
Photo by Susan Ellis, http://Bugwood.org.

# What Happens to Arthropods Following a Wildland Fire?

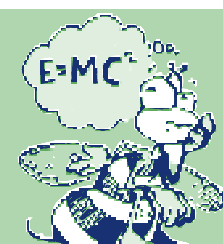
## Meet the Scientists

Dr. Jim Hanula, Entomologist (ˌ**en**-tə-ˈ**mä**-lə-jist): My favorite experience as a scientist was discovering a new species. I was working on Japanese beetles at the time and kept finding larvae infected with a fungus. Other people had seen the fungus in the past but didn't realize it was a new species. When my co-worker and I looked at it closely (really closely) with an electron microscope we found out it was a new genus and a new species of fungus. I had the chance to name them and describe both.

Dr. Joe O'Brien, Ecologist: When I was a graduate student, I studied the rain forest in Costa Rica. I was studying how climate influenced tree growth. Sometimes, I had to take measurements of leaves in the forest **canopy.** Using a **crossbow,** I would send a rope into the top of a tree. Then, with my instruments, I would climb 150 feet up the rope to the tree canopy. At the forest floor, only 3 percent of sunlight comes through. It is dark and gloomy there. I would slowly inch my way up into the bright, sunny, breezy canopy. I could see all kinds of wildlife up close. I saw toucans, parrots, monkeys, and butterflies. When I was finished, it was fun to **rappel** back down.

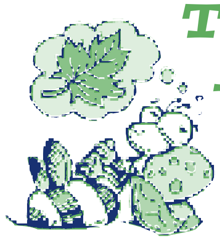
Dr. Susan Loeb, Research Ecologist: My favorite science experience is observing animals in their natural environment, whether they are small mammals, bats, or chimpanzees.

## Thinking About Science



Before they do a study, scientists sometimes state a hypothesis. A hypothesis is a statement of an observation, usually about the relationship of one thing to another. A hypothesis can provide the basis for a scientific study, in which the observation is examined to determine if it is true or false.

Scientists usually state their hypothesis as what is called a null hypothesis. A null hypothesis states that there is no relationship between two or more **variables** being studied. After they do their study, scientists determine whether the null hypothesis is true or false. If it is false, it means a relationship appears to exist between two or more variables. Think of a time that you observed something about the relationship of two things. For example, if the sky is dark and cloudy, you might think it will rain. What would be the null hypothesis in this case?



# Thinking About the Environment

Have you ever turned over an old log in the woods? If you have, you know that many small creatures live in and around these logs. Many of these creatures are arthropods (ˈ**är**-thrə-ˌpädz). Over 80 percent of all known animal **species** are arthropods, a group that includes insects, spiders, scorpions, ticks, mites, centipedes, and millipedes. In the ocean, arthropods include crabs, shrimps, and lobsters. Scientists have identified over 1,170,000 species of arthropods. Many more will probably be discovered over time.

Arthropods provide many **ecosystem services** to people. These services include pollination, food, **decomposition,** insect control, and beauty. Can you imagine what would happen if insects didn't help decompose dead animals and plants? It would be gross! Some arthropods bite or sting if they think people or other animals are trying to hurt them or their nests. For example, bees and scorpions can sting, and sometimes people get sick from some arthropod bites like mosquitoes or tick bites if they are carrying a disease.

The scientists in this study investigated one kind of arthropod. This type of arthropod lives among **leaf litter** on the forest floor. The scientists wanted to discover what happens to arthropods living among leaf litter after a forest fire moves through the area.

# Introduction

Longleaf pine (*Pinus palustris*) (**pī**-nis pə-**lus**-trəs) once could be found from southeastern Virginia to eastern Texas **(figures 1 and 2).** This was an area covering 90 million acres or almost 82 million football fields.

**Figures 1a and 1b.** How do you think longleaf pine got its name? Photo by Rebekah D. Wallace, courtesy of http://Bugwood.org (1a) and David Stephens, courtesy of http://Bugwood.org (1b)

## Number Crunches

About how many acres of longleaf pine forest exist today? To find out, multiply 90,000,000 acres by 0.05.

