

# Scoring Guidance: Monarch Butterflies on the Shortgrass Prairie

Scientists study the eastern monarch butterfly population. They measure the population size every winter when the butterflies form colonies. The colonies are made when butterflies become densely packed together in one area of the forest. Because there are so many butterflies in one area, it is difficult to count them. To estimate butterfly population size, scientists measure the area of land taken up by the colony that assumes a certain number of butterflies per area of land.



1. In 2009, the butterfly colony took up 5 acres of land. In 2011 the colony took up 10 acres of land. What inference can you make about the butterfly population in 2011, based on the area of land that they took up?

Students are expected to estimate that there would be an increase in butterfly population size based on the increase in land size. This is an indication of proportional thinking based on a rate of butterflies to area of land.

- + The butterfly population increased because the amount of land they took up increased.
- + The butterfly population more than doubled because the amount of land they took up more than doubled.

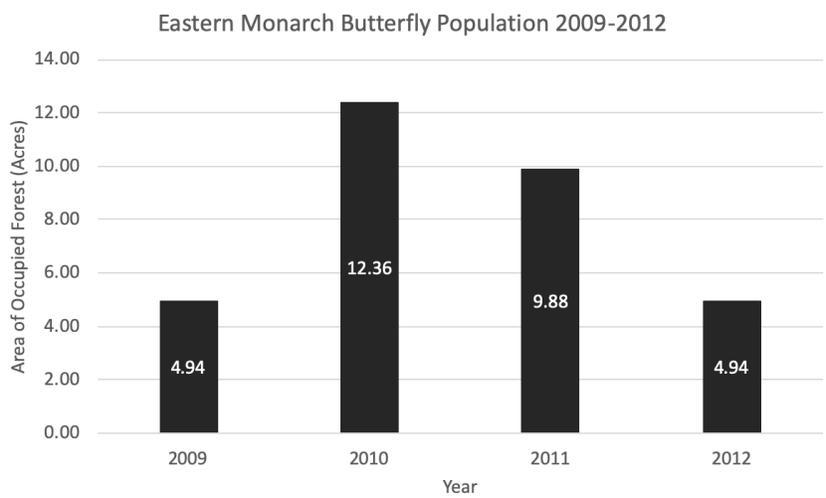
2. Milkweed is important to the survival of the butterflies. In 2009 there were only 500 milkweed plants per acre because rainfall was much lower than normal. In 2010 there were 1500 milkweed plants per acre and normal rainfall. Explain why a change to milkweed density impacted the butterfly population in 2009.



At the end of 6th grade, students are expected to be able to understand the idea of relating two quantities (i.e., milkweed and land area) using a ratio. This item prompts students to use what they understand about a lower ratio of milkweed:land area to explain a scientific problem.

- + Less rainfall meant fewer milkweed plants because plants need water to grow.
- + Fewer milkweed plants meant that there were fewer resources for the butterflies—less food and fewer places to lay their eggs.
- + In 2009 the density of milkweed was lower so there were fewer resources available to butterflies per land area.
- + Therefore, in 2009 more butterflies died than were born, and the population was lower that year than in 2010.

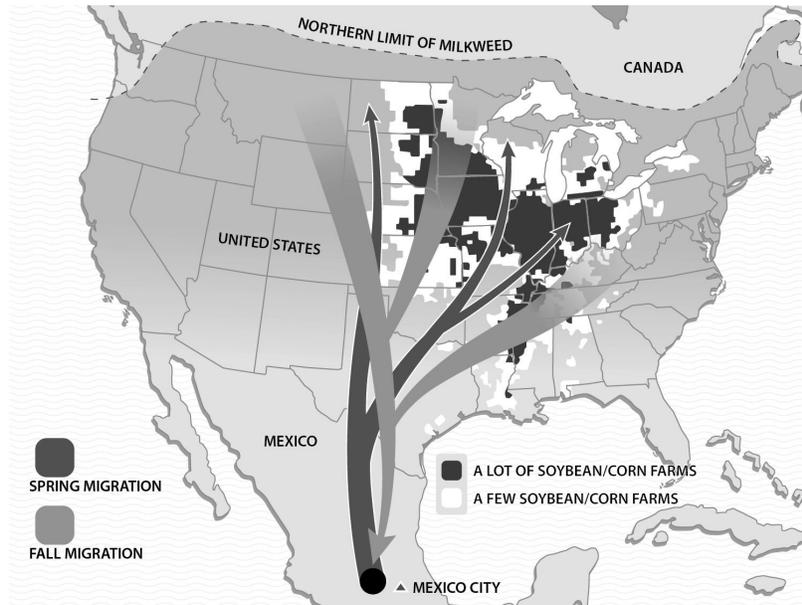
The graph below is the data collected between 2009 and 2012 for the monarch butterfly.



3. Assume that this is a stable population. Use the data to explain why the butterfly population goes up and down from year to year even when the population is stable.

Students are expected to interpret annual population sizes in terms of birth and death rates of butterflies due to normal environmental conditions.

