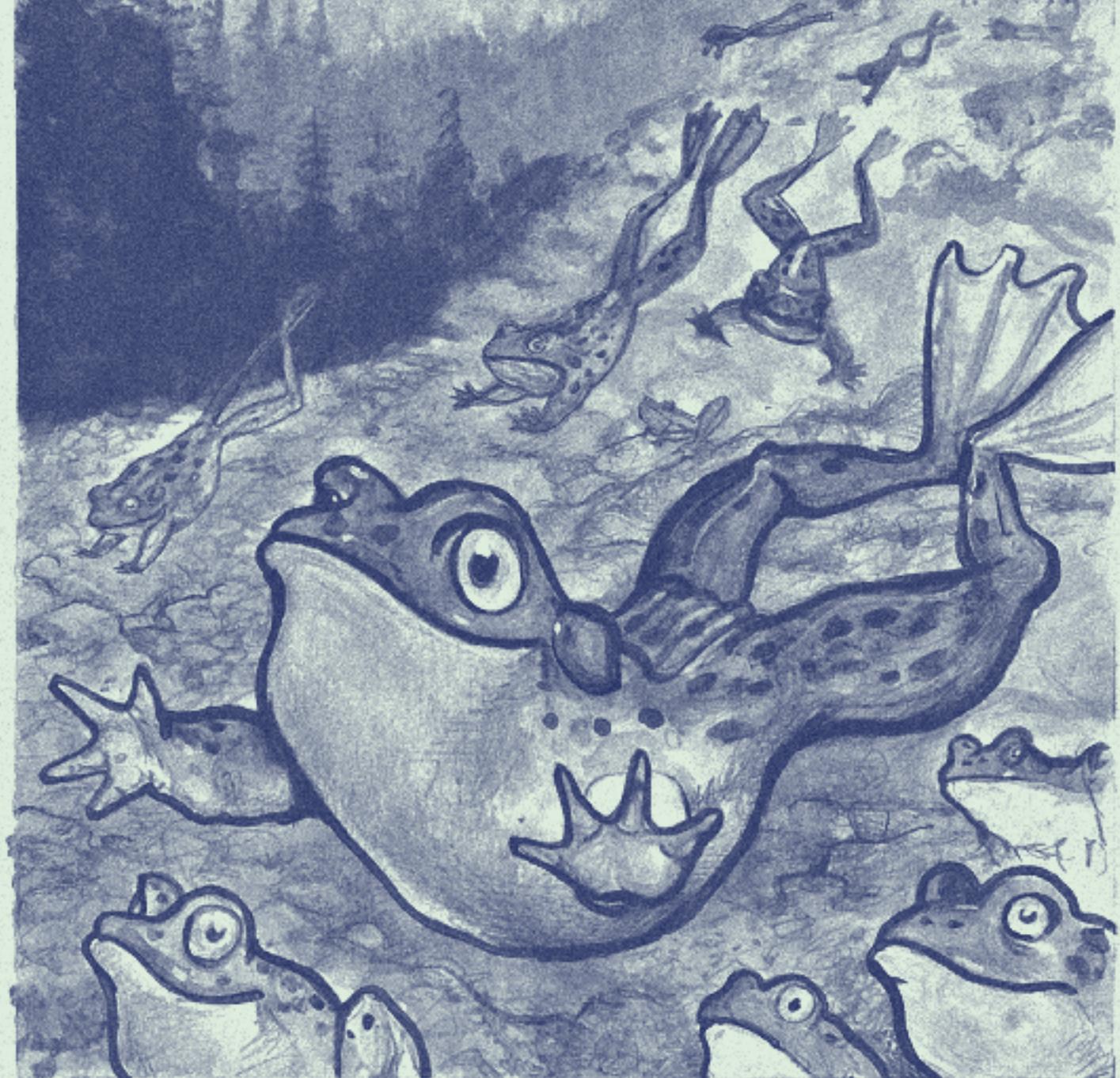


As the Frog Hops:

*What Routes Do Frogs Travel
in Mountain Environments?*



Meet the Scientists



▲ **Dr. Pilliod:** My favorite science experience is going out at night to look for frogs and toads. I use flashlights to find them clinging to branches in the trees, floating in ponds, or among fallen leaves and vegetation along streams. Sometimes I only see their beady eyes shining in the dark. I often work at night because that is the time when some frogs are most active. For example, I am studying the effects of disease on a *boreal* toad population in Wyoming. During the daytime I can find a couple of toads in the pond, but around 11 p.m. they appear in the pond by the hundreds. I am studying how social behavior influences the spread of disease in these toads.



