Plants and Human Affairs – Biol 106 name ___________________________

A Crabby Assignment

The periwinkle is a small (ca. 1 cm long) marine snail that lives in the intertidal zone in New England. Among this snail's predators is the European green crab. Before 1900, the green crab did not occur north of Cape Cod, MA. After the turn of the century, however, the crab expanded its range northward, and is now found as far north as Nova Scotia. The crab's range expansion exposed the periwinkle populations north of Cape Cod to a new agent of natural selection.

1. Suggest at least three hypotheses to explain how populations of periwinkles might evolve in response to predation by green crabs.

Biologist Robin Seeley investigated whether populations evolved in response to predation by green crabs. Seeley found, in a museum, samples of pre-1900 shells collected at Appledore Island, north of Cape Cod. She compared these old shells to those collected more recently at the same place. Seeley's data appear in the table below.

Table 1. Diameter of periwinkle shells collected north of Cape Cod. *(units are arbitrary)*

Shells collected in 1871				Shells collected in 1982-1983			
5	8	1	9	14	11	12	14
4	8	8	8	9	11	12	13
11	3	9	8	14	10	14	10
7	8	5	8	14	12	13	10
8	13	9	10	15	13	14	15
9	5	2	8	15	13	15	11
7	5	9	8	16	12	18	16
8	5	11	12	16	17	17	15
8	3	3	5	12	13	15	
9	8	6	7				

2. On the graphs on the next page, plot a frequency distribution of Seeley's data to allow you to visually compare the variation in shell thickness in the two populations. Label the Y axis - number of individuals and label the X axis - shell thickness. Then plot your data on the graphs.

1871 population

1882-3 population

3. What is the pattern in Seeley's data? Does this pattern suggest that the snail population of Appledore Island evolved in response to the arrival of the crabs? Explain.

4. Develop a specific hypothesis for the nature of the interaction between the snails and crabs that might have caused the snail population to evolve.

5. Design an experiment that would test to see if your hypothesis is correct. Describe the results you'll get if your hypothesis is correct, and the results you'll get if your hypothesis is incorrect.

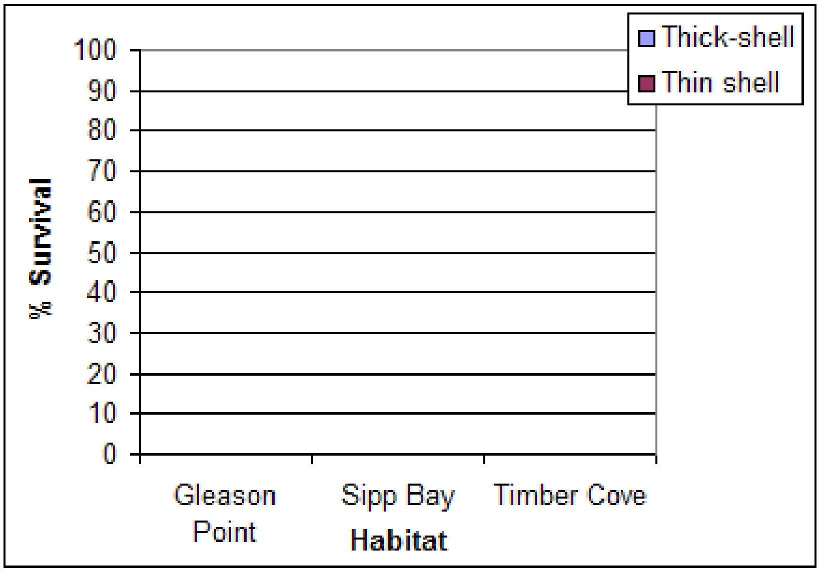
Seeley herself performed two experiments. In the lab, she offered each of 8 crabs a thin-shelled snail. All 8 crabs quickly crushed and ate their snails. It took them an average of 42 seconds. Seeley offered each of another 8 crabs a thick-shelled snail. Only one of these was able to crush and eat its snail within 8 minutes. During that time many of the other crabs gave up trying.

In the field, Seeley drilled small holes in the shells of a number of snails and used fishing line to tether the snails to seaweeds in the intertidal zone. She returned every few days to see which snails survived. This method allowed Seeley to distinguish between snails that were killed by crabs (part of their shell remain tied to their tethers, and those that broke free of their tethers or died in their shells. She tethered the snails in pairs, with each pair including one thin-shelled snail and one thick shelled snail. She tethered 15 pairs at Timber Cove where crabs appear absent, 15 pairs at Sipp Bay where crabs are present but rare; and 15 pairs at Gleason Point where crabs are common. She checked on the snail after 6, 9 and 16 days. Her data are presented in Table 2.

Table 2: Survival of thin & thick-shelled snails after 15 days tethered in habitats with no (Timber Cove), few (Sipp Bay) and many (Gleason Point) green crabs

	Gleason Point	Sipp Bay	Timber Cove
% thick-shell surviving	65	80	100
% thin-shell surviving	25	40	100

6. Prepare a histogram of these data below.



7. What is the pattern in the data from Seeley's field experiment? What does this pattern suggest about whether and why crabs cause snail population to evolve?

8. Are there any alternate hypotheses to explain Seeley's data?

9. Do you think museums should continue to collect snail shells? Why or why not?

References:
This exercise is adapted from one obtained at a conference entitled, "Bio-Forum: Teaching in the New Millenium," that I attended at the University of Minnesota, St. Paul in April 2001.