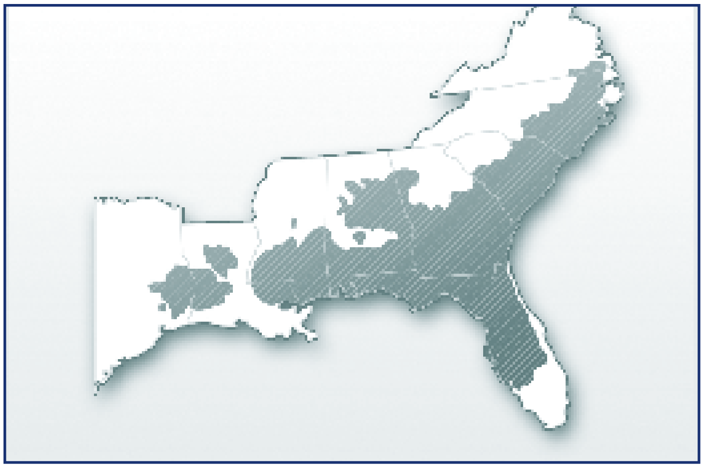


**Figure 2a.** Longleaf pine forests once covered much of the Southeast. Map courtesy of Southern Regional Extension Forestry.

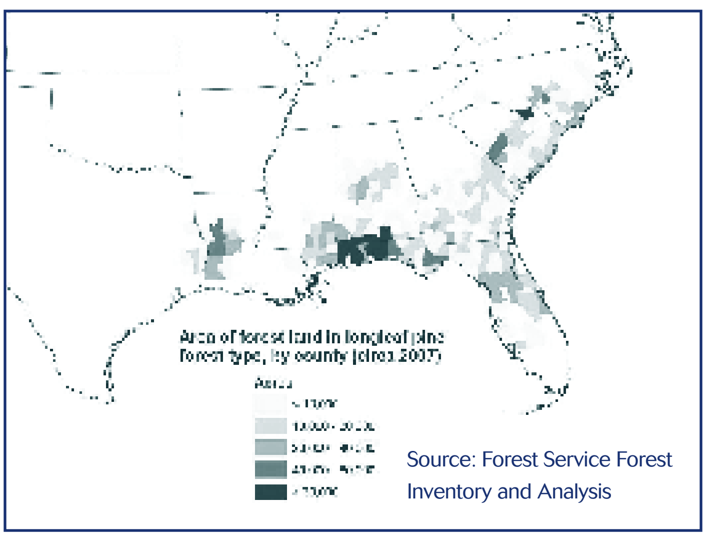



**Figure 2b.** The current range of the longleaf pine forests in the Southeast. Compare this with figure 2a.

Longleaf pines are not usually killed by fire. Because these pines need open spaces to survive, fire is a good thing for longleaf pines. Purposely set and controlled fires keep other plants and trees small, leaving more space for longleaf pines to grow. Even when longleaf pines are young, they can survive fires **(figure 3).** When old longleaf trees die and fall, the logs are also able to survive forest fires.

Over many years, much of the longleaf pine forests were cut for lumber. Since longleaf pine was hard to grow in nurseries for replanting and it grows slower than some other pines, longleaf pine was often replaced with those other pines. Also, because wildfires caused so much damage, forest managers tried to stop all fires because they wanted to protect the new forests. Land where longleaf pine grew was also used for other things like farming. These actions reduced the area where longleaf pine forests can still be found to about 5 percent of the area in figure 2a **(see figure 2b)**.

**Figure 3.** A young longleaf pine in what is called its grass stage. Longleaf pines can remain in this stage for the first 5 to 12 years of their life. Photo by Rebekah D. Wallace, courtesy of http://Bugwood.org.

Now, however, many people are concerned about longleaf pine forests. In many areas, these forests are being managed to help them survive and grow. Fire is a necessary part of this process. Forest managers, therefore, set planned fires every few years in longleaf pine forests **(figures 4a and 4b)**. These fires are tightly controlled so that they do not escape from the longleaf pine forest.

