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Lab 4 Prelab: Using Plankton as Indicators of Climate Variability

Lab Overview

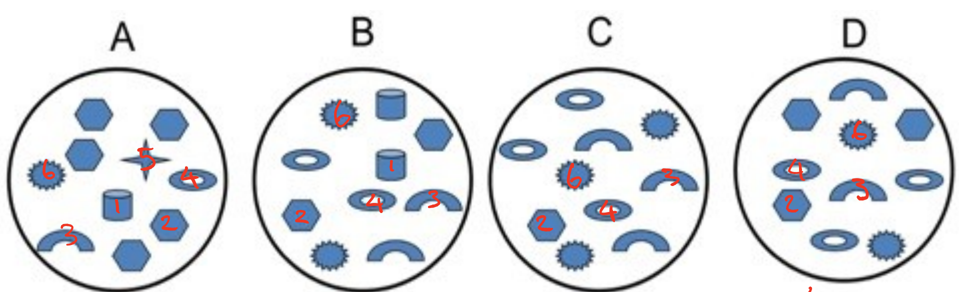
In this lab you will investigate the population structure of a phytoplankton community and what insight you might gain from this information. You will need to consider both the number of species present and the relative abundance of each species to classify phytoplankton diversity. For the pre-lab exercise, you will explore two methods to describe communities of different population structures.

Assessment

1. Print this out and submit with your answers at the **beginning** of class for Lab 4.

Pre-Lab Exercises

One measure of diversity is **Species Richness**, which is simply the number of different species in a sample. Communities with higher species richness are more diverse and communities with lower species richness are less diverse.



species: 6 5 4 4

Q1. Based on our definition of species richness, list the above communities in order from least diverse (1) to most diverse (4).

1. D
2. C
3. B
4. A

Q2. Give each of the phytoplankton species above a number. Now, for each of the communities, list the number of individuals of each species present in the table below.

	A	B	C	D
Species 1	1	1	0	0
Species 2	5	2	1	3
Species 3	1	2	3	2
Species 4	1	2	3	3
Species 5	1	0	0	0
Species 6	1	2	3	2

Q3. Now, using the information from the table above, *use your best judgement* to classify the populations from least diverse (1) to most diverse (4).

1. D
2. C
3. B
4. A

Q4. Did your answer change from Q1? If it did, justify your reasoning from Q3.

My answer did not change because diversity means the state of having variety. A still has at least one of each species, and both C and D are missing 2 species.

The Shannon Wiener Diversity Index:

The **Shannon Wiener Diversity Index (*H'*)** is an analytic measure of species diversity in a community. It is defined as

$$H' = -\sum_i p_i \, ln(p_i)$$

It is the (negative) sum over all the species of the relative proportion of each species multiplied by the natural log of the proportion. Mathematically, $p_i = n_i / N$ where n_i is the total number of the species i and N is the total number of all individuals in the sample.

$p_i = \frac{n_i}{N}$; $n_i \sim$ # of species i
$N \sim$ # of individuals in sample

The greater that ***H'*** is, the greater the population diversity. As an example, if a sample contains four individuals, two from one species, one from a second species, and one from a third species, the Shannon Wiener index is

e.g. $n_1 = 2$ $n_3 = 1$ $p_1 = \frac{2}{4} = 0.5$
$n_2 = 1$ $N = 4$ $p_2 = p_3 = 1/4 = 0.25$

$$H' = -(0.5)\ln(0.5) - (0.25)\ln(0.25) - (0.25)\ln(0.25)$$
$$H' = -\ln(0.25) = 1.04$$

Q5. Calculate H' for the 4 populations in Q1.

$N = 10$ A. H'= $5[-(0.1)\ln(0.1)] - 0.5\ln(0.5) = 1.498$

$N = 9$ B. H'= $4(-(0.\overline{22})\ln(0.\overline{22})) - (0.\overline{11})\ln(0.\overline{11}) = 1.581$

$N = 10$ C. H'= $3(-(0.3)\ln(0.3)) - (0.1)\ln(0.1) = 1.314$

$N = 10$ D. H'= $2(-(0.3)\ln(0.3)) + 2(-(0.2)\ln(0.2)) = 1.366$

Q6. How does the order of the Shannon-Wiener indices compare to your answer from Q4?

Order from least to most diverse from calculation:

1. C
2. D
3. B
4. A

My answer in Q4 is really similar except that I thought C and D has the same level of diversity.

MATLAB Skills

As before, there is nothing to submit for this section of the pre-lab. However, please read through it and give it some thought because you will need the information here to complete the lab.

You've used many functions in MATLAB so far. A few examples of functions we've used include:

```
plot()        subplot()     axis()
isnan()       mean()        std()
repmat()      datenum()     textscan()
```

These should all be familiar to you by now, some probably more than others, and you will notice that they all follow a similar structure:

a. They require an input argument or multiple input arguments
b. They perform a predetermined calculation or operation
c. They produce some sort of output, which you often assign to a new variable

Once you see this pattern, it should come as no surprise to you that you can define your own functions in MATLAB in order to perform an operation very specific to your needs. This is exactly what you will need to do in this week's lab.

As an example, say you want to define a function called `mymean()` which will be able to calculate the mean of a 1-D vector even if there are `NaN` values in the array. You would start by creating a new m-file in your working directory called `mymean.m` and within this file you would write your function. The function itself would look something like this:

```
function m = mymean(x)
     %%The algorithm to calculate the mean of x goes here
end
```

Using this syntax, I've indicated that I'm declaring a function with one input, which I'm arbitrarily calling `x`, and one output, which I'm again arbitrarily calling `m`. When you now call the function in the command window or in another script, it will expect one input variable, will perform whatever calculation you specify, and return whatever you have defined `m` to be within the body of the function. The names you use in the function are unimportant - they're not stored in your workspace - but you must be consistent between the variable names you use in the declaration (the first line of the function) and the variables you then use within the function.

Once I've made the function, I could now enter

```
>> mymean([3 5 NaN 7])
```

and the function would happily return

```
ans =

     5
```