THE BEE FREQUENCY:
How Does Lawn Mowing Affect Bee Populations?

Photo by Jessica Nickelsen.

MEET THE SCIENTISTS!

Photo courtesy of Susannah Lerman, used with permission.

◀ SUSANNAH LERMAN, Research Ecologist

My favorite experience is discovering exciting birds and insects in our backyards and neighborhood parks. I spend a lot of time exploring local habitats and talking with neighbors about the wildlife that visit their communities. I love listening to the public talk about their experiences with local nature—everyone has a story to share. I also enjoy talking with the public about ways they can enhance the habitat in their yards and parks and make these spaces better for wildlife.

Photo courtesy of Alexandra Contosta, used with permission.

ALEXANDRA CONTOSTA,
Soil Biogeochemist

One of my favorite science experiences happened during my first field ecology job. I was working for the USDA Forest Service in the White Mountains of New Hampshire and Maine. The job involved looking at visual signs of tree health to be able to compare them to the amount of nutrients in the soil. Trees are like people in this way. If they don't get the right nutrition, they can get sick. We were working in remote parts of the national forest, traveling every day to plots that were way off the main trails. I learned a lot about how to find my way in the woods using a Global Positioning System (GPS) and a compass. I also saw parts of the forest that most people don't get to visit.

One day we were in a section that had a lot of beech trees. They have smooth, gray bark that has always reminded me of an elephant's skin, which made it easy to spot scratch marks up and down the trunk. I looked up, saw clumps of sticks in the branches, and realized I was looking at black bear nests! I had heard that bears like to build these nests in the fall while they feast on beechnuts but had never seen them, either before or since. This experience has always stuck with me as a reminder to keep my eyes open for the unexpected. Scientific discovery often happens when I see something I did not mean to look for, like finding bear nests when I was supposed to look at tree health.

did you know?

Black bear nests are not like bird's nests. The black bear "nests" are created when the bears are feeding and there are leftover materials. Unlike birds, the bears don't use the nest as a home.

Photo courtesy of Joan Milam, used with permission.

JOAN MILAM,
Research Melittologist

My favorite experiences are catching uncommon bees throughout North America with fellow bee scientists (**melittologists**) and identifying them in my lab. I especially enjoy catching bees that collect pollen from just one plant species, meaning the bee is an **oligolege,** and collecting cuckoo bees. Cuckoo bees are **parasitic** bees that lay their eggs in the nests of bees that worked hard to collect pollen to feed their young! Learning about bees means that you also must know about plants (botany) and where plants grow. I also like catching bees on flowers that grow in a tree canopy of maple and cherry trees; that means putting traps up in trees as high as 70 feet! I enjoy giving public talks and workshops about pollinators to get people excited about the many amazing pollinators that live around us, including in city parks and backyards.

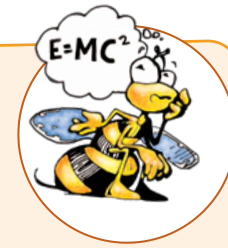
WHAT KIND OF SCIENTISTS DID THIS RESEARCH?

Research Ecologist: This scientist studies the relationship between living things and their living and nonliving environment.

Soil Biogeochemist: This scientist studies the interactions between the biotic (living) and abiotic (nonliving) components of soils.

Melittologist: This scientist studies bees.

Thinking About Science



Scientists use many different tools and technologies to complete research. They are increasingly using high-tech, computer-based instruments that require special knowledge or skills. However, not all scientific endeavors require high-tech equipment. Many sciences still use the same technologies that scientists used many years ago. For instance, scientists studying chemistry may still use beakers. Scientists have used beakers in chemistry since the 1800s, and modern beakers are similar to the ones used then.

Scientists may also use their creativity to find simple items at the grocery store that they can use for experiments. In this study, the scientists evaluated how mowing lawns affects bees. The easiest way to capture and learn about bees is to use inexpensive, disposable plastic bowls painted with bright, fluorescent colors that make the bowls resemble flowers. Soapy water inside the bowls prevented the bees from flying away before the scientists could identify and count them.

The scientific process requires a great deal of creativity. As you read this study, think about a question you want to investigate using the scientific process. What tools or technologies could you use to test your question?

Thinking About the Environment

Green, grassy lawns cover a large portion of the United States (figure 6). The scientists in this study found that grass lawns cover more than 400 million acres in the United States. That's an area approximately equivalent to the State of Alaska, the largest State in the United States. You may see lawns at homes, at schools, near businesses, in parks, and at golf courses.

