Global Warming

In this activity, you will examine the effects of global warming on the physiology, distribution, and phenoloy of different organisms. Then you will look at how climate change may influence species interactions. For each characteristic, you will make predictions and evaluate data about the ecological consequences of global warming.

**Physiology**

Some species of reptiles have temperature-dependent sex determination (TSD). In these species whether male or female offspring are produced is determined by the temperature experienced during development rather than genetic differences between the sexes. An increase in temperature would be expected to affect the sex ratio of species with TSD. Examine the figure and answer the questions below:

1. Are more male offspring produced at warmer or cooler temperatures?

   ![Graph showing annual cohort sex ratio (% male) as a function of mean July temperature.](image)

   **Fig. 1.** Annual cohort sex ratio (% male) of hatchling painted turtles (*Chrysemys picta*) from 1988 to 1993 as a function of the mean ambient temperature in July. No data are presented for 1993 because all nests were destroyed by flooding.

2. If global temperatures are increasing will the percentage of males produced increase or decrease?

3. How warm would the mean July temperature need to be for only females to be produced?

4. Climate change models predict that mean July temperatures will increase by 4°C during the next century. If this temperature change occurs, what consequences might these changes have for this painted turtle population?

5. If you examined changes in mean July temperature at this study site only between the years of 1988-1992 would these data support the claim that global temperatures are increasing? Defend your answer in 2-3 sentences.
**Distribution**

Edith’s checkerspot butterflies occur in discrete populations throughout their range and have been the subject of long-term population research studies. Therefore, you can examine how population distribution has changed over time with respect to latitude and altitude. Examine the figure and answer the questions below:

![Population Extinction Rates vs Latitude](image)

1. What is the relationship between Edith’s checkerspot butterfly population extinction rates and latitude?

2. What is the relationship between Edith’s checkerspot butterfly population extinction rates and altitude?

![Population Extinction Rates vs Elevation](image)

3. How are Edith’s checkerspot butterfly population distributions changing with respect to both latitude and altitude over time?

4. Why might some species be more likely to show change in population distributions than other types of species? What types of species are likely to be strongly influenced by global warming in terms of species distributions? Defend your answer in 3-4 sentences.
Phenology
Global warming may also affect the phenology of organisms. One important aspect of organism phenology is when to begin breeding. Examine the figures and answer the questions below:

1. Describe the relationship between winter weather and the timing of breeding in amphibians and birds.

2. Are some measures of breeding time more convincing than others? If so, are these measures more or less closely matched with changes in NAO?
1. Describe how first flowering dates (FFD) have changed during the past decade with respect to the mean FFD during 1954-1990.

2. An additional finding of this study is that plant species pollinated by insects have an earlier FFD than plants that are wind pollinated. Do you think that species pollinated by insects might be more likely to show changes in FFD than those pollinated by wind? Defend your answer in 2-3 sentences.
Species Interactions

Great European Tits are dependent on high abundance of caterpillar larvae during the breeding season because caterpillars are the primary source of food for their nestling offspring. Examine the figures and answer the questions below:

1. What is the relationship between temperature and peak caterpillar abundance?

2. How does bird laying date change over time?

3. How does caterpillar peak abundance date change over time?

4. Draw a picture that depicts the relationship between bird laying date and peak caterpillar abundance date over time.

5. Describe how the relationship between bird laying date and peak caterpillar abundance date probably influences nestling survival rates. Defend your answer in 2-3 sentences.