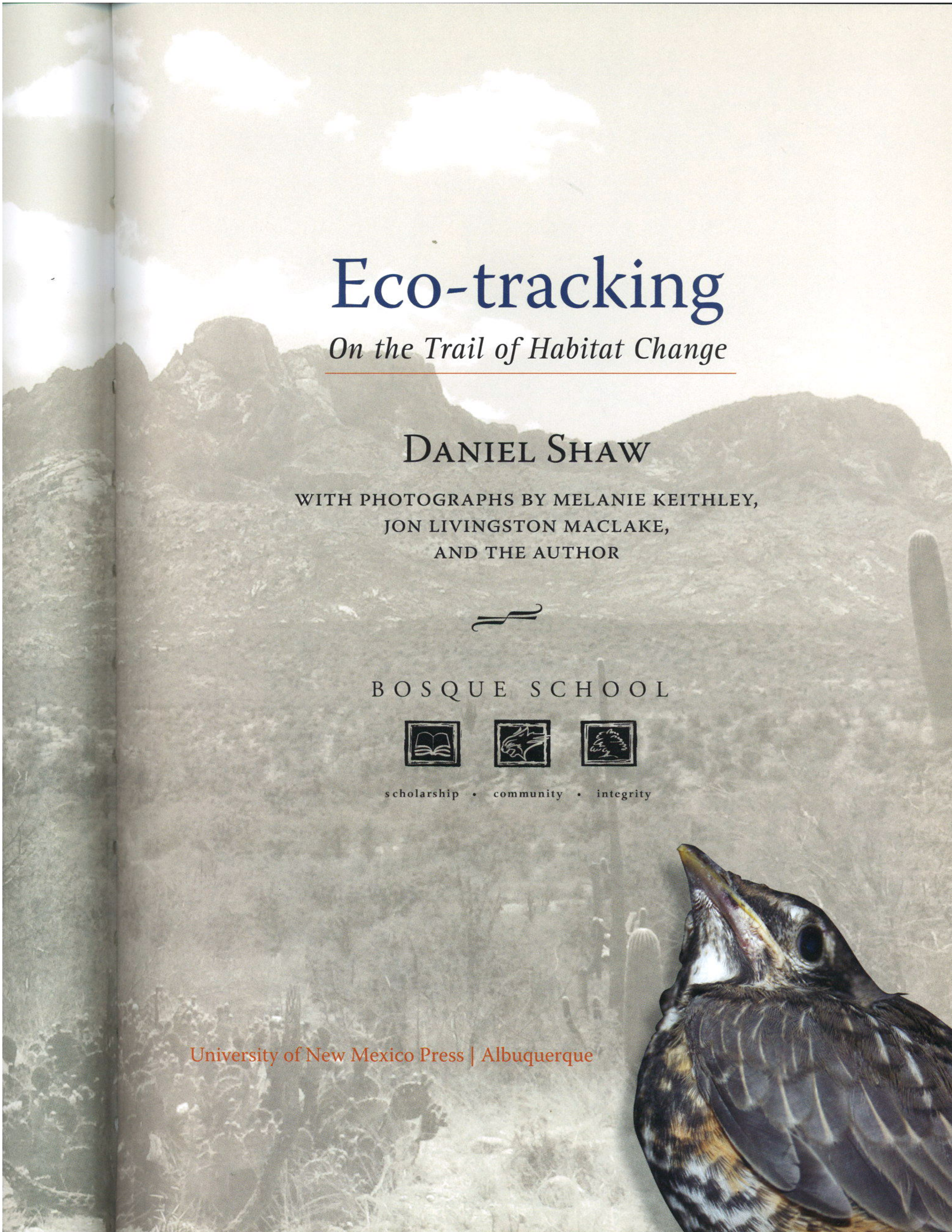

Eco-tracking

On the Trail of Habitat Change

DANIEL SHAW

WITH PHOTOGRAPHS BY MELANIE KEITHLEY,
JON LIVINGSTON MACLAKE,
AND THE AUTHOR

BOSQUE SCHOOL

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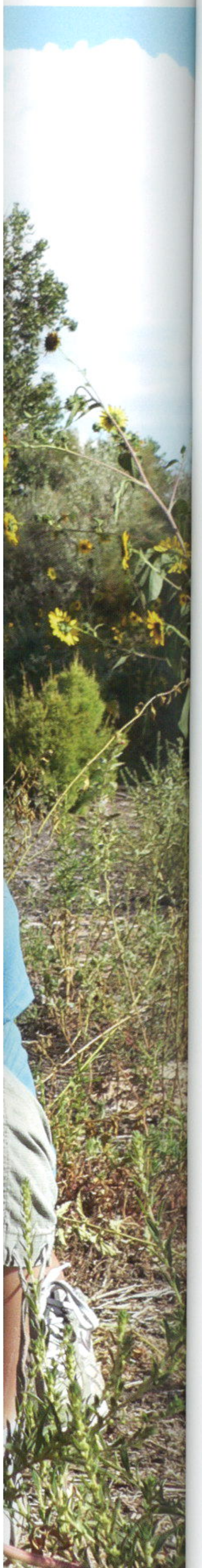


CHAPTER 5

Biological Diversity

In case something jumped out of the hole, Kiyomi carefully lifted the lid away from herself. Nothing jumped. Still, the cup buried in the ground contained a mass of crawling critters. Not one of them had a backbone. There were beetles as shiny green as a new car. A centipede swirled in an S shape; although it may not have had a full complement of 100 legs, it at least had dozens of them. There were insects so tiny that to truly see what they looked like would require a magnifying glass. All of these animals, and so many more, had fallen into the cup Kiyomi had buried in the ground two days before. The top rim of the cup was level with the ground; as insects and other creatures walked along the forest floor, they fell into Kiyomi's cup. Once she sorted and counted these little animals, Kiyomi would have a better idea about the different types of life found in her neighborhood forest. Her results would also become part of a larger study about the biological diversity, or different types of life, found in her forest.

Life comes in all different shapes and sizes. It ranges from tiny microbes smaller than the period at the end of this sentence to giant whales three times the size of a school bus. The number and types of living things found in one place is called **biodiversity**. Biodiversity is studied on many different levels. On the huge scale, it can include the whole planet. A biodiversity study can look at a part of the earth like a continent, region, or state. In Kiyomi's case, the biodiversity study covers a small area, the forest near her school.

Kiyomi's study focused on the biodiversity of only one group of animals. She just looked at the insects, spiders, and other tiny creatures with jointed legs and no backbones. These are known as **arthropods**. Arthropods are a great way to study biological diversity. First off, they tend to have very specific needs. For example, some beetles feed only on the leaves of one type of tree. Others need certain levels of soil moisture. Arthropods do all sorts of jobs in an ecosystem. An animal's or plant's job is its **niche** and how it fits into the whole community. Each arthropod has its own niche. By filling that niche, it helps the whole ecosystem stay healthy. Greater ecosystem diversity provides and maintains greater strength and health.