One reason for these controlled fires is to remove the leaf litter on the forest floor so that uncontrolled fires or wildfires will be less likely to happen. Remember, however, that the old logs do not readily burn. The scientists in this study were interested in what happens to arthropods after a fire. They developed a hypothesis about the importance of old logs lying on the forest floor to leaf-litter-dwelling arthropods. The scientists thought that after a fire, arthropods living among leaf litter would move to the areas around old logs because they didn't have other places to hide. They stated their hypothesis as a null hypothesis.

**Figure 4a.** A forest manager igniting a controlled fire. Permits are required for controlled burning. To prevent fire hazards, authorized personnel should be involved with the process.

**Figure 4b.** A forest manager on a boom lift recording fire intensity. Forest managers record fire intensity using different devices.

## Reflection Section

- State the null hypothesis used by the scientists. (See "Thinking About Science" for a hint.)
- Is fire a good thing for longleaf pine forests? How do you know?

## Methods

The scientists studied an area in the Osceola (ä-sē-ˈō-lə) National Forest in Florida **(figure 5)**. The scientists divided the area into 24 separate areas **(figures 6a and 6b)**. Each of these areas was 0.8 hectare in size.

In each of the 24 areas, the scientists placed a longleaf pine log in the center. Each log was three meters long. They placed four pitfall traps around each log. Pitfall traps are cups placed into the ground. An arthropod walking nearby may fall into the trap. The scientists placed a pitfall trap near each end of the log on both sides **(figure 7)**.

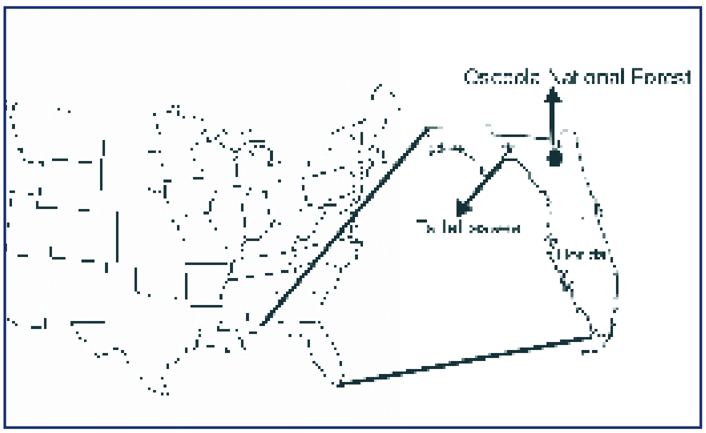


**Figure 5.** The Osceola National Forest is in northern Florida.

| | |
|---|---|
| Six areas were burned every year | Six areas were burned every other year |
| Six areas were burned every 4th year | Six areas were not burned at all |

**Figure 6a.** The scientists divided the larger area into 24 smaller areas.

**Figure 6b.** This area was burned every other year.

**Figure 7.** Logs were placed in the center of each area.

### Number Crunches

How many acres large was each of the 24 areas? To find out, multiply 0.8 by 2.47.

Then, the scientists located an area 10 meters away from each log. They placed a solid aluminum fence, three meters long and about 20 cm high (to arthropods that is high) in this area **(figure 8)**. They placed four pitfall traps around each fence, in the same positions as traps were placed around the log. The scientists used the fence because they were concerned that they might catch more arthropods around the logs simply because the logs acted like a fence. The fence would help direct any nearby arthropods into the traps. By using a fence the same length as the logs they could find out if the arthropods liked the logs because they were better places to hide or find food.

**Figure 8.** Drift fences, which are fences placed to direct animals into pitfall traps, were placed 10 meters away from the log.

The scientists used the pitfall traps for 6 months every year. They collected any arthropods caught in the traps. They identified the arthropod species and counted each one. They collected arthropods in the pitfall traps from 1994 to 2000.

The scientists compared the number of leaf-litter-dwelling arthropods captured near the log and near the drift fence for each of the four types of areas **(see figure 6a)**.

## Reflection Section

- Why did the scientists include areas that were not burned at all?
- Why did the scientists want to collect arthropods near the log and away from the log?