▲ **Dr. Ritson:** It is hard to pick my favorite science experience since I have had so many different types of experiences in geology, oceanography, chemistry, and biology. Remembering my time in Idaho with Dr. Pilliod always brings a grin to my face. Having the time to get to know a place, people, and a population of frogs is awesome. I spent 3 years watching the mountains turn from white (snow covered) to green (with new plants) to brown (as the vegetation dries out) to white again.

I learned where every secret lake, pond, and puddle was and the routes to and from them. Actually, the frogs taught me a lot of short cuts over the years as we followed them. It was awesome what I learned from these frogs (but I had to be patient and take time to observe them). I still don't know how they know where the different lakes are or how to use a short cut between them, but these questions keep me curious.



▲ **Dr. Peterson:** My favorite science experience was working on a study of where garter snakes like to hide at night. Garter snakes are interesting and live in beautiful areas. My colleagues and I were doing our study at a mountain lake in northern California. We used a variety of techniques to discover that snakes usually chose rocks of intermediate thickness to hide under at night. This allowed them to digest their prey at the best body temperature and prevented them from getting too hot or too cold.

Glossary:



boreal (bôr re uł): Relating to a northern climate, with long, cold, and dry winters. The trees in a boreal forest are evergreen.

colleague (kä leg): A fellow worker in a profession or office.

Congress (kong gres): The group of elected officials in the United States that makes the laws. Congress is made up of the Senate and the House of Representatives.

migration (mi grá shun): The act of moving from one place to another.

elevation (el uh vā shun): The height of a place or thing above sea level.

population (páp yoo la shun): The whole number of

individuals of the same type occupying an area.

habitat (hab uh tat): Environment where a plant or animal naturally grows and lives.

hibernate (hi bür nat): To pass the winter in a sleeping or resting state.

species (spe sez): Groups of organisms that resemble one another in appearance, behavior, chemical processes, and genetic structure.

native (nat iv): Naturally occurring in an area.

amphibian (am fib e un): Any organism that is able to live both on land and in water.

natural resource manager (na cha rôl re sôrs ma ni jür): Skilled person who takes care of natural resources.

foraging (for ij ng): The act of taking food by animals, usually taken by browsing or grazing.

silt (silt): Very small particles left as sediment in water.

wetland (wet lend): Area of land with lots of soil moisture.

metamorphosis (met uh mōr fuh sis): The process of change in the form of some animals from an immature stage to an adult stage.

wildlife: (wild lif): Animals that live in the wild.

Pronunciation Guide

a	as in ape	ô	as in for
ä	as in car	ü	as in use
e	as in me	œ	as in fur
i	as in ice	oo	as in tool
ö	as in go	ng	as in sing

Accented syllables are in bold.



Thinking About Science

Sometimes, environmental scientists must do their research in natural areas away from the disturbance of humans. In the United States, there are few natural areas left where people have not disturbed the land and water. When Congress created the National Wilderness Preservation System, they intended that among its many purposes, wilderness would be used for scientific research.

In this research, the scientists wanted to study the *migration* of frogs at high *elevations*.

They needed to find a large natural area that had several *populations* of frogs and was not disturbed by human activity. They identified an area called Skyhigh Basin, which is located within Frank Church-River of No Return Wilderness in Idaho (**figures 1 and 2**). As part of a wilderness, Skyhigh Basin is protected from machines and all human development. Because it is almost 12 miles from a road, few people go there. It was the perfect place to study the migration of frogs.

