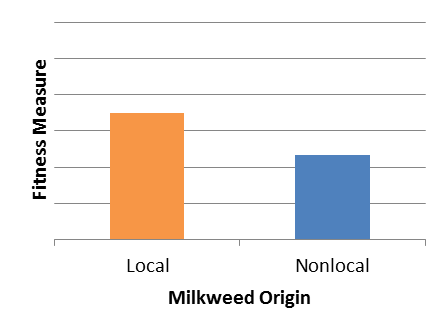
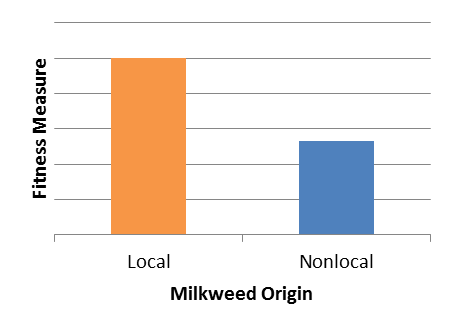
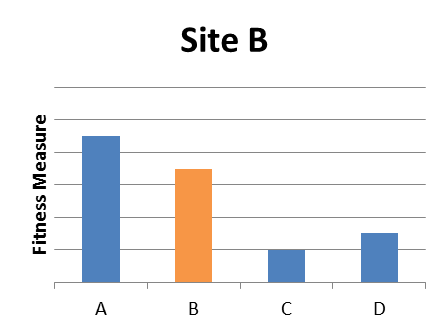
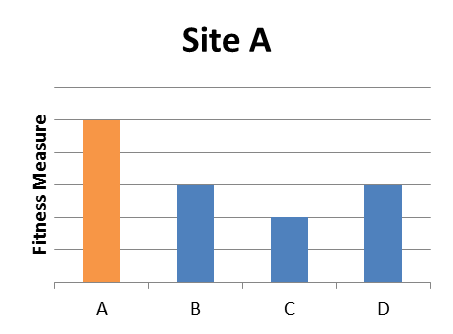
**Hypothetical Data**



A

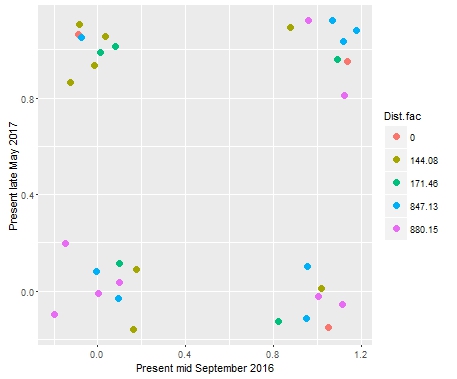
B

**Figure 1**. Hypothetical Data Supporting Alternative Hypotheses about Milkweed Adaptation. **A.** The top panel shows the average performance of four ecotypes planted at Site A. The bottom panel compares the average fitness of the local population with the average fitness of all nonlocal individuals. **B.** At Site B, Ecotype A still outperforms other varieties on average, despite being nonlocal. Again, the bottom panel compares the average fitness of the local population, in this case Ecotype B, with the average fitness of all nonlocal individuals.

Discussion Questions

1. Which of the graphs show patterns consistent with local adaptation? Explain.
2. Is the evidence for local adaptation stronger at site A or site B, or the same? Explain.
3. What is the value of the top graphs with 4 bars compared to the bottom graphs with just 2 bars?
4. Can you tell how many plants were measured from each site or how much variation there was between plants at each site? How could you change the figure or the caption to clarify this?
5. Based on these figures, can you explain how analyzing data from more than one site is important for developing a more complete understanding about the patterns of local adaptation?

**Pilot Study Data**

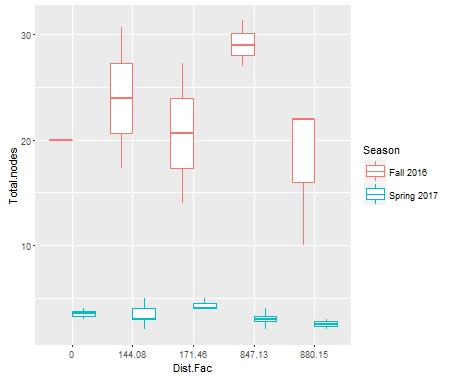
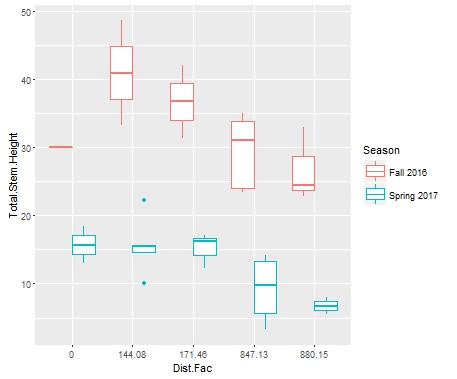


**Figure 2**. Presence of plants at seasonal census. Plants from 5 different sources were germinated in the spring and planted in a common garden site at St. Olaf College in June 2016. Colors represent the different source populations, and the legend shows their distance from St. Olaf in miles. Plants were measured that fall, in September 2016, and again in the following spring, May 2017. Plants that were present at a given time are plotted near 1, plants that were not found at a given time are plotted near 0.

