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Amphibian Population Decline in the Interior West

Amphibians appeared on the earth about 150 million years before the dinosaurs, and survived the huge mass extinction event that preceded dinosaurs at the end of the Triassic period. Amphibians then survived the global changes that drove the dinosaurs to extinction and through the ice ages when great glaciers advanced and retreated across the land. Amphibians survived the global changes that the wooly mammoth and saber-toothed cat could not. But now, amphibians are in dramatic decline around the world.

"The decline of amphibian species has emerged as a major global conservation issue in the last decade," Research Zoologist Stephen Corn, from the Rocky Mountain Research Station's Aldo Leopold Wilderness Research Institute in Missoula, Montana, reported in the *International Journal of Wilderness*.

Scientists have no single definitive answer for declining amphibian populations. Most believe population decline is a combination of complex global and environmental changes. Habitat destruction, introduced predators, pollutants, disease, and climate change can all contribute to declines.

Living close to the base of the food chain, amphibians feed on zooplankton and macro-invertebrates. Their thin, sensitive skin quickly shows damage to increases in solar radiation, and they readily absorb poisons that flow into marshes, lakes, and streams. There are lots of good ecological reasons why human beings should be concerned about the global decline of amphibians.

Corn, a Principal Investigator in the U.S. Geological Survey's Amphibian Research and Monitoring Initiative (ARMI), points out that, compared with other species of concern in the Rocky Mountains, we know little about frogs, toads, or salamanders. For example, compare them to grizzly bears or gray wolves where researchers know in great detail where they occur and where they do not, and why they have declined. With some large carnivores, researchers have a fairly high percentage of individuals tagged, numbered, and even radio collared. Most National Forests and National Parks can provide bird lists that include information about relative abundance and directions about where to see different species. In contrast, current surveys of amphibians are not adequate to reveal the status of many species. Many National Parks and National Forests have not been able to complete inventories so that biologists know with confidence the species that occur there or where they live.

Natural resource managers need basic information on species diversity, distribution, and habitat requirements before they can monitor population trends or preserve habitat. But how do you survey nocturnal species that hide under the water and in rodent burrows? One answer has been to get hundreds of volunteers to drive road transects at night during the breeding season and listen for the vocalizations that identify both presence and species of frogs or toads.

The U.S. Geological Survey's Patuxent Wildlife Research Center in Maryland provides leadership for the North American Amphibian Monitoring Program (NAAMP), also called Frogwatch USA. http://www.mp2-pwrc.usgs.gov/naamp/ . Patuxent's website explains the volunteer monitoring program and enables volunteers to check the amphibian database. However, the NAAMP sampling protocols aren't appropriate for remote wildlands in the Interior West.

"The road density is not adequate, many western species are not vocal, and there is not an adequate number of volunteers," Corn said. ARMI researchers are developing sampling protocols that will be effective in the West's large wilderness areas and rugged public lands. ARMI's goals are to detect population trends and determine the causes of declines. Corn launched ARMI research in Glacier, Yellowstone, Grand Teton, and Roosevelt National Parks, and is collaborating with the University of Montana on surveys of National Forests in Montana. Amphibian population trends will be studied by analyzing changes in occupied habitat.

The surveys will provide data that could result in more amphibian species being listed as sensitive, threatened, or endangered under ESA. Corn points out, however, that not monitoring will not stop any declines.

In the Rocky Mountains, from Colorado to Canada, Boreal Toads, Northern Leopord Frogs, and Spotted Frogs are creating the most concern. Biologists are especially concerned about Boreal Toads and Northern Leopard Frogs in Idaho and Montana. Boreal Toads have inexplicably disappeared from both human-influenced valley bottoms and pristine, high elevation remote areas. Columbia Spotted Frogs are still widely distributed and common in much of their range, but substantial habitat has been devastated by well-intended natural resource managers attempting to provide recreational fishing opportunities.

