Estimating Biodiversity on a VIRTUE Disc
Student Worksheet

Now that you have collected your VIRTUE discs from the water, let us perform some *quantitative analysis* of biodiversity on your discs and these can be performed by calculating some basic *diversity indices* commonly used in ecological surveys. These indices will provide you with numbers you can use to make objective comparisons of discs.

1. **Predict your results**. If you haven't done it before deploying the discs, you can now formulate your hypotheses. Discuss with your classmates and write down what results do you expect after analyzing your discs. In disc do you expect the highest or the lowest diversity. Or do you expect any differences in the diversity among the discs?

2. **Count the individual organisms for each species**. You can use the identification plates provided by your teacher to identify the main groups of organisms you can find or alternatively refer to the identification plates available on the VIRTUE-s website. Examine the disc under a stereomicroscope and count the individuals of each species you can identify. Another way of doing this is to make photos of your discs and count the organisms following the instructions for the ImageJ program.

3. **Create a table for your data.** Record your counts on the table below. If you are counting more than 1 disc, write the name or the number of the disc and some data, which may be important to consider when you interpret your results.

	Disc _____	Disc _____	Disc ____
Date of deployment			
Date of retrieval			
Number of days in the water			
Special remarks or characteristics			
Organisms found	**Number of individuals (n)**		
Total number of individuals (N)			
Total number of species found (S)			

4. The vast majority of biodiversity estimates are based on three basic parameters; **the number of species identified (S)**, **the number individuals of each species (n)**, and the **total number of organisms in a sample (N)**. You will notice that you already have these parameters on your table.

Next your teacher will tell you the biodiversity index you will calculate. Use the values in your first table to calculate the variables you need for your biodiversity index. Calculate the variables for all your discs. Enter your values below. You may not need to calculate all the variables on the table. Add and extend the tables as needed.

Disc 1					
Organisms found	Number of individuals (n)	Pi n/N	log n (Pi)	Pi * log n (Pi)	n (n-1)
Sum (Σ)	N=				

Disc 2					
Organisms found	Number of individuals (n)	Pi n/N	log n (Pi)	Pi * log n (Pi)	n (n-1)
Sum (Σ)	N=				

Disc 3					
Organisms found	Number of individuals **(n)**	Pi **n/N**	log n (Pi)	Pi * log n (Pi)	n (n-1)
Sum (Σ)	**N=**				

5. **Calculate your indices using the given formulas and enter your results in the table.**
   Calculate only the Index specified by your teacher. Extend the table as needed.

Index		Formula	Disc 1	Disc 2	Disc 3
Species Richness **(S)**					
Simpson's **(D)**		$1 - \left(\dfrac{\sum n(n-1)}{N(N-1)}\right)$			
Shannon-Wiener **(H)**		$\sum - (Pi * \ln Pi)$			
Evenness **(E)**		$\dfrac{H}{\ln(S)}$			
Effective Number of Species **(ENS)**	Simpsons **ENS$_{Si}$**	$\dfrac{1}{(1-D)}$			
	Shannon-Wiener **ENS$_{Sh}$**	$\exp(H)$			
Menhinick **(D$_{Mn}$)**		$\dfrac{S}{\sqrt{N}}$			
Jaccard **(J)** **Disc 1 &Disc 2**		$\left(\dfrac{x \cap y}{x \cup y}\right) * 100$			1)

6. **Analyse your data.**

   a) In which disc is the biodiversity the highest? Where is it lowest? Explain the differences, if any, in the biodiversity of the different discs.

   b) Create a bar graph showing the different biodiversity of the discs. If the discs were deployed at different lengths of time, plot the change in diversity over time/ or plot the evenness over time.

   c) If you had left the discs in the water longer, what would you expect to happen to the biodiversity on the disc? Justify your assumption. (Hint: You can get some information from the Biofilms and Biodiversity website and …….. from the Virtue-S website, Add link)

For on-line biodiversity calculations go to: