Where have all the amphibians gone?

Is the loss of amphibian populations just part of a general decline in freshwater plants and animals or is something else happening? Some scientists have suggested that amphibians might be analogous to canaries in coal mines—their welfare capable of forecasting a catastrophic deterioration in the environment.

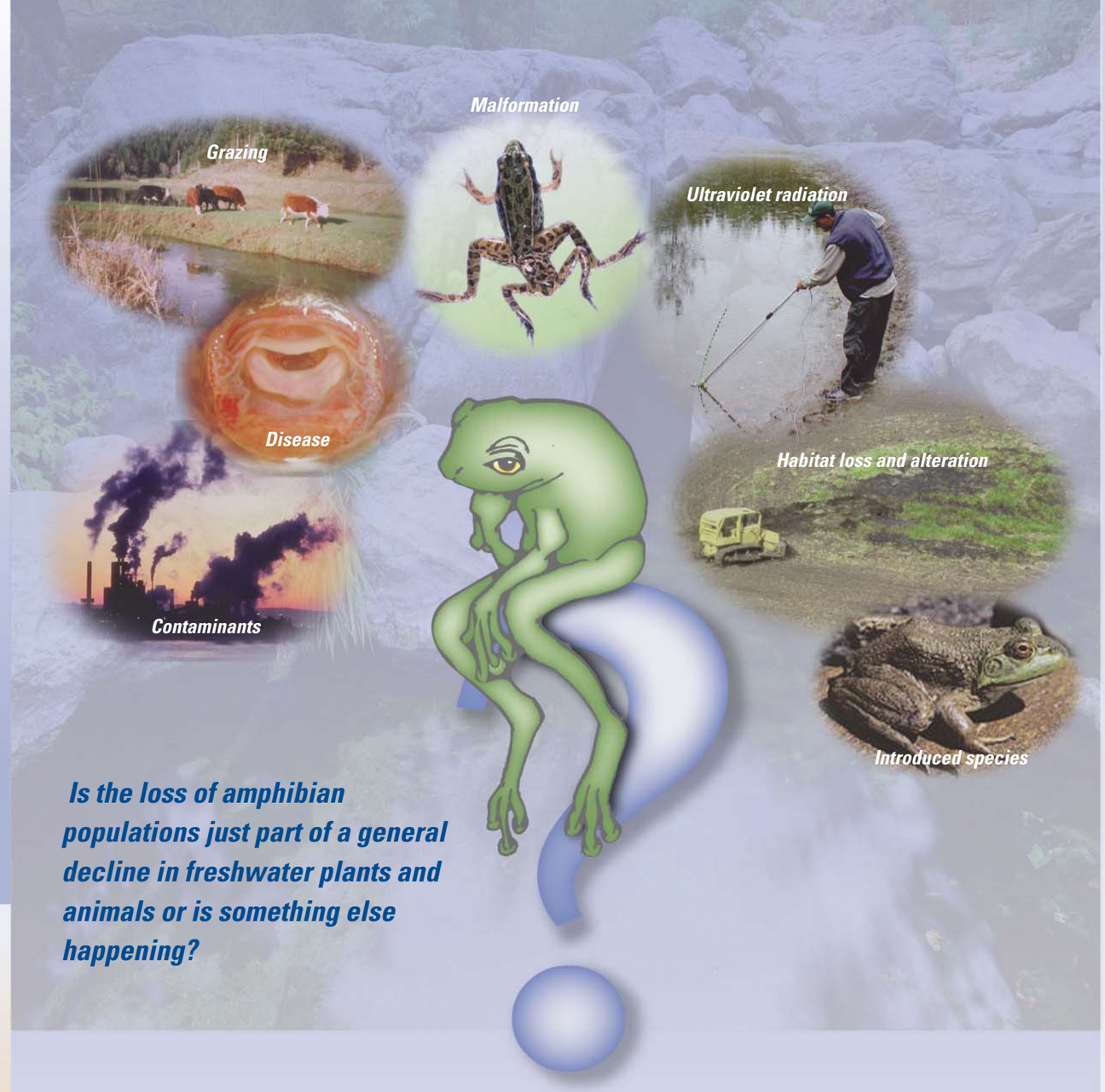
Amphibians are thought to be particularly susceptible to toxins, both because of their permeable skin and eggs, and because they could be negatively affected by disturbance to both aquatic and terrestrial habitats. The high rate of malformations in some populations and the decline of amphibians in some of our most protected environments may indicate that there are urgent problems to be addressed in the world's ecosystems.