## Findings

The scientists caught more leaf-litter-dwelling arthropods in traps near the drift fences than they did in traps near the logs. When they compared the sites that had been burned at different frequencies **(see figure 6a)**, they found no difference in the number of arthropods captured. The scientists found no evidence to support the idea that leaf-litter-dwelling arthropods move close to logs after fire burns through an area.

## Reflection Section

- Do you think the scientists accepted or rejected their null hypothesis? Why or why not?
- Do you think this study proves that leaf-litter-dwelling arthropods do not use logs as **habitat** after a fire? Why or why not?

## Discussion

The scientists were surprised at their findings. They considered other reasons that fewer arthropods than expected were trapped near logs. One reason may be that drift fences, since they are hard to crawl over, are better at directing arthropods into the traps. Arthropods near logs, in contrast, may dig under or climb over logs, thus finding other routes away from the traps. Another explanation may be that fire, regardless of how often it comes to a longleaf pine forest, does not cause leaf-litter-dwelling arthropods to seek logs as habitat.

## Reflection Section

- Is it important to understand what happens to arthropods following a fire? Why or why not?
- What are some advantages of being surprised at your findings?

# Glossary

**Canopy** (ˈ**ka**-nə-pē): Anything that covers like a roof. On a tree, the area of leaves that cover the ground.

**Crossbow** (ˈ**krȯs** ˌbō): A tool used for shooting stones that consists of a short bow mounted on the end of a wooden stock.

**Decomposition** ((ˌ)**dē**-ˌkäm-pə-ˈ**zi**-shən): The act or process of breaking up, as by decaying or rotting.

**Ecosystem services** (**ē**-kō-**sis**-təm ˈsər-vəs): Any of the various benefits provided by plants, animals, and the communities they form.

**Habitat** (ˈ**ha**-bə-ˌtat): Environment where a plant or animal naturally grows and lives.

**Leaf litter** (ˈ**lēf** ˈ**li**-tər): The decaying leaf material on the surface of the forest floor.

**Rappel** (rə-ˈ**pel**): To descend by sliding down a rope, usually outfitted with a special device to create friction.

**Species** (ˈ**spē**-(ˌ)shēz): Groups of organisms that resemble one another in appearance, behavior, chemical processes, and genetic structure.

**Variable** (ˈ**ver**-ē-ə-bəl): Thing that can vary in number or amount.

Accented syllables are in **bold.** Marks taken from Merriam-Webster Pronunciation Guide.

This article was adapted from Hanula, J.L.; Wade, D.D.; O'Brien, J.; and Loeb, S.C. 2009. Ground-dwelling arthropod association with coarse woody debris following long-term dormant season prescribed burning in the longleaf pine Flatwoods of north Florida. *Florida Entomologist*. 92(2): 229–242. http://www.srs.fs.usda.gov/pubs/ja/jahanula017.pdf.

## FACTivity

The question you will answer in this FACTivity is: What are the key characteristics of arthropods? You will create your own aPod based on the characteristics of arthropods and describe the creature's life history.

### Time:

One class period

### Materials:

Pieces of white construction paper for each student and markers or crayons

Your teacher will provide the following background to the students (or students may read it on their own): Arthropods are invertebrate (without a backbone) animals of the phylum Arthropoda. All arthropods have the following characteristics:

1. Invertebrate
2. A hard outer body covering called an exoskeleton
3. Specialized mouth parts
4. Jointed legs
5. Compound Eyes
6. Segmented body

Arthropods include insects, crustaceans (lobsters, crabs, shrimp, crayfish), millipedes, centipedes, horseshoe crabs, arachnids (spiders, ticks, and mites) and sea spiders. Together, arthropods comprise the largest and most varied group of invertebrate on Earth.

The bodies of arthropods are divided into different segments, each having a specialized role. The segments have numerous paired, jointed appendages (legs, antennae, claws, and external mouth parts) that serve many varied functions. The exoskeleton acts as a protective covering to the underlying segmented body. It also provides an attachment for muscles and a barrier to water loss for animals living on land. It is made mostly of chitin (ˈ**kī**-tən), a rigid, complex carbohydrate, and is usually covered by a hardened, waxy cuticle. The cuticle acts as a hinge between segments, allowing the body to bend and move to the right or left. Periodically, the rigid exoskeleton is shed in a process called molting. The temporarily soft animal then swells in size, and its new, larger exoskeleton hardens.

