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GLOBAL AMPHIBIAN DECLINES: A REVIEW OF SOME CURRENT HYPOTHESES

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Background & Management Issues

Concern over global amphibian declines has fueled a spate of academic and public interest. Much of the recent research has added considerably to knowledge of current status and distribution of amphibian populations. Efforts to uncover the factors driving large-scale population declines, however, have yielded few conclusive results.

Project Objectives:

- To summarize current knowledge about the status of declining amphibian populations.
- To review causes of amphibian population declines.

Population Status:

North America

Most of the 21 amphibian species in the U.S. listed as threatened (9 species) or endangered (12 species) are narrowly distributed and endemic to specific areas that are threatened by habitat destruction. Of all species, Ranid frogs are experiencing the most significant population declines. In fact, only one native Ranid, the northern red-legged frog, has a relatively stable population. On the other hand, two introduced species, the bullfrog and Rio Grande leopard frog, are expanding their distributions.

In species with extensive distributions, populations have experienced widespread declines. Specifically, populations have declined in a particularly large number of species in California and the Southwest, including the California red-legged frog, arroyo toad, three salamander species, Yosemite toads, and western toads. Severe declines of historically abundant and widely distributed species also have occurred in other parts of North America. In fact, declines in Oregon spotted frog populations in the Pacific Northwest were probably the most severe of any widespread species on the continent. Only recently was this species differentiated from the more common Columbia spotted frog. Indeed, Columbia spotted frogs also declined in population size and occurrence at the southern end of their distribution in Utah and Nevada in recent years.

Boreal toad populations in the Rocky Mountains have shown signs of serious declines, although the same species was not declining in the Pacific Northwest. Declines in Northern leopard frog populations in the Midwest were among the first reported for a widely distributed, abundant species. Populations in the Midwest have since stabilized, but not in the Western part of the continent. On the eastern portion of the continent, only one widely distributed amphibian showed serious population declines, however. The cricket frog was retreating from the northern portion of its range in Eastern Canada. Amphibian declines in the East may have gone unrecognized due to a lack of research.

Central and South America

Much of the research in Central and South America has occurred in Costa Rica, where declines of frog, toad, and salamander species have been reported at several distinct locales. In the Caribbean, declines in Puerto Rico's ridge-headed toad and several species of coquis have been reported. Several studies have reported bufonid declines in the Venezualean and Ecuadorian Andes. At coastal and mountain sites in Brazil, several species have declined or disappeared from sites monitored beginning in the 1980s or earlier.

Australia

Documented disappearances or declines in Australia have been most acute in stream-dwelling frog species in the eastern part of the country. Declines were more serious among high-elevation species, or montane populations of widely distributed species. Pond-breeding frogs in southeastern Australia also have declined in population size and distribution.

Europe, Asia, and Africa

Little research on amphibian populations has occurred Europe, Asia, and Africa. Declines have been documented in Great Britain, Scandinavia, the Netherlands, and the countries of the former Soviet Union. In most of Africa and Asia, basic faunal surveys have not even been completed.

Causes of Declines in Amphibian Populations

Weather and Climate Change

Variation in weather patterns and extreme events, such as drought, frost, and hurricanes, are implicated as causes of amphibian declines at regional scales. The influence global climate change has and will have on amphibian populations is less clear. Warmer temperatures at the higher latitudes may be causing some species to breed earlier in the season.

Contaminants and Disease

Little direct evidence links contaminants to declines of widely distributed species. Sublethal effects of contaminants are poorly studied, however, and there is speculation about a link between frequency of limb deformities and contaminants. Limb deformities also may occur as a result of parasites, however, and no evidence that deformities cause substantial declines in population sizes exists.

Incidence of amphibian disease may be increased by contaminant-weakened immune systems. Disease is the subject of considerable discussion within the research community; it may be related to declines of a number of species in both North and South America. Proof that disease causes substantial declines is difficult to establish and requires more data than is currently available.

Habitat Destruction and Alteration

Direct habitat destruction usually is cited as the most significant anthropogenic cause of amphibian population declines, and amphibian numbers are often much reduced in urban and agricultural landscapes. The extent of the effect of specific activities, such as timber harvest, is hotly debated.

Most high-elevation lakes in the Western U.S. were historically fishless but have now been stocked with non-native salmonids. This subtle habitat alteration in what first appears to be near pristine areas was related to many population declines in the western U.S. Ranid frogs and salamanders were the most susceptible to predation by non-native fish. A similar situation has been observed in northern Spain after salmonid were stocked in historically fishless lakes.

UV-B Radiation

Although a few studies link increasing levels of UV-*B* exposure, caused by thinning of the ozone layer, to amphibian mortality, a growing body of evidence casts doubt on this hypothesis. Timing of breeding alone can result in variation in annual UV-*B* exposure–much greater than that attributable to thinning ozone. In addition, regions with large-scale amphibian declines don't coincide with those receiving increased levels of UV-*B*.

Conclusions and Management Implications:

- Most amphibian population declines can be traced to anthropogenic causes.
- Habitat alteration and destruction are the primary causes of declines in developed countries.
- Disease and UV-*B* radiation have been proposed as explanations for widespread amphibian declines in the tropics, but these hypotheses don't fully explain the declines.
- Stress induced by environmental changes or other factors may cause amphibians to be more susceptible to disease.
- Some habitat alteration, such as stocking non-native fish, is easily reversed, which may allow fairly rapid recovery of affected populations.
- Understanding population response to changing climates will be an important in the future conservation of amphibian populations.

Publications / Products:

- Corn, Paul Stephen. 2000. Amphibian declines: review of some current hypotheses. In: Sparling, Donald W.; Linder, Greg; Bishop, Christine A., eds. *Ecotoxicology of Amphibians and Reptiles*. U.S. Geological Survey, Midwest Science Center. Columbia, MO: 663-696. **Leopold Publication Number 424.** Read the abstract here.

For additional information…

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