

In cooperation with Northern Arizona University Merriam-Powell Center for Environmental Research, National Park Service, and Bureau of Land Management

Southwest Caves Reveal New Forms of Life

Caves in northern Arizona and western New Mexico are being researched and inventoried by scientists with the U.S. Geological Survey and cooperating agencies. Southwestern caves have been little studied, and scientists are now finding that these lightless and nutrient-poor natural systems are home to life forms found nowhere else on Earth. This research has identified unique communities of arthropods (insects, arachnids, and crustaceans) that include 3 new genera, or groups of species, and at least 15 new species—some only known to exist in a single cave. This exciting research is yielding information that will be used by resource managers to better understand and protect fragile and important Southwestern cave ecosystems.

Few caves in any region of the world have been studied at an ecosystem level, and the caves of the southern Colorado Plateau—the Four Corners region of the Southwestern United States—are no exception. Scientists from the U.S. Geological Survey (USGS), Northern Arizona University, National Park Service, and Bureau of Land Management have begun an effort to inventory and study caves in northern Arizona and western New Mexico. The research team is not only studying the physical environments found in caves but also documenting their biodiversity.

When it comes to the American Southwest, many people think of the desert as the region's ultimate challenging environment, but a Southwestern cave may be an even more extreme environment than the above-ground desert. Isolated from light



A scientist explores a recently discovered cave in Grand Canyon-Parashant National Monument, Arizona. This desert cave is unusual because it has numerous standing pools of water. (Photograph courtesy of Jon Jasper, Bureau of Land Management, and Kyle Voyles, National Park Service.)



A breeding pair of cave crickets that belongs to a genus new to science. U.S. Geological Survey scientists and their cooperators recently discovered the crickets in Grand Canyon-Parashant National Monument, Arizona. (Photograph courtesy of Kyle Voyles, National Park Service.)

and vegetation, caves are inherently nutrient starved and rely on inputs from the surface to support life underground. Cave dwellers like bats and crickets “import” nutrients by feeding outside of caves and returning to

deposit guano, or feces. Guano can be a critical part of the food web in cave environments. Other nutrients are brought into caves when flooding or wind carries vegetation and other organic material into caves.



This tiny barklouse, measuring only 1.3 millimeters (smaller than a grain of rice), represents a new genus. It was recently discovered from a cave in Grand Canyon-Parashant National Monument, Arizona. (Photograph courtesy of Ed Mockford, Illinois State University.)

Not only are Southwestern caves nutrient poor, but also water is often scarce. Those subterranean pools and streams that do exist in caves can be oases for cave-adapted species.

Despite being extreme environments, caves shelter a wide range of life. Some cave animals such as bats live part of their lives outside of caves, and some creatures never leave them. For example, “troglobites” are animals that spend their entire lives underground and may include invertebrates such as spiders, insects, and millipedes. Aquatic troglobites called “stylobites” include animals such as shrimp, crayfish, and fish.

Cave-adapted animals have interesting evolutionary adaptations that reflect the extreme environments found in caves. These animals often lack skin pigmentation and eyes and have elongated appendages that help them to move more efficiently, thus conserving energy. Troglotic invertebrates may also have longer hairs, or “setae,” and antennae than their surface counterparts that help them sense their surroundings in complete darkness.

Microbes are some of the organisms best adapted to life in caves. Some microbes can feed on the minerals found on rocks or within subterranean pools, and others

even filter nutrients from the air. These tiny organisms can be very important to cave ecosystems—in some cases, microbes can serve as the center of a cave’s food web. To better understand and document cave ecosystems, scientists have developed an inventory protocol based on the most effective techniques of specimen collection and random sampling to better characterize cave environments.

As of March 2009, USGS scientists and their cooperators have identified 3 new invertebrate genera—a millipede, a cricket, and a barklouse—and at least 15 new species of arthropods from caves in northern Arizona.

Pools and streams in caves are proving to be good places to look for new forms of life. USGS researchers have found a new species of amphipod, a small shrimp-like crustacean, in a stream cave in Grand Canyon, Arizona, that is not known to exist anywhere else on the planet. Scientists may also have identified a new species of copepod, a small crustacean, in subterranean pools in a cave on the north rim of Grand Canyon.

Cave dwellers and cave environments are proving to be fragile. For example, pregnant female bats congregate in the early summer at roost sites, known as maternity roosts, to bear



This eyeless cave-limited millipede represents a new genus, Pratherodesmus, and is helping scientists better understand cave ecosystems. (Photograph courtesy of Bern Szukalski, Cave Research Foundation.)

and raise their pups. Even seemingly harmless activities, such as shining a light into a maternity colony, may cause some species of bats to leave their roosts and abandon their pups. Bat populations are of special concern because they are in decline worldwide. These winged mammals are important pollinators and seed dispersers and help to control agricultural insect pests. To limit their impacts on caves, researchers schedule their investigations at times when bat maternity roosts are not in use, or they wait until the bats have left for the night before they begin work in the cave.

The discovery of new species and communities of organisms living in cave environments may help scientists piece together the unique natural systems that Southwestern caves support. New research and recent discoveries help to underscore the importance of cave ecosystems. USGS scientists are working cooperatively with land managers to develop biodiversity inventory and monitoring strategies and ways to monitor visitor impacts on caves. Expanding the body of knowledge available to land managers about cave ecosystems in the American Southwest is an important step toward conserving these fragile natural systems.

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