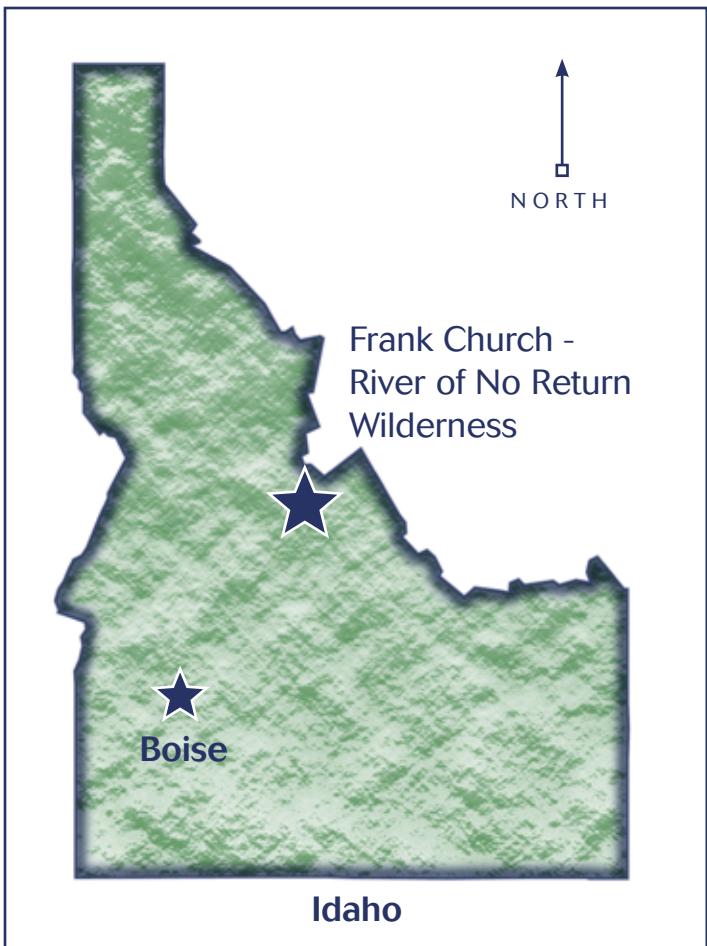


Figure 1. Location of Frank Church - River of No Return Wilderness in Idaho.

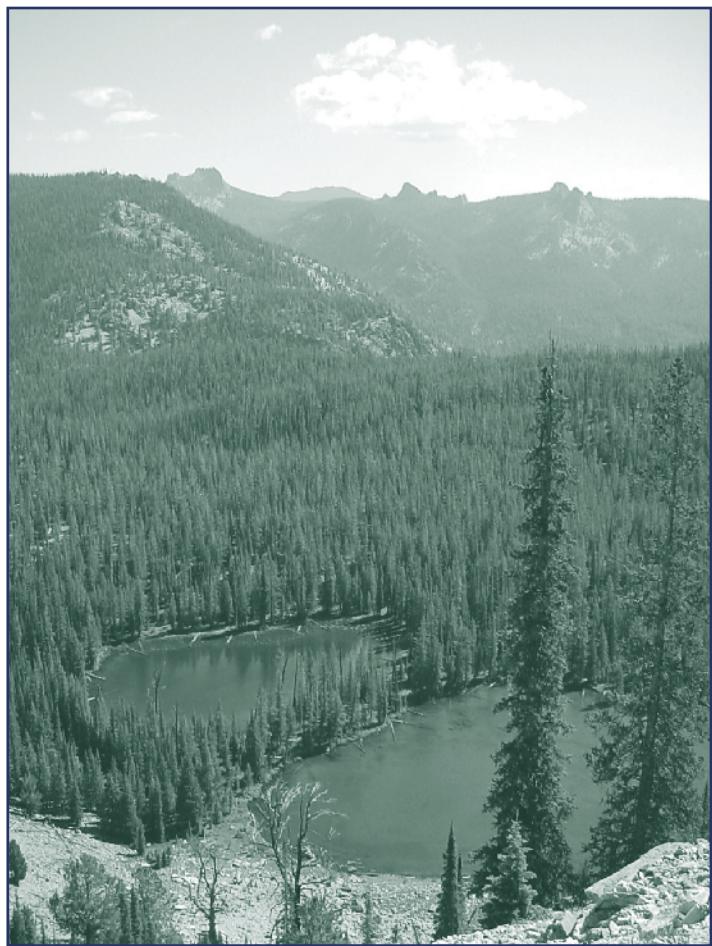


Figure 2. Skyhigh Basin.

