



Andrew Blaustein and Deanna Olson (of the U.S. Forest Service) conducting their yearly census of toads in the central Cascade Range of Oregon.

Declining Amphibian Populations in Perspective

By Andrew R. Blaustein

The National Science Board (1989) recently concluded that an ongoing and unprecedented loss of the variety and numbers of species around the world exists. Indeed, members of all taxa are affected. As part of this overall "biodiversity crisis" there have been numerous recent reports suggesting that the populations of amphibian species in a wide array of geographic regions and habitats apparently have declined or have experienced range reductions (e.g. reviewed by Barinaga 1990; Blaustein and Wake 1990; Phillips 1990).

Disappearance of frogs, toads, and salamanders have been reported on all continents where amphibians are found. Some

species have become extremely rare and others recently may have gone extinct. For example, the golden toad (*Bufo periglenes*) from Costa Rica was abundant as recently as 1987 and has become extremely rare since then (Crump et al. 1992). The gastric brooding frog (*Rheobatrachus silus*) from Australia has not been seen since 1979 (Tyler 1991).

However, not all amphibian species are in decline and there are species whose populations seem to be persistent in the same areas where populations are declining. Moreover, most of the reports on declining amphibian populations are based primarily on anecdotal information. The lack of long-term data regarding amphibian populations makes it difficult to assess the overall significance of

these reports. Below, I briefly summarize some of the major issues concerning the amphibian decline problem.

Ecological Importance of Amphibians

Amphibians are integral components of many ecosystems and they may constitute the highest fraction of vertebrate biomass in certain ecosystems (e.g. Burton and Likens 1975). Because of the important contribution of amphibians to trophic dynamics in a variety of communities, a decline in their numbers could have important impacts on other organisms. Adult amphibians play major carnivore roles in many systems and serve as prey in others (Duellman and Trueb 1986); larval amphibians can be important

predators and herbivores as well as prey (Duellman and Trueb 1986) in aquatic habitats.

Moreover, amphibians may serve as good bioindicators of environmental stress (1) due to their permeable skin that readily absorbs toxic substances, (2) because they are not protected by hair or feathers, (3) because their eggs are not encased in hard shells, and (4) because many species may come in contact with both terrestrial and aquatic stresses due to their complex life cycles.

Long-term Studies

There have been few studies where amphibian populations were sampled at least once per year on a long-term basis. Of those long-term studies that have been conducted, some show populations that are in decline, while others do not. Two long-term studies from Europe have documented declines. Semb-Johansson's (1989) study of common toads (*Bufo bufo*) on islands off the Norwegian coast is one of the best examples of a long-term population study of an amphibian. Toads were monitored for 24 years (1966 to 1989). Their numbers declined dramatically from 1966-1975 and have remained low. Beebee et al. (1990) have documented the decline of the natterjack toad (*Bufo calamita*) in Great Britain over a 20 year period.

Studies in the U.S. show different population dynamics in different regions. Corn and Fogelman's (1984) study documented the local extinction of leopard frogs (*Rana pipiens*) in Colorado across a number of sites. In this study, six populations of *R. pipiens* were examined for 10 years (1973-1982). Reproductive failure was seen in 1973 at one site and by 1981 no *R. pipiens* were seen at any site. *Rana pipiens* was absent from the area at the end of the study.

Kagarise Sherman and Morton (1993) documented the population changes over 20 years in *Bufo canorus* at Tioga Pass, California. Comprehensive surveys of breeding aggregations were made from 1971-1982 and less systematic observations were taken from 1983 to 1991 at Tioga Pass. Six additional populations in northern California also were monitored from 1973-1990. At the largest breeding pools at Tioga Pass, the populations declined about 9-fold from 1974-1982. The mean number of toads found in daily searches also declined during the 20 year period. Similar declines at the other sites were reported.

A 14 year study by Jaeger (1980) in Virginia suggests that the Shenandoah salamander (*Plethodon shenandoah*) has been declining probably due to competition with *P. cinereus* whose populations are relatively rare.

Pechmann et al. (1991) monitored the breeding population sizes of four amphibian species at one site in South Carolina for 12 years. They showed that the populations of three species fluctuated and one species increased over that time span.

In addition to the subjects of the long-term studies cited above, populations of other amphibian species have disappeared from portions of their historical ranges (without concomitant shifts in their ranges) and have failed to reestablish at such sites for periods longer than their estimated maximum life span. For example, this has occurred in several species in western North America, including the Cascades (*Rana cascadae*), Red-legged (*R. aurora*), and western-spotted (*R. pretiosa*) frogs and the western toad (*Bufo boreas*). In addition, the eggs of several of these species have experienced unusually high mortality in recent years (Blaustein et al. 1993). In the same region as these species, populations of the Pacific treefrog (*Hyla regilla*) seem to be persistent.

Causes

Habitat destruction and habitat alteration probably are the major causes for decline in amphibian populations. However, due to lack of long-term data it is difficult to distinguish between human-induced causes and natural population fluctuations. For example, very little is known about the population dynamics of golden toads and gastric brooding frogs, so it is possible they may be in dormancy and may again be common when conditions are better.

The author (Andrew Blaustein) holding a device that filters out ultraviolet light. The filters are placed over developing eggs in experiments investigating the role of ultraviolet radiation on amphibian declines.



Besides overt habitat destruction and natural population fluctuations, other proposed causes include introduction of exotic species such as fish and bullfrogs, disease, ultraviolet radiation, and acidification. Most of these hypothetical explanations have not been examined experimentally.

In the Pacific Northwest, where there have been range reductions in a number of species, unusual egg mortality, and disappearances of large numbers of tadpoles, we are continuing to accumulate long-term population data at a variety of sites for a number of species. We also are investigating the role of pathogens and ultraviolet radiation in the declines of several species of amphibians from Oregon.

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