We know that the massive loss of freshwater habitats (greater than 50% during the past 100 years in North America) has contributed to many declines of native biota. However, this habitat loss cannot explain the large-scale declines in protected areas. A number of other factors are also suspected, including invasive species, disease, contaminants, ultraviolet radiation, and climate change.

The challenge for us now is to investigate the status of amphibians on DOI lands and to determine the factors responsible for population declines.

PAO—Proportion of Area Occupied

Proportion of Area Occupied (PAO) is the primary response variable for ARMI Mid-Level Monitoring Areas. PAO is an unbiased estimate of site occupancy rate that incorporates species detectability. Surveys for amphibians are rarely 100% effective and may result in species being overlooked at a site. This biases estimates unless the probability of detection is estimated. Multiple visits to sites and USGS software (called Presence) are used to estimate PAO and to estimate change over time [http://www.mbr-pwrc.usgs.gov/software]. The software allows the testing and incorporation of factors that may affect species presence, such as pond depth, and factors that may affect detectability, such as air temperature.



Why are amphibians vulnerable?

Permeable skin and eggs
The permeable skin and eggs of amphibians can easily absorb pollutants. Pollutants can adversely affect all stages of development.

Complex life cycles
Living in both terrestrial and aquatic habitats increases an amphibian's exposure to environmental stressors. This dual exposure makes amphibians potentially broad indicators of ecosystem health.

Malformations
Although malformations may exist in every population to a small degree, the higher than typical malformation rates in some amphibian populations could signal environmental degradation.

Contaminants
Amphibians can be sensitive to a variety of pollutants. The USGS Water Resources and Biological Resources Disciplines are working together to understand the role of contaminants in amphibian declines.

Disease
Diseases, such as a skin fungus called chytridiomycosis, have been associated with amphibian declines in Australia, Central America, and North America. In cooperation with the USGS National Wildlife Health Center, we are monitoring this and other pathogens, and are studying the role of pathogens in declines.

Grazing
Cattle grazing can be both an effective management tool and a potential degrading force in the environment. Grazing occurs over large portions of the western United States, including much of the range of the Columbia spotted frog, which is a candidate for federal endangered status. We do not know if the effects of grazing on spotted frogs are positive, negative, or nonexistent.

Malformation
Parasites, pollutants, and other agents can cause malformations by affecting tadpoles during early development. In cooperation with the USGS National Wildlife Health Center, Madison, WI, we are addressing the range, frequency, characteristics, and causes of malformations in amphibian populations.

Ultraviolet radiation
Some studies have shown that ambient ultraviolet-b radiation can increase mortality of amphibian embryos and larvae compared to filtered sunlight. However, it is not known if this difference in mortality translates into population losses. Other recent studies suggest that most amphibians are naturally protected from ultraviolet-b radiation by dissolved organic matter that is present in water.

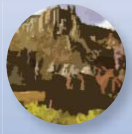
Habitat loss and alteration
Regional trends in land use and wetland management are extensively altering the physical and biotic characteristics of wetland habitats. Understanding how the hydrological diversity, spatial arrangement, and landscape context of wetlands influence the health of native amphibian populations is critical for effectively developing techniques for managing wetland resources.

Introduced species
Non-native species, such as the bullfrog and a variety of fishes, have been suggested to cause amphibian declines in the western U.S. Recent findings suggest that non-native fishes have a stronger negative effect on native amphibians than bullfrogs, but the interactions are complex and understanding their effects will require more research.

ARMI's Pacific Northwest and Adjacent Aridlands Project

In the Pacific Northwest, the USGS, the National Park Service, and the Bureau of Land Management (BLM) are working to establish three Mid-Level Monitoring Areas. These areas are:


North Coast and Cascades Network, Washington


National Park and BLM lands on the Colorado Plateau, Utah


BLM lands in the northern Great Basin, Oregon

We have obtained preliminary data on amphibian occurrence and water quality and are currently evaluating the suitability and feasibility of continued monitoring of these areas over the long-term. We also have Apex Monitoring Sites scattered around our region. Focal research projects include interactions among non-native species that affect amphibians, the effects of cattle grazing on the Columbia spotted frog, and the effects of ultraviolet-b radiation on amphibians.

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Bureau of Land Management

National Park Service

U.S. Fish & Wildlife Service

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Edited by: Danielle Jarkowsky
Graphic design: Gretchen Bracher
Photo credits: Disease: Gary Fellers, Grazing: Bill Rogers, Malformation: USGS National Wildlife Health Center, Ultraviolet radiation: USGS, courtesy of Stephen Corn, Introduced species: Alan Resetar, Tree frog: Glenn McCrea. All others: stock photos or public domain.