The contents of a pitfall trap must be handled carefully and the animals returned safely to the area where they were gathered as soon as possible after they have been identified.

To discover the arthropod biodiversity, Kiyomi did an **inventory**. In an inventory, you count the number and types of something. In this case, it was an arthropod inventory. Doing an inventory was simple, but it gave her excellent information. Kiyomi took 20 drinking cups and placed them, one at a time, into the ground. The cups made tiny pits along the surface of the ground. They became **pitfall traps**. As arthropods walked around as they always do, some fell into her cups. Kiyomi identified and counted the animals that fell into the cups. By looking closely at her pitfall traps, Kiyomi compared areas. She discovered what areas had greater biological diversity. By looking at the contents of all the cups, she looked at the biodiversity across her whole forest.

Biological diversity can also describe the differences within species. For example, within human populations differences exist among people. Some people are faster runners. Others are better at learning a foreign language. Conditions like diet and disease impact differences between every plant and animal. Biological diversity also impacts those differences. Each person, rosebush, or bit of moss, for that matter—every living thing has its own **genetic** makeup. Genetic makeup determines the possibility of what each life-form can become. A house cat's genetic makeup limits it to being a house cat. It can't grow to become a fish. Based on its diet and environment, it might grow to be four to six pounds (two or three kilograms) lighter or heavier. Its genetic makeup prevents it from growing to the shape and size of a cow. Tiny but very long strings of chemicals create the **genes** inside each life-form. The chemicals making up genes are called **DNA** (deoxyribonucleic acid). If you straightened out a string of DNA in one of your cells, it would stretch three feet (one meter) long. Inside that long string of DNA is your genetic makeup.