Figure 6. Lawns are areas covered mostly in grass. Many lawns are small but, together, they cover a large part of the United States.
Photo courtesy of Michelle Andrews.

Lawns can be easy to maintain, attractive, and provide a good place to play or picnic. Chemical-free lawns can also be good for the environment. For instance, lawns can slow stormwater runoff, store carbon, and lower temperatures caused by the **urban heat island effect**. These benefits are especially important in urban and suburban areas with limited green space.

While lawns do have benefits, the scientists knew that most lawns are not an ideal habitat for many plants and animals. Keeping lawns looking good often requires chemical treatments that can pollute waterways and can also kill some pollinators. Lawns also require frequent mowing to maintain a tidy look. In fact, there are even some places in the United States where the law requires mowing! While mowing makes a lawn look neat, scientists know that frequent mowing can make it difficult for native plants and animals to survive (figures 7a, 7b, and 7c).

Figure 7a. Frequent mowing can lead to a lawn with fewer plant species. While it provides a tidy look that many people enjoy, a mowed lawn is not the ideal habitat for wildlife.

Photo courtesy of Jessica Nickelsen.

Figure 7b. What differences do you notice between the freshly mowed lawn (left) and the unmown portions (right) of the lawn?

Photo courtesy of Jessica Nickelsen.

Figure 7c. In this figure, again look closely to see the freshly mowed lawn (left) and the unmown lawn (right). What differences do you notice in this photo between the mowed lawn and the unmown portion? How does this photo compare to the photo in figure 7b?

Photo courtesy of Babs McDonald.

Introduction

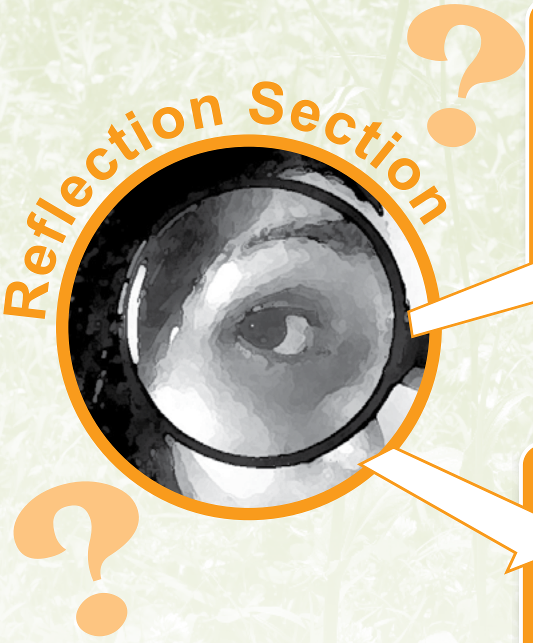
Lawns are a common sight in the United States. As discussed in "Thinking About the Environment," lawns can have both good and bad effects on the environment and on pollinators. Because humans find lawns so desirable, removing lawns altogether is not likely to happen.

The scientists found previous research showing that lawns mowed frequently or treated with chemicals had limited flowering plants for pollinators. Without frequent mowing and treatment with chemicals, however, lawns are home to numerous native, flowering plants (figures 8a and 8b). Pollinators are in decline across much of the United States. Therefore, the scientists determined that lawns with flowering plants could play an important role in providing habitat and food to pollinators. This determination is especially important in suburban and urban areas where there isn't a lot of natural pollinator habitat.

The scientists **hypothesized** that mowing less and providing fewer chemical treatments to lawns could increase the diversity of flowering plants. In turn, more flowering plants would improve the **abundance** of bees on lawns.

Figure 8a. Lawns do not always provide a good habitat for pollinators, but lawns that are allowed to grow do have many flowering plants that wildlife can use.
Photo courtesy of Susannah Lerman, USDA Forest Service.

Figure 8b. Notice the pollinator enjoying the flowering plants in this lawn.
Photo courtesy of Babs McDonald.



Review the scientists' hypothesis. In your own words and in the form of a question, what are the scientists studying in this research?

How did the scientists use the research of other scientists to inform their study?

Methods

The scientists conducted their research in the city of Springfield, Massachusetts (figure 9). They chose 16 homes in the city that had similar lawns of approximately the same size. The lawns had no or limited flower gardens and were separated by at least 500 meters.