According to Corn, until about 150 years ago, 85 percent of the high-elevation lakes in the West contained no fish. Amphibians were the dominant aquatic vertebrates in most mountain lakes. In the natural undisturbed lake ecosystems amphibians played a major role in ecosystems processes. Historically, the many millions of juvenile amphibians born every year provide a huge food source for salamanders, otter, mink, Gray Jays, Stellar Jays, Ravens, Kingfishers and other native predators. But after 150 years of artificially stocking non-native trout into most of the deep-water lakes, the aquatic ecosystems are

"Stocking programs have dramatically transformed the formerly fishless aquatic ecosystems," Corn and fellow authors Roland Knapp and Daniel Schindler reported in the June 2001 issue of *Ecosystems*, explaining that 95 percent of the deep lakes now contain non-native trout.

Biologists sample a wilderness lake for juvenile amphibians in 6-year study to help determine the causes of population decline

Can a Spotted Frog Become a Spotted Owl?

Will the Spotted Frog achieve threatened or endangered status and create large constraints on human use of wildlands? Will all the non-native fish artificially planted in mountain lakes have to be removed to restore native biodiversity? Not necessarily, Leopold Institute Research Associate David Pilliod concluded from his six years of studying Spotted Frogs and Long-toed Salamanders in the spectacularly rugged Bighorn Crags area of the Frank Church - River of No Return Wilderness in Idaho.

Pilliod studied 11 drainage basins that include both deep lakes with fish and shallow lakes that freeze solid in the winter and do not support fish. During the summer the comparatively warm shallow lakes teemed with tadpoles and metamorphosing spotted frogs. Some people see the thousands of newly born tadpoles in the nursery ponds and conclude that frogs can survive with only shallow ponds

Pilliod's research says otherwise. "Deep lakes free of fish are essential to the long-term survival of the Spotted Frog," Pilliod reported in the June 2001 issue of *Ecosystems*, documenting a seldom-witnessed natural phenomenon. Using adult frogs with radio transmitters attached, he discovered frog migrations from shallow lakes over rocky dry ground to nearby deep lakes. The adult and miniature juvenile frogs left the shallow water and migrated to deep lakes where they could hibernate and survive the winter below the winter ice. Salamander and frog migrations from winter habitat to breeding habitat are well documented for other species in lower elevation habitats, but Pilliod's work confirms that high-elevation amphibians, such as the Spotted Frog, can migrate by the thousands across montane habitat suited for Rocky Mountain Goats. Perhaps even more important, his data shows that deep, fishless waters are essential for maintaining healthy amphibian populations.

The same Bighorn Crags research reveals that deep lakes are even more important to the Long-toed

Scientists have concluded that the Spotted Frog is declining in many high-mountain wilderness areas because non-native trout have been stocked in over 90 percent of deep wilderness lakes. (Photo by Charles Peterson)

Salamander because their juvenile stage may take up to three years to mature in the cold water – that's three winters that the juveniles are subject to winter fish predation. This salamander has completely

The Good News

The good news, according to Pilliod, is that Spotted Frogs don't need all deep lakes to be fish free. Natural resource managers can even leave introduced non-native fish in most of the deep lakes as long as they restore a few lakes to their historic fish-free condition to provide hibernation habitat for the Spotted Frog and breeding habitat for the Long-toed Salamander.

The biological compromise Pilliod suggests may be easier to achieve than settling the legal, philosophical, and political debates about fish stocking in areas set aside by the 1964 Wilderness Act. The Spotted Frog need not become a political issue like the Spotted Owl. Pilliod's research suggests that the species' decline in high mountain lakes can be reversed and anglers can continue to enjoy wilderness-fishing experiences if State and Federal resource managers discuss and modify current fish stocking practices such that some deep-water lakes are restored to a fishless condition in each mountain basin.