Discussion Questions

1. Can you tell from the plot how many plants total were used in this experiment?
2. Where on the plot are the plants that were never present? What might we infer about these plants?
3. Where on the plot are the plants that were present for both fall and spring measurements? What might we infer about these plants?
4. How can we explain what we observed with the other two groups of plants on the plot?
5. Do you see any patterns in the presence of the 5 different populations at different times? Can we make any inferences about local adaptation from this figure?
6. What do these data suggest about how useful “survivorship” or “presence” is as a measure of fitness? Of phenology (or the time a plant reaches different developmental stages)?

**Pilot Study Data**



A

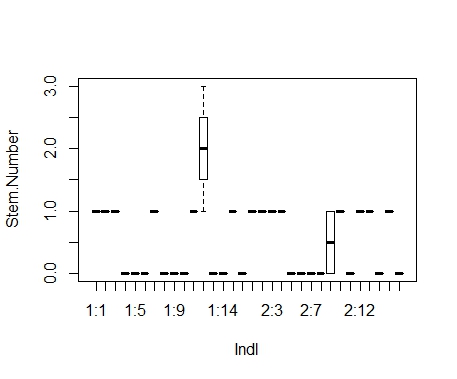
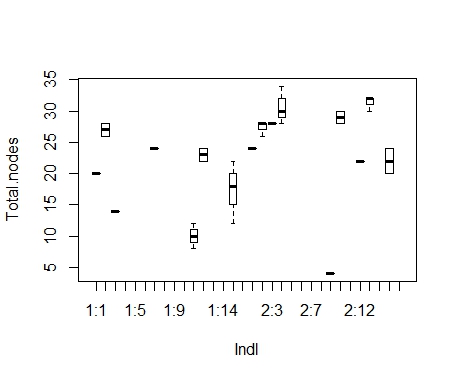
B

**Figure 3**. The effect of distance of origin on plant growth. A total of 32 plants from 5 different sources were germinated in the spring and planted in a common garden at St. Olaf College in June 2016. The x-axis shows the distance of the plant origin from St. Olaf in miles. Growth measures are plotted for plants that were present, using boxplots, for two different times in the life cycle: fall 2016 and spring 2017. Boxplots show the distribution of the data points in a group: the line in the middle represents the median of the data, the bottom and top of the box show the 25th and 75th percent of the data, and the “whiskers” represent the range of the data. Outliers are indicated with dots above or below the whiskers. A) The sum of the heights of all stems of a plant was higher in the fall than in the spring. Although there appears to be a negative relationship between distance and height, it is not statistically significant. B) The total number of nodes, or buds where leaves grow, on all the stems of a plant, was also higher in the fall than in the spring.

Questions:

1. Why do you think the red boxes are all higher than the blue boxes?
2. Why is the distance of origin from St. Olaf plotted on the X axis? What kind of relationship would you predict between fitness and distance if plants are locally adapted?
3. The figure caption describes the relationship between distance and stem height for Figure 3A, but there seems to be a sentence missing from the caption for Figure 3B. How would you describe the relationship between distance and total number of nodes?
4. Given the figures, what do you think about total stem height and total nodes as measures of fitness? Why might we expect similar or different patterns for these different measures? How do you think leaf number or number of seed pods might compare to the data shown here?
5. Do you think these data provide evidence of local adaptation on common milkweed? How convincing are the data?

**Pilot Study Data**



A

B

Figure 4. Variability among measurements by students in fall 2016. Plants from 5 different sources were germinated in the spring and planted in a common garden at St. Olaf College in June 2016. Each of the plants is represented on the X axis, and growth measures are plotted, using boxplots, to represent the measurements from up to 3 different groups of college students on the same plant. Boxplots show the distribution of the data points in a group: the line in the middle represents the median of the data, the bottom and top of the box show the 25th and 75th percent of the data, and the “whiskers” represent the range of the data. Outliers are indicated with dots above or below the whiskers. A) Most plants had either 0 or 1 stem, but there was some variation among these measurements for individual plants. B) Plants that grew produced highly variable numbers of nodes, or buds from which leaves grow, ranging from 4-34. There were highly variable node counts for some individual plants.

Questions:

1. Can you tell from these figures how many total plants were used in the experiment?
2. Why do there seem to be fewer individuals plotted in Figure B than in Figure A?
3. What percent of plants had at least one stem in the fall of 2016? What do you suppose happened to the other plants?
4. Circle the two individuals with variable measurements in Figure A, and circle the plant with the single most variable measure in figure B.
5. Why do we ask multiple students to take the same measurements on the same plant? What would be different if we only had one measure for each plant?
6. Do you think the data for stem number or total nodes are more reliable? Why?
7. What could be causing this amount of variability in measures of the same plants across groups?
8. What can we do to make sure our data are more reliable?