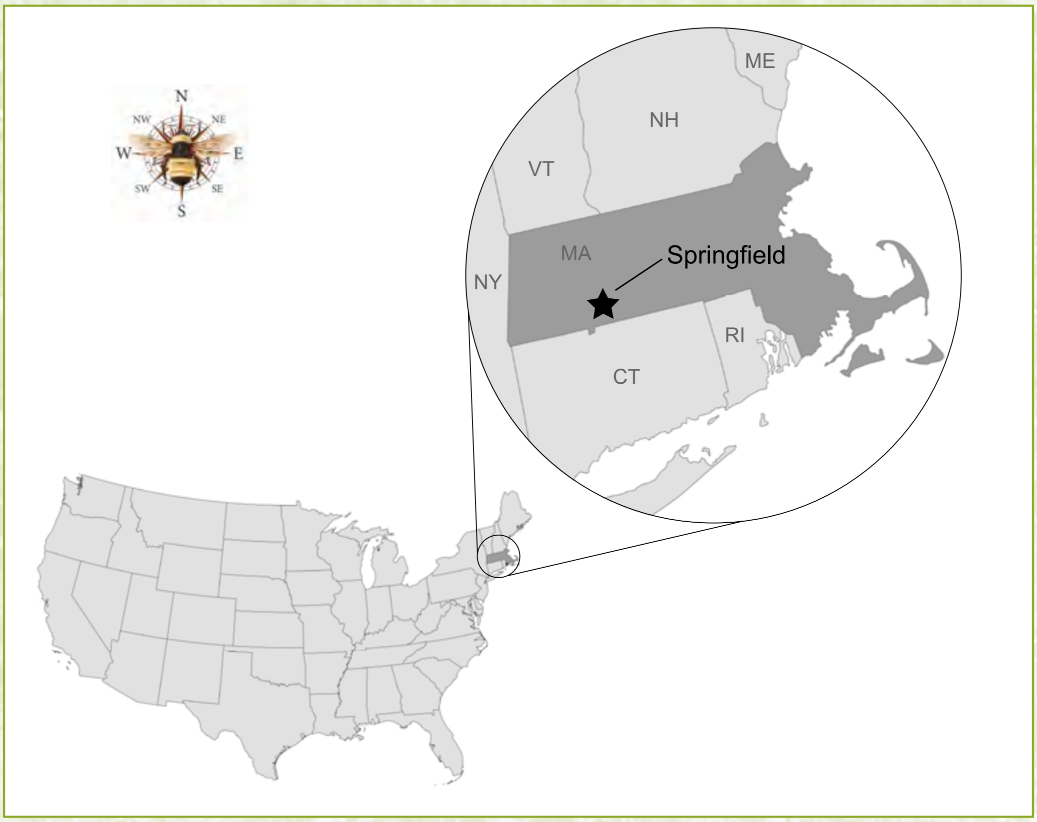


Figure 9. Springfield is a small city in the northeastern United States. It is the third largest city in the State of Massachusetts.
Map by Carey Burda.

Number Crunch

Lawns in the study were at least 500 meters apart. There are approximately 3.2 feet in each meter. How many feet are in 500 meters?

The scientific team used a Toro 19-inch push mower (figure 10) to mow lawns from May through September during 2013 and 2014. They used the same mowing techniques and equipment for each lawn and left all grass clippings on the lawn after mowing.

To determine the impact mowing had on the 16 lawns, the scientists chose 1 of 3 mowing **regimes**:

- Mowed every 7 days (every week)
- Mowed every 12 to 14 days (every 2 weeks)
- Mowed every 18 to 21 days (every 3 weeks)

The scientists also sampled flowering plants and bees at each lawn 5 times per year, for a total of 10 times per lawn.

All sampling took place before mowing. They identified and counted flowering plants, then added them up to calculate each lawns' total **floral** abundance.

To sample bees, the scientists strategically placed 30 plastic pan traps filled with soapy water across each lawn to catch the greatest number of bees (figure 11). They left the pan traps on each lawn for 24 hours. Because pan traps often collected mostly small bees, the scientists also swept each yard with hand nets for 15 minutes to catch larger bees. They followed a standard process (figure 12) while sweeping with the hand net. The scientists brought the collected bees to a lab to wash, pin, identify, and label them, and then entered the information into a database (figure 13).

Figure 10. The scientists mowed each lawn with a basic lawn mower. Photo courtesy of Susannah Lerman, USDA Forest Service.