Thinking About the Environment

Did you know that frogs are complex animals? For many frogs, each season brings the need for a different *habitat*. You probably know that as tadpoles, young frogs must have water to live. Actually, frogs need watery habitat throughout their lives. They need areas to reproduce, find food, and *hibernate*. Because one area might not provide for all of these needs, frogs can migrate from area to area, depending on the time of year.

In this research, the scientists wanted to know how far and to which habitats a certain *species* of frog migrated. This particular species is called the Columbia spotted frog. Although it is found throughout the mountains of the Northwestern United States, its population has become threatened in some areas. One of the reasons is the introduction of non-native trout, which eat the tadpoles. Other reasons for the decline in frog populations include taking water from natural streams and lakes for human purposes and the loss of habitat to human development, such as buildings and roads.

Introduction

Frogs are a species of *amphibian*. In recent years, there has been a decline in the numbers of amphibians worldwide. This decline is thought to be caused by many things. A few of those reasons are mentioned in the “Thinking About Environment” section.

Natural resource managers need to have more information to protect frog populations. Not much is now known about the habitats needed by frogs. The scientists in this study wanted to discover the types of habitats needed by Columbia spotted frogs at different times of the year (**figure 3**). In the early summer, these frogs breed and lay their eggs. The adults then spend the summer finding food, an action called *foraging*. During the winter, they hibernate under water. (The frogs do not breathe while under water, but absorb oxygen from the water through their skin.) The scientists also wanted to find out how far Columbia spotted frogs will travel or migrate to reach different habitats, and which routes they take when they are migrating.

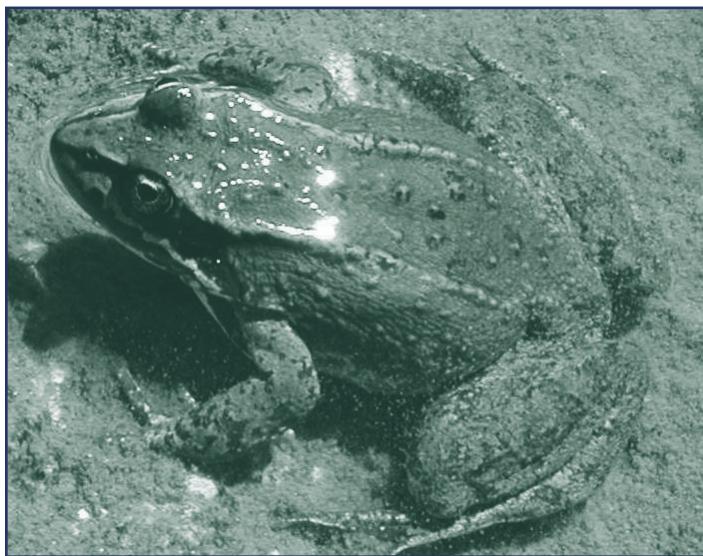


Figure 3. Columbia spotted frog.

Reflection Section



Do you think that a nonnative species of animal should be allowed to harm the population of a native species? Why or why not?

The last paragraph in the “Introduction” describes three things that the scientists wanted to discover. Restate these three things as questions.

Methods

The first thing the scientists did was identify and map all of the bodies of water in Skyhigh Basin (**figure 4**). Beginning in the early spring, the scientists walked around the edge of each lake and pond and looked for Columbia spotted frogs (**figure 5**). They also looked for frogs while walking along the banks of streams. In nearby water-filled meadows, the scientists walked back and forth through the meadows looking for frogs.

When frogs were found, they were caught, measured, weighed, and released. The sex of each frog was also recorded along with its measurements and weight. The scientists marked the toes of each frog. The marking indicated the habitat in which each frog was first captured.

