Assignment B: Graphing and Interpreting Long-Term Data

One of the unique aspects of the warbler project at Hubbard Brook is the length of time the study has been conducted. Not only do we know how the reproductive success of warblers has varied from year to year, but we can also relate variation in reproductive success to changes in the amount of food, the abundance of predators, and the density of warblers. As you saw on the website, all of those factors are important in determining the number of young warblers are able to raise in any given year. But would we know that had Dr. Holmes and his colleagues not collected data for all those years? For this assignment, you will graph a subset of the data used to make the graphs on the website. By doing this, we can see what the data would look like and what the researchers may have concluded had they collected the data for only 4-5 years.

Download the data file from the website, and open it in Excel. Also, read the instructions for how to make graphs in Excel; these can be downloaded from the website, next to the link for the data.

Every scientific study has two types of variables: dependent and independent variables. As the name implies, a dependent variable measures something that can depend on another variable. Dependent variables are also called response variables. An independent variable is one that might explain variation in the dependent variable. For this reason, independent variables are also called explanatory variables. In science, we often want to know how much of the variation in a dependent variable is explained by variation in an independent variable. For example, if you wanted to know how the amount of water that a plant receives affects its height, you could compare the heights of multiple plants that were watered different amounts. The plant heights would be your dependent variable, and the amount they were watered would be your independent variable. To visually look at data, scientists always graph the dependent variable on the Y-axis, and the independent variable on the X-axis.

1. In our study of how food abundance affects reproductive success:

   a) What is the independent variable?

   b) What is the dependent variable?

   c) Should food abundance or reproductive success be graphed on the Y axis?

2. Use the graphing instructions to create a new graph of reproductive success vs. food abundance, which includes only data from 1994-1998. When you are done, there should be five data points on the graph, one for each year.

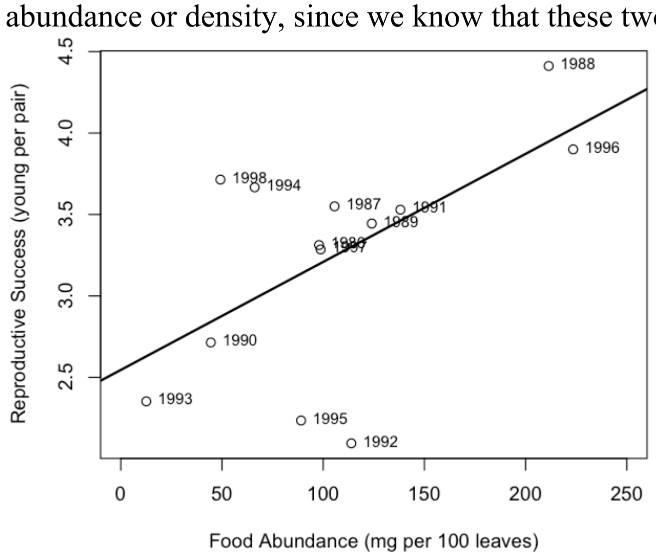
What does the graph look like? Is there a clear relationship between the amount of food and the birds' reproductive success in these years?

3. Next, you will make and interpret two more graphs of reproductive success vs. food abundance, similar to the graph in the previous question, but using data from different years.

a) Create a graph of reproductive success vs. food abundance using data from 1986-1989.
b) Create a graph of reproductive success vs. food abundance using data from 1990-1993.
c) Do you see any clear relationship between food abundance and reproductive success in each of these graphs?

4. Compare the three graphs you created to the graph on the website that included all of the data from 1986-1998. If you were a scientist trying to decide if food abundance affected warbler reproductive success, would your opinion depend on how many years you collected data for, or on which years you did your study? Why or why not?

5. Look at the graph below, in which each year is labeled. Overall, higher food abundance led to higher reproductive success. The line on the graph, which is called a regression line, summarizes the effects of food on reproductive success. Most of the points fall close to the line, but in some years the reproductive success was higher or lower than would be expected for the amount of food in that year. For example, in 1992 reproductive success was very low, even though there was an average amount of food. In 1998, reproductive success was higher than expected given the amount of food in that year, so the point falls above the line. The highest reproductive success was in 1988, but this isn't surprising since food availability was also very high in that year. Some of the variation in the data might be due to differences between years in predator abundance or density, since we know that these two factors also affected success.



a) Recall that in 1992 reproductive success was very low, even though there was an average amount of food. In searching to explain this, would you predict that nest predators were more or less common than average in 1992?

b) Would you predict nest predators to be more or less common than average in 1998?

c) Create a graph of predator abundance versus year. Be sure to think about which variable makes more sense on the X axis, and which variable belongs on the Y axis.

d) Looking at your graph of predator abundance in each year, were your predictions for the abundance of predators in 1992 and 1998 correct?

e) Looking at your graph of predator abundance again, choose one year (not 1991, since predator abundance wasn't measured then), and answer the following questions:
    i. Was the number of predators in that year about average, higher than average, or lower than average?

    ii. Given this number of nest predators, would you expect reproductive success in that year to be above the line on the graph of reproductive success versus food abundance, below the line, or very close to the line.

    iii. Looking at the reproductive success graph, were your results what you expected? Can you make a prediction about the density in the year that you looked at?

6. Can we say that variation in food and predators *causes* variation in warbler reproductive success? If so, why? If not, what would need to be done to establish causation?