Figure 11. Scientists left pan traps, like these colored bowls, on the lawns to collect bees for identification.

Photo courtesy of Michelle Andrews.

Figure 12. A hand net (also called an aerial net) is lightweight; has a long, thin handle; sometimes a flexible hoop; and a soft bag. These nets are ideal for collecting delicate specimens, including many pollinators like bees, moths, or butterflies. Scientists typically use this type of net to “scoop” insects from the air or off a plant, but they can also “pancake” the nets flat against the ground to catch insects on or near the ground.

Photo courtesy of Michelle Andrews.

(A)

Figure 13. The scientists identified and pinned all the bees they collected. Identifying and pinning the bees enabled the scientists to visualize the different bee species that might be impacted by changing how people mow lawns.

Photo courtesy of Michelle Andrews.

Reflection Section

Why do you think the scientists sampled the lawns multiple times over 2 years?

Explain in your own words why the scientists used multiple techniques to sample bees from the lawns. Can you think of another way to identify and count bees? If so, how would you do it?

Findings

After 2 years of lawn mowing and 10 sampling events per lawn, the scientists collected a total of 4,587 bees. They identified a total of 93 bee species on the lawns and an additional 8 species as part of another study, for a total of 101 species. This represents about 25 percent of bee species recorded in Massachusetts. Of those 93 species identified in the lawn mowing study, 10 species accounted for 78 percent of all 4,587 bees identified. The sweat bee (figure 14) was the most common type of bee found, accounting for 42 percent of all bees collected. During the same 2-year period, the scientists identified 54 different flowering plants and found another 11 unidentifiable plants.

Number Crunch

Sweat bees accounted for 42 percent of all 4,587 bees collected. How many bees from the total were sweat bees?

Figure 14. Sweat bees are a diverse group of bees. Some species are blue or green in color, like this green metallic sweat bee. As the name suggests, these bees are attracted to human sweat, which they eat for salt. Luckily, they are not aggressive toward humans unless they feel threatened.

Photo courtesy of Wayne Boo, U.S. Geological Survey Bee Monitoring and Inventory Lab, Flickr.

The lawns with the greatest diversity of bee species were those that scientists mowed weekly (table 1). However, these lawns also had many single captures. Single captures are bee species from which scientists only captured one bee over the course of the entire study, rather than bees that scientists caught frequently and in high numbers. The lawns that had the greatest number of bees were those that scientists mowed once every 12 to 14 days (every 2 weeks). The scientists found that lawns mowed every 18 to 21 days (every 3 weeks) had significantly higher grass and 2½ times more flowers.

Lastly, the scientists found that yard characteristics, such as lawn size or tree **canopy** cover, did not impact the abundance of bees or flowering plants.

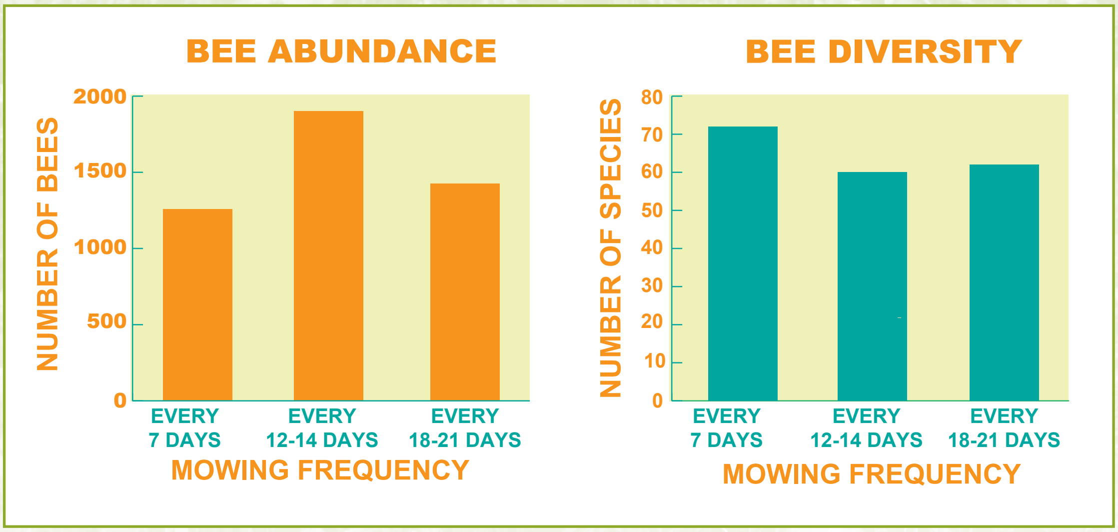


Table 1. Those lawns mowed once every 7 days had a high diversity of bee species, but fewer total bees. Lawns mowed in the other regimes had a lower diversity of bee species, but more total bees.