- + It's normal for a population to fluctuate (or go up and down).
- + Some years more are born than die, and in other years, more die than are born.
- + Use data to support their response: For example, in 2010 more butterflies were born than died.
- + Provide a reason why this might happen, such as (1) more food was available so that they could reproduce, (2) less food was available, so they didn't have the energy to reproduce, (3) there wasn't enough food to survive, or (4) the climate was too cold or too hot that year, and more died than usual.



This map shows the eastern monarch butterfly migration route. The black shaded area shows where the prairies in the Midwestern United States used to be but is now mostly soybean and corn farms.

In the 1990s, farmers of corn and soybean changed their farming practices. Before 1990, there was space between plants for milkweed to grow. Now, farmers can grow corn and soybean from fence to fence leaving no space for milkweed.

Before 1990 (space for milkweed at edges of farm)

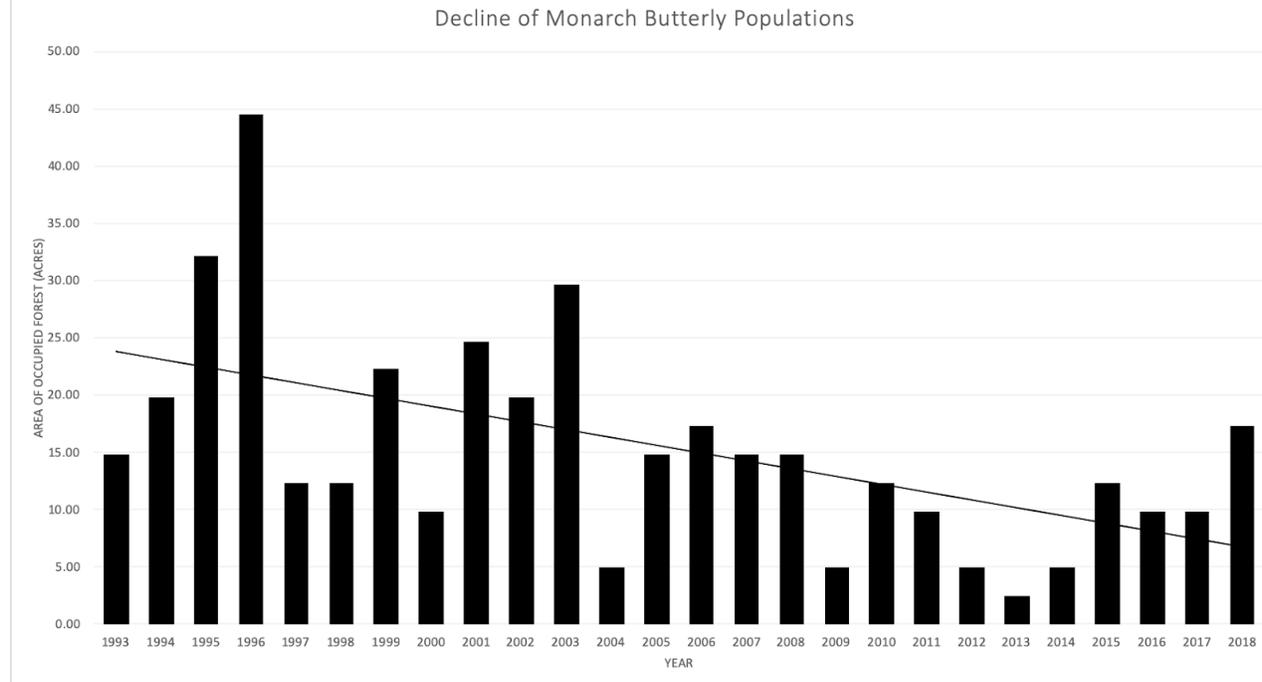
After 1990 (crop planted fence to fence)



4. Scientists estimate that there is only 1-2% of milkweed left in this area now compared to what was there before we started farming. Write an explanation to explain the change in the amount of milkweed per area of land, and how this impacts the monarch butterfly population.

- + Since the 1990s soybean and corn farming, there is less space for milkweed to grow between the crops.
- + Without the milkweed butterflies do not have access to resources—food, protection, and milkweed for laying eggs.
- + There's less milkweed, so there is more competition between butterflies.
- + When there is more competition, fewer butterflies are able to meet their needs and survive.

5. The graph below shows the eastern monarch butterfly population from 1993 to 2018.



a. Draw a line on the graph to show what you would expect to see in a stable population from 1993 to 2018.

This item prompts students to represent the concept of “stable population” on a histogram.

- + Straight horizontal line across, somewhere between 10-25 acres.
- + Oscillating line (up and down) that stays between a 10-25 acres range, indicating a normal fluctuation.

b. Using the data from the graph above, explain why the butterfly population is unstable.

Students are expected to explain that the overall downward trend indicates that butterflies are declining, which is not a stable population. Students may link this back to resource and habitat availability. Students may also cite key values from the graph to support their explanation.

- + Over time, the butterfly population is going down, and it's lower in 2018 than in 1993.
- + Even though the population goes up and down from year to year, the population numbers are still going down overall, and you can see this in the line on the graph.
- + We know that the butterflies are experiencing a loss of habitat/resources, which can explain why the numbers are not going back up.