Water Quality Indices

Field Ecology

An index is a number that is created by mathematically combining a set of numbers. In and of itself, the index does not represent a particular measurement, but it can be used to make comparisons more simple and intuitive.

Water quality indices combine several different water quality parameters. The particular parameters used to develop a water quality index are picked based on historical information, ecological importance, human use, seasonal fluctuations, and other considerations. For example, water quality indices in the Willamette Valley might consider trout and salmon habitat, drinking water quality, and recreational use.

The particular mathematical formulas used for an index can be weighted so that one or more parameters are more important than others in computing the index. This allows people to include many different parameters without losing sight of which ones are the most important.

So far, we have discussed pH, turbidity, temperature, and dissolved oxygen. To design an index that takes all of these into account, we would first need to scale each parameter properly so that it made up the correct percentage of the index. To do this, we would need to know what sorts of values are typical for the different parameters, and assign these values ratings. For example, suppose that we wanted to assess the quality of local creeks in terms of their **suitability for native trout**. We might want to assign the following values to our parameters (please note that these are hypothetical values and do NOT necessarily represent actual recommendations):

Parameter	Excellent		Good		Poor	
Dissolved Oxygen	> 10 mg/L	30	5-10 mg/L	20	0-5 mg/L	0
Temperature	< 15 C	10	15-25 C	5	> 25 C	5
Turbidity	< 50 NTU	10	50-250 NTU	7	> 250 NTU	0
pH	6-8	5	4-6 or 8-9	3	< 4 or > 9	0

In the table above, I decided that dissolved oxygen was the most important parameter, so I used higher values for DO than for the other parameters. This results in an index from 5 – 55, with 5 being extremely poor water quality and 55 being excellent water quality (keeping in mind that our goals would be trout habitat).

Questions:

1. Using the above table, what would the Water Quality Index value be for a creek that had DO of 7.6 mg/L, a temperature of 18 C, a pH of 6.7 and turbidity of 15 NTU?
2. Using the above table, what would the Water Quality Index value be for a creek that had DO of 12.8 mg/L, a temperature of 33 C, a pH of 4.5 and turbidity of 68 NTU?
3. Which of the above creeks do you think would be more suitable for trout?

4. Why do you think high dissolved oxygen is important for trout?
5. Why do you think low temperatures are important for trout?
6. Why do you think low turbidity is important for trout?

7. Now, you will create a water quality index that assesses water quality with respect to drinking water. Assume that we have decided that the following information is reasonable:

Parameter	*How Important?*	*Ideal Values*
pH	Very	5.5 – 7.5
Temperature	Somewhat	40 – 50 F
Dissolved Oxygen	Not	XXX
Turbidity	Pretty Imp.	0 – 100 NTU

Using this information, fill in the boxes to the LEFT of the dotted lines in the table below. (I've started you off by transferring the ideal values from the table above; I also filled in values for temperature so you can see how it might work). Make sure to take these requirements into account:

a. The values you pick should fit within the possible values of the parameter (for example, pH should range from 0 – 14).
b. All possible values for each parameter should fit within the table (for example, if you measured a temperature of 61 F, you should be able to find where it fits on the table).
c. The categories you put each value in should make biological sense (for example, I've chosen "OK" temperature values of 32 – 40 and 50 – 70 because these are water temperatures that would be drinkable, but not ideal).

Parameter	*Excellent Values*		*OK Values*		*Poor Values*	
pH	5.5 – 7.5					
Temperature	40 – 50 F	**10**	32 – 40 F 50 – 60 F	**5**	< 32 F > 60 F	**3**
Dissolved Oxygen						
Turbidity	0 – 100 NTU					

Now, finish the water quality index by assigning point values to each of the parameters – use the boxes to the RIGHT of the dotted lines. (I've filled in points for temperature to start you off). Make sure to take these requirements into account:

a. The parameter that is the least important (in this case, DO) should be worth the fewest points overall. The parameter that is the most important (pH, in this case) should be worth the most points for excellent values and the fewest points for poor values.
b. For this activity, assume that pH is more important than turbidity and turbidity is more important than temperature – and assign points accordingly.

8. Next, use the hypothetical water quality data you looked at in questions number 1 and 2 and evaluate it using your drinking water quality index table. Which creek would be better for drinking water? Is this the same creek that would be better for trout habitat? Does this make sense, given how the two water quality index tables were constructed?

9. Finally, try to make another water quality index table – this time, for recreational purposes (swimming). You might need to do some research into what water quality parameter values are ideal, OK, and poor for swimming. (You can assume that the water being collected is from a stream or a lake that is deep enough for swimming.)