Reflection Section

The scientists found that lawns mowed every 18 to 21 days had the most flowering plants. Does this result surprise you? Why or why not?

Review table 1.
Based on these results, which mowing regime would you choose if you were managing a lawn for bees? Why?

Discussion

The scientists believe the results of the study partially supported their hypothesis. Although lawns do not have the same habitat quality as a native habitat, people can manage lawns to provide more resources for bees. The scientists suggest a "lazy lawnmower" approach of mowing less frequently, with every 2 weeks as the sweet spot. Less frequent lawn mowing results in the growth of more flowering plants and increases the abundance of bees. Although the study results indicated a lower diversity of bee species when mowing less, the scientists believe a lower diversity of species would not impact the role of bees in the ecosystem.

These findings are important, as lawns are common across the United States. Those who have lawns in urban, suburban, and even rural areas can actively add flowers to gardens to attract bees. Even those without specially designed gardens can support bees by managing lawns to encourage **spontaneous** flower growth.

The scientists recognized that these results are limited because they include only one city from one region of the United States. Additionally, there may be barriers to acceptance of the "lazy lawnmower" approach. For one, many people simply prefer a tidy lawn that is easy to care for. The scientists also recognize that certain laws in some parts of the country prevent lawns with taller plants. However, the scientists believe the "lazy lawnmower" approach to lawn management is an easy and inexpensive method for improving urban and suburban areas for bees.

Reflection Section

In your own words, explain the "lazy lawnmower" approach to lawn management.

Why do the scientists support the "lazy lawnmower" approach for lawn management?

The scientists note some possible issues with the "lazy lawnmower" approach. In your own words, what are those issues? Are there other issues? If so, what do you believe would be an issue?

At the beginning of this article, we posed two questions:

1. What is a question you want to investigate using the scientific process?
2. What tools or technologies could you use to test your question?

Take a moment to think through your answers to these two questions. Share your answers with a classmate or with your whole class. Create a class list of questions that the class would like to investigate.

Adapted from Lerman, S., et al. 2018. To Mow or to Mow Less: Lawn mowing frequency affects bee abundance and diversity suburban yards. Biological Conservation. 221:160-174. https://www.fs.fed.us/nrs/pubs/jrnl/2018/nrs_2018_Lerman_001.pdf.

THE BEE FREQUENCY
GLOSSARY

abundance (ə **bən** dən(t)s): A degree of plentifulness.

anther (**an(t)** thər): On the male flower, the part of the flower that contains pollen.

canopy (**ka** nə pē): (1) Anything that covers like a roof; (2) On a tree, the area of leaves that cover the ground.

cross-pollinate (**krȯs pä** lə nāt): To pollinate (a flower or plant) with pollen from another flower or plant.

fertilization (**fər** tə lə **zā** shən): The joining of an egg cell and a sperm cell (pollen in a plant) to form the first stage of an embryo (a seed in a plant).

floral (**flȯr** əl): Of, relating to, or depicting flowers.

hypothesize (hī **pä** thə **sīz**): (1) To propose an explanation in light of known facts; (2) To make an assumption to test its logical consequences.

nectar (**nek** tər): In botany, a liquid made by the flowers of plants.

oligolege (ə **lē** gə lāj): Pollinator species which requires the pollen of a particular plant for development and survival.

parasitic (per ə **si** tik): Relating to or having the habit of a parasite.

pollen (**pä** lən): Particles containing genetic material for reproduction of plants.

pollinator (**pä** lə nā tər): An agent (such as an insect) that pollinates flowers.

regime (rā **zhēm**): A regular pattern of occurrence or action.

stigma (**stig** mə): On the female flower, the sticky knob which collects pollen from pollinators.

urban heat island effect (**ər** bən **hēt ī** lənd ē **fekt**): An urban area that is significantly warmer than its surrounding rural areas due to human activities.

Accented syllables are in **bold**. Marks and definitions are from https://www.merriam-webster.com. Definitions are limited to the word's meaning in the article.