Some of the female frogs were fitted with a transmitter that was placed around the waist (**figure 6**). The transmitter allowed the scientists to track the movements of the female frogs. The scientists checked the female frogs every 1-3 days to make sure that the transmitters were not cutting the frogs’ skin. If the frog had any shallow cuts, the scientists put Neosporin® ointment on the skin before releasing the frog. If the cuts were deep, the scientists removed the transmitters so that the frogs would not be harmed. The scientists tracked the

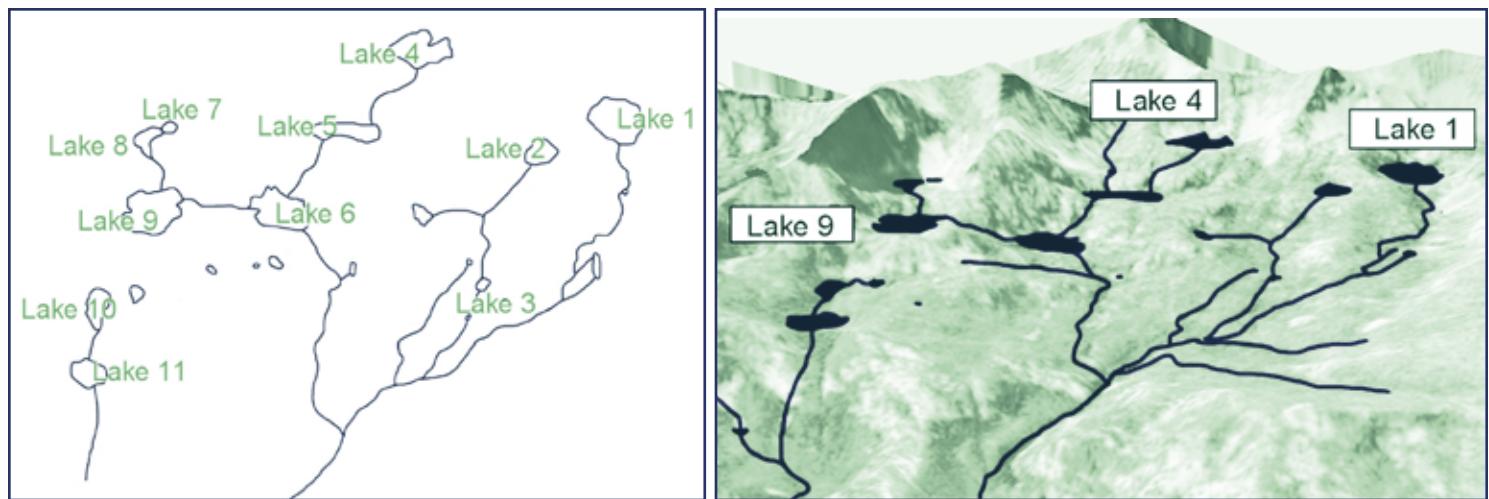


Figure 4. The study site in Skyhigh Basin. In this figure, a photograph is shown on the right. The location of the lakes is shown in blue. The streams are shown as blue lines. Lakes 1, 4, and 9 are identified. On the left, the location of all of the lakes is shown as a map. Using the map as a guide, locate the 11 lakes on the photograph.

movements of the frogs throughout the summer and into the early fall.

When frogs were found during their breeding season, the areas in which they were found were identified as breeding habitat. When frogs were found during the

middle and late summer, the areas in which they were found were identified as summer foraging habitat. In late August and early September, the areas in which frogs were found were identified as winter habitats.



Figure 5. Scientists looking for frogs in the lakes. (Photo by Peter Landres)

Reflection Section



leaf The scientists marked the toes of each frog that was found. Can you think of one reason why the scientists would want to identify the frogs that had been caught?

leaf The scientists were careful not to harm the frogs during their research. Do you think that scientists should take care not to harm the animals that they study? Why or why not?



Figure 6. Scientist placing a transmitter on a female frog.

Findings

The scientists identified a number of different habitats according to the use that was made of the habitat (**figure 7**). Shortly after laying eggs in early July, some of the adult frogs began to leave the breeding habitat for summer foraging. A greater number of female frogs migrated from their breeding habitat than males or young frogs that had not yet begun to breed. After 4 weeks, adult male frogs were found up to 424 meters away

from the breeding habitat. Adult females were found up to 1,033 meters away.

Number Crunches

How many yards away from their breeding habitat were adult male and female frogs found? Multiply the number of meters by 1.09 to find out. To find out how many feet this is, multiply the number of meters by 3.28.