Within plant and animal populations, there are genetic differences. These differences help the species survive. For example, some individuals in a raccoon population are better suited for hot weather and others for cold. If the climate changes and gets hotter, the raccoon population can survive. The raccoons better suited for hot weather will thrive, while cold-weather raccoons either move to a colder area or die. In this manner, through genetic biodiversity, the species survives. There are always individual members that do not. Every species has individuals die before they are able to breed or give birth. The ones that die are sometimes just unlucky. Most of the time, those that die aren't as fit for their environment at that time and place as those that survive. An animal's fitness to survive starts with its genetic makeup.

Counting different species and numbers of animals, like these Canada geese, is part of doing an area census.

The world constantly changes. Climate, fires, floods, and other ecological drivers are forces of change. Survival often depends on the ability to respond to changing conditions. Biological diversity is a key to a species' survival. When ecosystems change, some individuals die and some live. Those that live have the right physical abilities to survive the change. The genetic makeup and behaviors that help survival are adaptations. Biodiversity is ecological strength. It permits a population, an individual species, or even an ecosystem to live into the future.

Since biodiversity comes in so many different shapes and sizes, many different types of inventories can describe the biodiversity of a place. This includes doing a **census** of all of the different types of living organisms in a place, calculating how many of each type of organism there are in that place, and how much **biomass**, or total weight, of each species makes up the weight of that place.

One deer can weigh 150 pounds (70 kilograms). It would take 5 million ladybird beetles to have that same biomass. As we look into a forest, we are more likely to notice one big deer than millions of beetles and other **invertebrates** (animals without backbones) although a forest is more about invertebrates than deer. Invertebrates make up over 90 percent of forest animal biomass. They also account for most of the earth's animal biodiversity. A forest will have thousands of different invertebrate species but only one species of deer. This is why Kiyomi's study of the arthropods in her forest is so important. It's a census of that place's biodiversity.

When it comes to understanding earth's biodiversity, scientists only know a little. Less than one-tenth of the plants and animals on this planet have even been given names by scientists. By far, more is known about **vertebrate** (animals with backbones) than invertebrate species. Very little is known about the lives, habitat needs, and niches for many of the named

Although a forest has more beetles than deer, many people are more likely to notice even a camouflaged deer than a million beetles in the same area.

The biomass of five million lady bird beetles can equal one deer, yet a forest has far more biomass of beetles than it does deer.

invertebrate species. As an eco-tracker, you can still discover plenty about wildlife and habitat.

How humans benefit from biodiversity is a major study topic. The life-forms we share with the planet often keep us alive. As plants live, they make available the oxygen we need to breathe. Plants and animals are also the sources of our food supply and most medicines. For a long time, many people in the Pacific Northwest area of the United States thought of the yew tree as a giant weed. Recently, scientists found a chemical in the yew tree that can be used as a cancer-fighting drug. We don't know what plant or animal might lead us to another lifesaving drug. To destroy biodiversity is to destroy undiscovered knowledge. For very selfish reasons like these, it's a good idea to protect biodiversity.

To study biological diversity in your area, you can start with some simple steps.

First, maintain the species lists described in chapter 2. These will help you to record and track local biodiversity. An area's biodiversity changes over time as habitat changes. Your notes and lists will record that change. Take an inventory of small sections in your local environment. A smaller section used to represent a larger portion is called a **sample**. You want your samples to represent the whole area. **Representative samples** are smaller, average pieces of something larger. For example, instead of watching and recording all the seagulls at the beach, you watch only five of them. The five birds are a representative sample of all those birds. Sample size can vary, but a larger sample size makes it a more representative sample. If you watched only one seagull, it might be an odd bird. It could be sick. It may act in some other way that isn't a good example of the whole. By looking at five birds, you reduce the chance of observing odd birds.

A representative sample should be chosen without prejudice or bias. To do this, scientists use what is called a **random sample**. In the random seagull sample, any seagull was just as likely to be studied as any other. A random sample prevents you from looking at only what is close and easy to see and study.

In Kiyomi's case, she measured out 100-foot (30-meter) straight lines. Every 33 feet (10 meters), she buried a cup. This prevented her from burying cups only where it was easy to dig into soft soil. It made her collection cup placement more random. In this way, the sample was more likely to be representative and less likely to be biased. How and where she placed the cups followed an established protocol. One advantage of participation in a citizen science program is the ability to use already established protocols. When you follow the established protocols, your gathered information is easily compared with the data someone else gathered. This is true because both of you collected the information in the same way.