**Figure 10.** Check out the segmented body on the Walking Cicada. Photo by Whitney Cranshaw, Colorado State University, courtesy of http://Bugwood.org

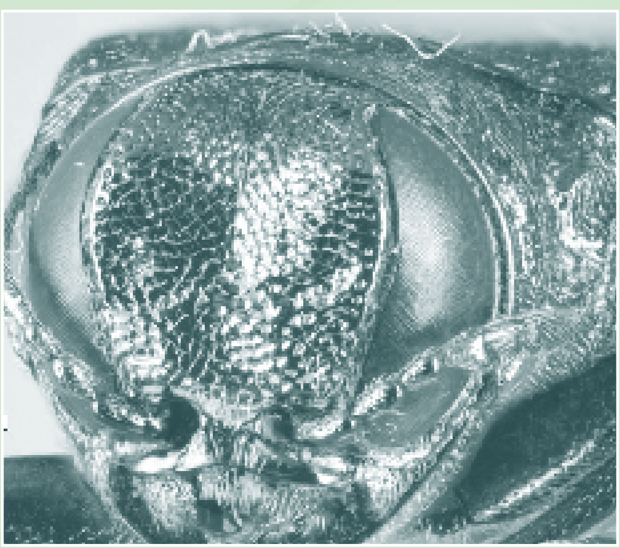


**Figure 9.** Emerald Ash Borer's compound eyes. Photo by Ken Walker, Museum Victoria Pest and Diseases Image Library, Australia, courtesy of http://Bugwood.org

**Figure 11.** Check out the jointed legs on this Leaffooted Pine Seed Bug. Photo by Larry R. Barber, Forest Service, courtesy of http://Bugwood.org

**Figure 12.** Check out this bizarre Walkingstick. Photo by Herbert A. "Joe" Pase III, Texas Forest Service, courtesy of http://Bugwood.org

Arthropods are divided into chelicerates (kə-**lis**-ə-rāts), meaning "claw-horned ones," and mandibulates (ˈ**man**-də-bəl-ləts), meaning "jawed ones." The bodies of chelicerates are divided into two parts: a fused head and thorax, and an abdomen. They have no antennae, and most have four pairs of jointed legs. They are named for their first pair of appendages, which are modified as clawlike fangs used for feeding. The chelicerates include the arachnids, the marine horseshoe crabs, and the sea spiders.

The mandibulates have one or two pairs of appendages that function as antennae on their head, with the next pair modified as jaws for feeding. Included in this group are the crustaceans (crabs, lobsters, crayfish), the millipedes and centipedes, and the insects.

Arthropods are so diverse and come in so many different shapes and sizes and specialized features! You now get to create your own aPod by thinking about the characteristics that all arthropods share and making your own creature.

**Figure 13.** Check out the Chaco golden knee tarantula's specialized fangs! Photo by David Cappaert, Michigan State University, courtesy of http://Bugwood.org

- Use a piece of paper and markers or crayons.
- Review and reflect on the characteristics that all arthropods have in common.
- Design your own aPod.

Once the aPod is finished, write at least two paragraphs about your aPod's life history. Where does the aPod live? What does it eat? How does it move about (fly, crawl, jump, etc.) Be creative and have fun!

## National Science Standards

**Science as Inquiry:**
Abilities Necessary To Do Scientific Inquiry;
Understanding About Scientific Inquiry

**Life Science:**
Structure and Function in Living Systems;
Regulation and Behavior;
Populations and Ecosystems;
Diversity and Adaptations of Organisms

**Science in Personal and Social Perspectives:**
Populations, Resources, and Environments;
Natural Hazards;
Risk and Benefits

**History and Nature of Science:**
Science as a Human Endeavor;
Nature of Science

## Additional Web Resources

National Science and Technology Center: Soil Arthropods
http://www.blm.gov/nstc/soil/arthropods/index.html

**Teachers:**
**If you are a Project Learning Tree-trained educator, you may use Activity #80, "Nothing Succeeds Like Succession" or #24, "Nature's Recyclers," as additional resources.**