The scientists wondered if the difference in distances migrated was due to the sex of the frog or its size. The scientists found that larger frogs migrated farther than smaller ones.

At the end of the summer, the frogs migrated to winter habitat. The scientists found that the youngest frogs traveled up to 350 meters from breeding habitat to winter habitat areas. These young frogs had recently undergone *metamorphosis*, and so had spent the summer growing from tadpoles into frogs. The scientists found that the adult frogs traveled up to 708 meters in a day. Some of the female frogs traveled between 50 and 160 meters per hour. Most of the females migrated during the nighttime when the temperatures were cooler.

Time of year	Habitat use	Description of habitat
Early July	Breeding	Small, silt-bottomed lakes with no fish; or larger, rock-bottomed lakes with little vegetation.
Early July to late August	Summer foraging	All types of wetland habitats.
Mid-August and later	Winter habitat	Large, deep rocky lakes with a constant flow of water into and out of the lake. Some of these lakes had nonnative trout living in them.

Figure 7. Types of habitats used by Columbia spotted frogs.

Number Crunches

How many feet did the youngest frogs travel to reach winter habitat areas? Up to how many feet did the adult frogs travel in a day? What proportion of a mile is this? (Divide the number of feet by 5,280 to find out.) What was the range in speed traveled by some of the females in feet per hour?

The scientists found that when the female frogs migrated from place to place, they generally traveled in a straight line. They did not follow the streams that connected the habitats (**Look again at figure 4, under “Methods”**). By traveling a straight distance over dry ground, the frogs shortened the distance they had to travel by up to 1 kilometer (1 kilometer = .621 miles) (**figure 8**).

Reflection Section



The scientists found that the female frogs migrated farther than males. They also found that larger frogs migrated farther than smaller frogs. What does this tell you about the size of male and female frogs?

If you were a natural resource manager and you wanted to protect the Columbia spotted frog, would you only focus your attention on the lakes, ponds, and streams where frogs breed, forage, and spend the winter? Why or why not?

Discussion

This research indicates that frogs living in the high mountains of the American West need a diversity of water bodies as well as the drier habitats between them. Scientists had previously thought that frogs migrated only along streams or other water bodies. The scientists in this study found that frogs will also travel across dry areas to reach a desired water body. Frogs generally travel when it is raining or at night, which may help them travel across areas with no water. A frog's ability to travel quickly may also help them to travel across dry areas.

If natural resource managers want to protect the Columbia spotted frog population or similar frog species, they should focus on at least two things. First, they should protect many types of water bodies in mountainous (**mown** ten us) areas of the American West (See figure 7 under “Findings,” above). In addition, the scientists suggest that managers should protect the dry land areas within 1 kilometer of these water bodies.

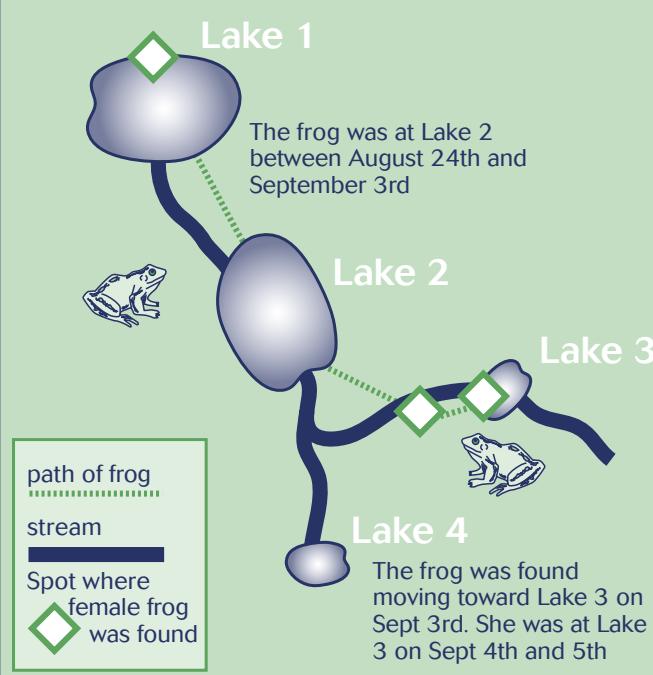


Figure 8. An example of the migration pattern of one of the female frogs. You can see that these frogs generally traveled in a straight-line direction.

