Life Sciences/HHMI OutReach PROGRAM

Bird Biodiversity
(Using the data collected during field studies)

Let's use the concepts you learned in the "Bean Counter" activity to determine the biodiversity and health of actual ecosystems utilizing data sets collected during field studies at a salt marsh and a freshwater wetland ecosystem. Recall that biodiversity, as it is most commonly employed, is the variety of different species within a defined area. After completing "Bean Biodiversity" you should also be able to describe a community in terms of species richness and relative abundance. We will also use three additional indices to analyze and express biodiversity. The indices are: Frequency, Community Dominance Index, and Shannon-Weiner Index.

- Frequency refers to the percentage of times a species is observed. If a specific species such as a Northern Harrier is observed 2 times in 8 trips (effort) to a field site the frequency (2/8*100=) is 25%.
- Community Dominance Index measures the proportion of the two most abundant species in a community. The total of all individuals of all birds in an area is 100 and the population of starlings is 45 and the population of house sparrows is 20. The Community Dominance Index (45 + 20 / 100)*100= for this ecosystem is 65%. Higher Community Dominance Index values are generally found in ecologically degraded areas.
- The Shannon-Wiener Index measures how evenly species within a community are distributed on a logarithmic scale. The formula for calculating Shannon-Wiener Biodiversity Index is:

$$H' = -\sum_{i=1}^{S}(p_i \ln p_i)$$

p_i is the relative abundance (n_i /N) of each species calculated as the proportion of individuals of a given species (n_i) divided by the total number of all individuals of all species (N). ln is the natural log. S is species richness. The Shannon-Wiener Index is increased either by having additional unique species, or by having greater species evenness. We will utilize an online **Shannon-Wiener Diversity Index / Shannon Entropy Calculator.**

We will use the various indices to compare biodiversity from the "Bird Biodiversity Data Sheet" for the same location during different seasons or for two different locations at the same time.

Materials:
Carefully selected bird data from Rumney Marsh and Leaveritt Pond.
Pencil
Calculator / Computer
Graph Paper

Procedure:

1. Choose two sets of data either:
   a. same location at two different dates, or
   b. two different locations on the same approximate date

2. Enter species (taxa) in Avifauna Table 1
3. Enter # for each species observed
4. Calculate total # of Avifauna for each site / date
5. Calculate taxa richness for each site / date.
6. Calculate relative abundance for each species
7. Create a bar graph representing relative abundance for each location or date.

8. Calculate frequency if looking at the same site but different dates
9. Calculate Community Dominance Index (see formula above)
10. Calculate Shannon-Wiener Index by using an online calculator
    http://www.changbioscience.com/genetics/shannon.html
    In the box labeled "Paste (Ctrl-v or Apple-v) your data here:" enter the number of each species and hit "go"
    Record the information the appears in the results box.
11. Answer questions

Questions:

1. Which species has the greatest relative abundance for each condition (location / time)?

2. It is difficult to control variables in field studies. Which variables may account for variation in the richness, abundance, frequency, community dominance index, Shannon-Wiener biodiversity index observed at the field sites.

3. Which location or date has the greatest biodiversity? Use biodiversity indices to support your answer?

4. Account for variation in biodiversity observed at different locations or dates. What abiotic or biotic factors may be involved in different biodiversity indicators (richness and abundance)

Bird Data Table.

Location / Date			Location / Date			
Bird Species	# of Birds	Abundance	Bird Species	# of Birds	Abundance	Frequency
Total # of Avifauna			Total # of Avifauna			
Taxa Richness			Taxa Richness			
Community Dominance Index			Community Dominance Index			
Shannon-Wiener Index			Shannon-Wiener Index			

Bird Biodiversity Data Sheet for " Bird Biodiversity"Activity

The data below were collected by students at two locations during field studies. Rumney Marsh is a salt marsh in Revere, Massachusetts. Leaveritt Pond is a freshwater ecosystem in Boston, MA.

Date	10/24	4/24	11/19	4/2
Location	Rumney Marsh	Rumney Marsh	Leaveritt Pond	Leaveritt Pond
Hooded Merganzer			4	
Pied Billed Grebe				1
Snowy Egret		4		
Great Egret	1	1		
Little Blue Heron		1		
Glossy Ibis		10		
Canada Goose	4	1	82	14
Mallard	1		74	46
American Black Duck	10	2	10	4
Ruddy Duck			14	21
Coot				6
Bufflehead			20	8
Double Crested Cormorant	1			
Ring-Billed Gull	18	10	125	83
Greater Yellowlegs	3	2		
Northern Harrier		2		
Rock Dove		2	6	1
Mourning Dove		3		2
Belted Kingfisher				1
Common Flicker		2		
Barn Swallow		1		
Blue Jay	2			
American Crow	6	9	6	3
Golden Crowned Kinglet				1
American Robin	1	4		
Northern Mockingbird	2	3	1	
European Starling	69	91		12
Northern Cardinal		1		
White Throated Sparrow		1		
Song Sparrow		3	1	
Red-winged Blackbird		13		1
Common Grackle		18		8
American Goldfinch		8		
House Sparrow	1		7	1