high.

4. What do you think is the best indicator of biodiversity, the number of species, the number of individuals, the evenness, or a combination of all three indicators? Why?

I think you need to look at a combination, because it is important not only that there be a lot of species, but also a number of individuals of each species. Biodiversity measures both the number and the variety of organisms at a site.

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Lesson 2.4: Measuring biodiversity using tree data – Version 1

Purpose

In Module 2, you collected tree data at your field site. You are now going to revisit that tree data to calculate the tree biodiversity of your field site. Before conducting your calculation please answer the following questions.

Predictions

1. Do you think you have diverse sampling of trees? Why or why not?

Students' responses will vary depending on their site.

Results

1. Use the **biodiversity_measures.xls** spreadsheet to calculate the Simpson and Shannon-Weaver indices for your field site. Record the results below.

Students' responses will vary depending on their site.

Conclusion

1. Do you think the biodiversity of your field site is high or low? What is your evidence for this?

Students' responses will vary.

2. Do your results from the biodiversity indices surprise you? Why or why not?

Students' responses will vary.

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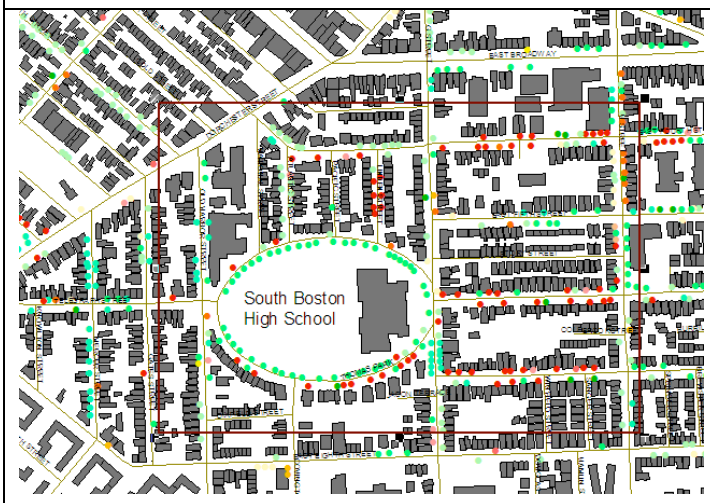
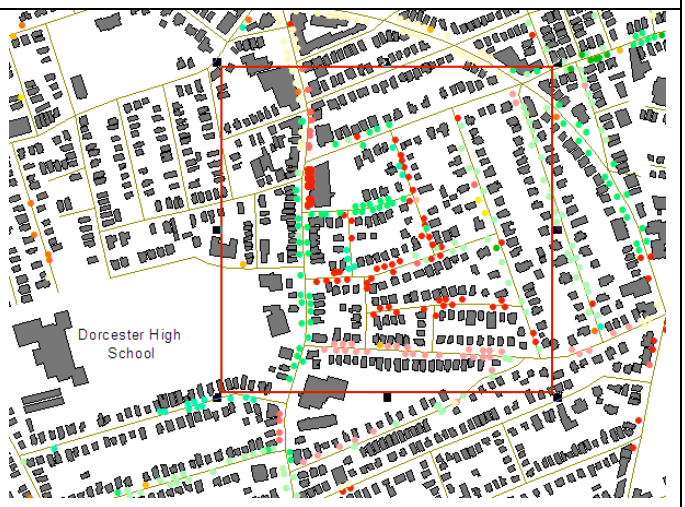
Lesson 2.4:Measuring biodiversity using tree data – Version 2

Background

During the summer of 2006 a group of volunteers conducted an urban street tree inventory and collected data about trees in the entire city of Boston. Below are two images from the neighborhoods of South Boston and the Codman Square area near Dorchester High School. The square is the study area in which trees were sampled and each dot represents a tree. The gray areas are buildings. The different color dots represent a different species of tree.

South Boston Tree Sample Site	Dorchester High School Tree Sample Site
	

South Boston Tree Sample	
American Elm	3
American Sycamore	5
Elm hybrids	5
Green Ash	8
Honey Locust	65
Japanese Tree Lilac	6
Japanese Zelkova	6
Littleleaf Linden	64
London Planetree	12
Norway Maple	38
Total Trees	212
Total Species	10

Dorchester High School Tree Sample	
Callery Pear	7
Gingko	26
Green Ash	14
Honey Locust	49
Littleleaf Linden	68
Norway Maple	33
Total Trees	197
Total Species	6

Prediction

Looking at the data, predict which area do you think has the greatest tree biodiversity? Why?

Students' responses will vary. Example – South Boston because it has more species.

Results

Record below the species richness. Then use the excel sheet to calculate the Shannon Weaver and Simpson indices for both sites. Record both indices below.

Site	Species Richness	Simpsons	Shannon-Weaver
South Boston	*10*	*0.78*	*1.76*
Dorchester High School	*6*	*0.77*	*1.59*

Conclusion

1. Which site has a higher biodiversity? What is your evidence that it has a higher biodiversity?

South Boston has a higher biodiversity, because the Species Richness and Shannon-Weaver index are higher. The Simpsons index is basically the same for the two sites.

2. What do you think is the best indicator of biodiversity, the number of species, the number of individuals, the evenness, or a combination of all three indicators? Why?

I think you need to look at a combination, because it is important not only that there be a lot of species, but also a number of individuals of each species. Biodiversity measures both the number and the variety of organisms at a site.