Reflection Section

- leaf What new thing did the scientists learn about the migration of Columbia spotted frogs?
- leaf Why do you think the scientists suggest protecting dry land areas within 1 kilometer of a water body?
- leaf Do you think that the scientists could have done this study in an area that was not a wilderness? You might want to reread "Thinking About Science" before you answer this question.

Wondering About Wilderness



What are public lands? Public lands are lands owned by the citizens and managed by a government agency for citizens' benefit. Our Nation's largest areas of public lands are managed by the Federal Government. There are many categories of Federal public lands. One of these categories is wilderness. Wilderness is different than any other Federal land. Land that is wilderness has been granted legal protection from human development. Because of this protection, wilderness provides many benefits. What wilderness benefit is being presented in this article? For more information about wilderness, read page 5 in this journal or visit <http://www.wilderness.net>.

From Pilliod, D. S., Peterson, C. R., and Ritson, P. I. (2002). Seasonal migration of Columbia spotted frogs (*Rana luteiventris*) among complementary resources in a high mountain basin. *Canadian Journal of Zoology*, 80: 1849-1862.

FACTivity

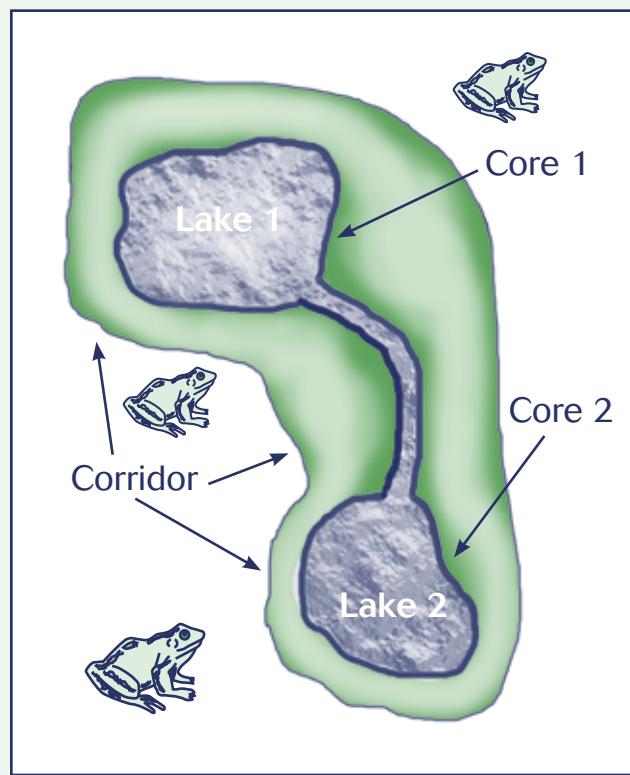
In this study, the scientists discovered that wildernesses provide good habitat for frogs because the land and water are protected from human activities. In a society, all of the land and water cannot be protected from human activities. There are many areas of land and water that are available to wildlife, such as frogs, but they are not protected from human activities as is wilderness. Many of the animals living in these areas need to migrate, like the frogs in this study.