Kiyomi is a partner in the **Bosque Ecosystem Monitoring Program (BEMP)**. Working with BEMP, Kiyomi sends the results from her 20 traps to the University of New Mexico. Her data are added to data collected at 460 other pitfall traps that are spread out across 24 BEMP sites. All site data are collected in the same manner so scientists can compare all of the samples. It allows them to describe biodiversity across 175 miles (280 kilometers) of their state.

At her BEMP site, Kiyomi measures biological diversity in other ways too. One way she does this is with large rubber tubs. Each one is about as big around as your arms held in a circle. She places 10 tubs in her BEMP site and leaves them in place all year long. Once a month, she gathers up all of the leaves and twigs that fall into her tubs. Kiyomi then identifies, sorts, and weighs those plant parts. It lets her know what plants are in the forest. She finds which plants create and shed the most biomass. Looking at the same site over time is called **monitoring**. By monitoring biodiversity over time, Kiyomi can see changes brought about by climate and other ecological drivers.

The Bosque Ecosystem Monitoring Program involves students in gathering information about ecological conditions along the Rio Grande and its riverside forest, the bosque.

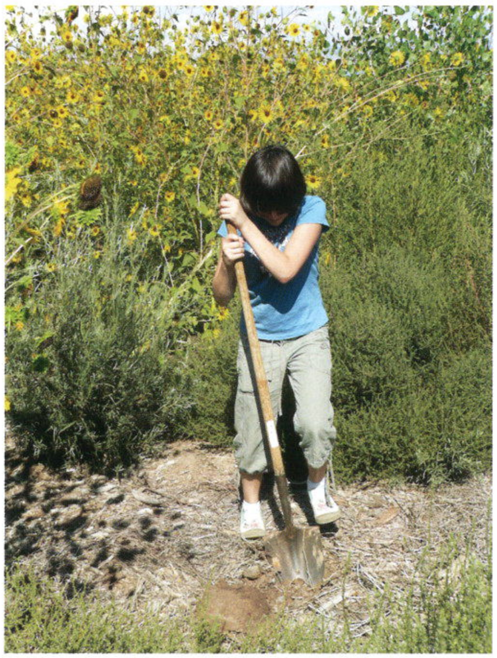
An advantage of a program like BEMP is that it is a long-term ecological monitoring program, meaning it looks at one place using the same study protocols each year. Therefore, changes over time can be detected. BEMP is just one of many monitoring programs young people can join. BEMP is part of a national **Long Term Ecological Research (LTER)** network. BEMP works with the University of New Mexico's Sevilleta LTER, which is one of many LTER stations across the country. Some are in remote areas, but many are not. In fact, one is in downtown Baltimore, Maryland. The LTER sites form a representative sample of different types of ecosystems. Each LTER site has a responsibility to teach young people about the environment. LTER sites are often great places to find scientists looking at ecosystem topics that include biological diversity, climate change, and other ecological conditions in your area. The LTER website has a special section, http://schoolyard.lternet.edu/, for young people.

A litterfall tub is just an oversized dog bowl left in one spot to catch the leaves and other plant materials that fall in a specific place in a forest.

Kiyomi won't monitor her BEMP site forever. She and her fellow students study their site for a school year, and at the end of the year, they pass their BEMP site to a new group of students. The new arrivals will follow the same protocols. Data will be collected and studied. All students, across the years, help explain their area's biological diversity and ecological changes.

Setting Pitfall Traps

Placing pitfall traps to monitor arthropods that are active on the surface like Kiyomi did is quite simple. The most important part of using pitfall traps is safety. It's more important to stay safe and to properly care for the arthropods than to collect data. Arthropod pitfall traps are just plastic drinking cups set into the ground. To place a trap, you dig a hole a little larger than the cup. Place the cup in the hole. Use one hand to cover the top of the cup and the other to scoop dirt around the sides of the cup. When you're finished, the rim of the cup should be level or just a tiny bit below ground level. A piece of wood or cardboard with a wood screw or nail in each corner can serve as a roof. Leave a few inches (centimeters) of room between the lid and the cup so small arthropods can walk under the roof. Then leave the trap alone for a day.



A pitfall trap will easily fit into the hole created by removing one shovel-full of soil.

When you return to check a trap, always lift the lid away from yourself. That way if something jumps out, it won't hit you in the face. For temporary storage and study of the arthropods that fell into the trap, you can put them into a zipper-style plastic bag. Just lift the cup by the rim out of the ground. Pour the contents into the bag, seal the bag, and quickly study and record what you found. As soon as you can, return the arthropods back to the area where they were caught. When you're done, collect the cup and trap lid, and fill in the hole with dirt.