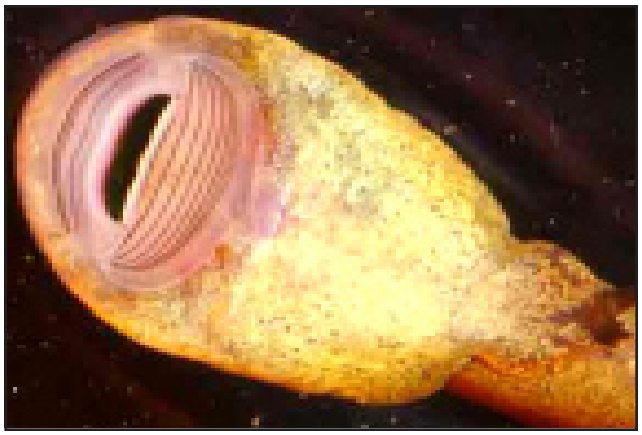
Beyond amphibians, fish stocking has ecological costs to zooplankton, macro-invertebrates, and natural ecological dynamics, such as nutrient cycling. Research in California suggests that fish stocking may have ripple effects throughout the ecosystem well beyond amphibians. A single species solution for saving the Spotted Frog does

Another Chapter, Another Frog

Pilliod continues his scientific adventures in the Idaho wilderness, but has moved from lakes to the cold tributary streams that feed the South Fork of the Salmon and Big Creek on the Payette National Forest. While these areas are best known as spawning habitat for anadromous fish and bull trout, the headwaters of these tributaries also provide habitat for the Tailed Frog and Idaho Giant Salamander.

The young of both these amphibians thrive in torrents of cascading water. The Tailed Frog tadpoles have mouths built like powerful suction cups that enable them to cling to slippery rocks in streams without being swept away. Few people ever accidentally stumble upon these species. Scientists had seen enough to generalize that what's good for salmon spawning is also good for Tailed Frog and Idaho Giant Salamander reproduction. In other words, when sediment clogs the gravel substrate in spawning streams — both salmon and amphibians suffer.

Years of earlier intensive research in the South Fork addressed questions about sedimentation, road building, and logging. New concerns rose from the 1990's when huge stand replacing fires burned more Idaho wilderness than in any other decade since 1910. Following some wildfires, entire watersheds blew out and transported millions of tons of sediment downstream. New questions included: How much sediment will be generated by unplanned ignitions of wilderness prescribed fires, and how much will be produced by prescribed fires designed to reduce severe stand replacing fires? Will restoration of fire dependent ecosystems affect amphibian populations or other aquatic organisms at the base of the food chain in these vitally important headwater ecosystems?



Tailed-frog tadpoles are adapted to survive in swift mountain streams because of their suction-cup mouths that enable them to cling to slippery rocks. (Photo by Charles Peterson)

The USDA Forest Service's Region 1 and Region 4 National Fire Plan Adaptive Management and Monitoring Program and the Joint Fire Sciences Program funded Pilliod's new research to help answer those kinds of questions. His field crews hike up high-gradient streams to randomly located transects. Working as a team they cross the stream one rock at a time, turning every stone that could reveal a clinging tadpole or flush a giant salamander. A teammate downstream holds a net that extends from the steam's bottom to the water's surface, waiting to catch any tadpole, frog, or salamander swept down in the foaming current.

"The field research stays exciting because you don't know what you're going to get – which species, which life stage, or what size of adult. So little is known about these species, all kinds of significant discoveries are possible," says Pilliod. And much like his earlier research into the Spotted Frog, counter-intuitive conservation guidelines could rapidly emerge. So little is known that the future of discoveries in amphibian research is ripe with promise.

While the global picture for amphibians seems alarming, scientists are demonstrating that when they closely investigate an ecosystem, explanations of population decline are revealed. Natural resource managers and policy makers fully armed with factual information about population declines are better prepared to conserve biological diversity.