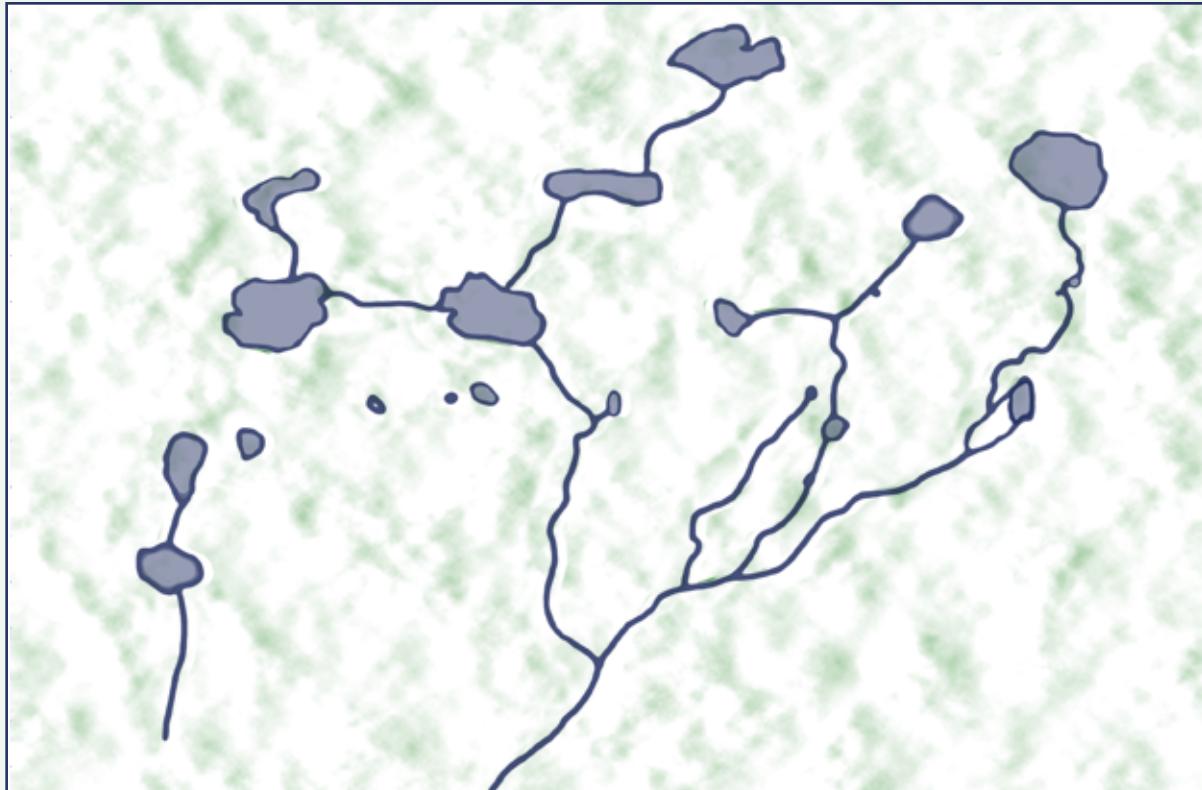
There is a way that we can help migrating wildlife to live in areas that are not protected in the same way that wildernesses are protected. This involves the protection of two types of land or water. One type of land or water is called the core. The core is where the animals breed, forage, and

spend the winter. As an example, the cores in this study are the bodies of water where the frogs breed, forage, and hibernate. The other type of land or water is called a corridor (*kôr uh dôr*). The corridors in this study would include the routes taken by the female frogs as they moved to and from bodies of water. Because the land and water in this study is wilderness, the core and corridors do not need additional protection. In nonwilderness, however, we might want to identify core land and water areas and corridors and give them special protection from certain kinds of human activities. That way, we could provide and protect the habitat needed by migrating wildlife in areas that cannot be set aside as wilderness.

In this FACTivity, you will use the same map as shown in figure 4, without the lakes being identified by number. Using the results from this study, you will modify the map by drawing in core areas and the corridors that might be used for frog migration. An example of a core area and corridor is given on the left. On the map on page 35, draw core areas and corridors for the Columbia spotted frog. Use different colored pencils to identify which areas are the cores and which are the corridors.

In small groups of 3-4 students, share your maps with each other. Are your maps similar or different? Hold a discussion about why you drew your map the way that you did. Each small group should appoint a reporter to share your discussion and maps with the class.





FACTivity Extension:



Visit these Web sites and conduct additional research on wildlife corridors and wildlife migration.

- ❑ http://www.wildlands.org/L_intro.html
- ❑ <http://www.conservationeconomy.net/content.cfm?PatternID=21>
- ❑ <http://www.learner.org/jnorth/>
- ❑ <http://www.safnet.org/archive/corridors501.cfm>

Identify the wildlife species that migrate in or through your area. The species will be different, depending on where you live. Discuss whether those migrating species could benefit from the creation of core areas and corridors. If so, try to identify some likely places in your community to place core areas and corridors.



If you are a Project Learning Tree-trained educator, you may use PLT Activity #88, "Life On the Edge" Part A and PLT Activity #45, "Web Of Life" as additional activity resources.