Publication Reviews

Shrubland Ecosystem Genetics and Biodiversity: Proceedings

(Proceedings RMRS-P-21)

The 53 papers in this proceedings include sections on: the 25-year anniversary of the Shrub Sciences Laboratory; themes, genetics and biodiversity; disturbance ecology and biodiversity; ecophysiology; community ecology, and a field trip. The anniversary section papers emphasize the productivity and history of the Shrub Sciences Laboratory, 100 years of genetics, plant materials development for wildland shrub ecosystems, and current challenges in management and research in wildland shrub ecosystems. The papers in each of the thematic science sessions center on wildland shrub ecosystems. The field trip features the genetics and ecology of chenopod shrublands of east-central Utah. The papers were presented at the "11th Wildland Shrub Symposium: Shrubland Ecosystem Genetics and Biodiversity," held at the Brigham Young University Conference Center, Provo, Utah, June 13-15, 2000. The proceedings can be ordered by writing the Rocky Mountain Research Station or visiting http://www.fs.fed.us/rm/main/pubs/order.html.

Proceedings: National Silvicultural Workshop

(Proceedings RMRS-P-19)

Silviculture, as an integrative discipline, combines management skills with scientific and technical knowledge in the management of forests and woodlands. While traditionally, silviculturists worked in fine resolution landscapes, today's practitioner must look at encompassing both larger geographic areas and wider objectives. The 12 papers in this proceedings explore the past, present and desired future of silviculture's role and practice. Examination of disturbance ecology in ecosystem management includes natural and induced disturbances, and management options. Discussion of desired future conditions includes the importance of understanding the connection between ecological values and social values, as well as historic reference conditions as they relate to creating forest plans. A section on inventory, monitoring and adaptive management looks at multiresource and multiscale data assessments and temporal continuity, including design alternatives and a discussion of how to adapt silvicultural prescriptions. Case studies throughout the proceedings highlight the practical applications, the successes and the need for further work. The publication can be order by writing the Rocky Mountain Research Station or visiting http://www.fs.fed.us/rm/main/pubs/order.html.

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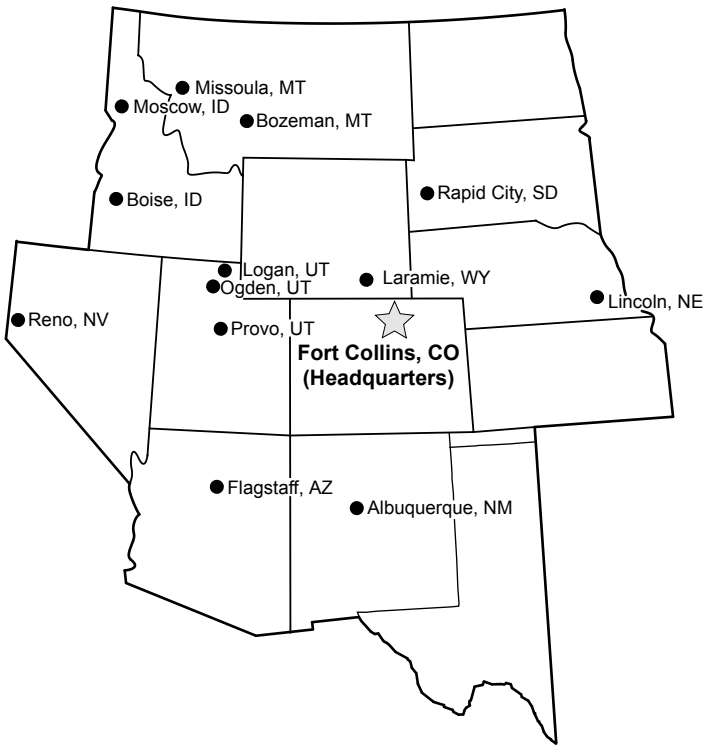

The USDA Forest Service's Rocky Mountain Research Station is one of seven units nationwide that make up the most extensive natural resource research organization in the world. Headquartered at the foot of the Rockies in Fort Collins, CO, the Station maintains 14 field laboratories within a 14 state territory (see map). Scientists conduct studies nationwide, with emphasis on the Rocky Mountains, Great Basin, Great Plains, and Southwest. Research serves the Forest Service, as well as other federal agencies, international organizations, private groups, and individuals. For more information, visit our website at http://

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