Recent trends in amphibian conservation: a report from the Third World Congress of Herpetology

RAYMOND C. NIAS[1]

THE Third World Congress of Herpetology was held in Prague, capital of the Czech Republic from 2nd to 10th August, 1997. Some 40 papers and posters about the conservation of amphibians were presented, including a full day symposium on declining amphibian populations. The Declining Amphibian Task Force (an IUCN Species Survival Commission Specialist Group) held an open meeting on Tuesday, August 5.

News from around the world of a dramatic decline in frogs was first made widely known in 1989 at the First World Congress of Herpetology held in Canterbury, UK. At this congress reports of dramatic frog declines occurring between 1978 and 1983 were reported by a number of delegates. These declines seemed to be centred in southern USA and South America, although frogs had also disappeared from Europe and Scandinavia. There has been considerable debate since as to whether the decline in amphibian populations can be attributed to known causes such as habitat alteration or pollution, or whether some additional factor such as increased UV radiation, a new chemical pollutant, climate change or disease was operating.

The Third World Congress extended the known occurrence of gradual and rapid declines in populations of amphibians in Europe, Southern Africa and Madagascar, Russia and the central Asian Republics, North and Central America, and Australia. The phenomenon appears to be a world-wide problem, with no single cause likely to explain all known declines. Indeed, given that amphibian populations fluctuate markedly under natural conditions, it was often difficult to infer that a decline had taken place. Amphibians typically have high natural mortality and fecundity and long-term population monitoring is required to establish the natural range of population variation. Director of the Declining Amphibian Task Force, Tim Halliday, concluded that there were four major priorities for addressing the issue;

- extending the geographic coverage of studies to regions such as Africa and Asia,
- investigating the causes of decline, including long-term chronic effects of factors such as pollution or climate change,
- investigating the potential interactions among factors (e.g., between climate change and disease),
- raising public awareness and support for the implications of a global frog decline.

Remaining presentations focused on a variety of concerns in amphibian conservation, including;

- the effects of persistent organic pollutants, particularly pesticides and associated surfactants, on the development, growth, and survival of individual amphibians and populations,
- reports on frog declines in various regions,
- habitat loss, fragmentation and disturbance,
- possible impacts of increased levels of UVB radiation,
- possible impacts of climate change,
- predators,
- disease,
- fluctuating asymmetry as a potential indicator of future population decline,
- nitrogenous fertilizers and water chemistry,
- conservation programmes and education.

OVERVIEW OF FACTORS CAUSING DECLINES

Factors likely to adversely affect amphibian populations can be divided into chemical, physical and biological processes. A wide range of papers on these topics was presented and some of the main conclusions are presented here.

Chemical factors

There is considerable research effort being targeted on the possible role of environmental contaminants in amphibian declines, particularly in parts of the USA and Europe. Both the immediate toxic effects of chemicals, such as common surfactants used in herbicides and the developmental impacts of endocrine disruptors such as PCBs, DDT, DDE and other persistent organic pollutants (POPs), are being investigated.

Surfactants in herbicide preparations, typically alcohol ethyoxolates and alkyl phenol ethyoxolates, are used to disperse the active ingredient, glyphosate, evenly over the target vegetation. It was suggested that lethal concentrations of these surfactants probably occur commonly in Australia despite the National Registration Authority ban on using 84 preparations near water. Impacts may occur where frogs use ephemeral pools in agricultural or urban regions for breeding, and where herbicide concentrations become extremely high due to lack of dilution within larger water bodies.

A large group of chemicals, known as endocrine disruptors (EDCs) may cause abnormal development, including sex reversal, in animals. Several researchers in the USA are conducting research into the effects of endocrine disruptors on frog development, including those chemicals that interfere with oestrogen function, as well as chemicals such as PCBs and members of the DDT complex that interfere with thyroid hormone and corticoid function. DDT/DDE levels in Californian frogs were found to be extremely high, despite these compounds not being used in America since 1973. Evidence of the

transmission of DDT from mother to offspring, and from food, was reported.

In Minnesota, USA, over 170 reports of abnormal *Rana pipiens* and other frogs were reported from 55 counties by the Minnesota Pollution Control Agency (MCPA) in 1996. Twenty of these reports were subsequently confirmed and abnormalities were found in six species; predominantly involving deformed, missing or extra rear limbs. Internal abnormalities have also been confirmed following pathology testing. Four focal areas have now been established in the State, and a wide range of chemical and biological testing is being carried out at these sites.

Environmental contaminants are also implicated in the rapid decline of frogs from pristine habitats in the Cascade and Sierra Nevada Mountains of California. Although introduced trout are present, and known to affect frog populations, it has been suggested that a variety of agricultural chemicals which are abundantly applied in the Central Valley of California are being windblown into the mountains with biologically significant levels being reported up to 3 000 metres above sea level.

Physical processes

Ultraviolet radiation

Given that a number of frog species have declined from high altitude regions it is not surprising that the recent increase in incident UV radiation, resulting from thinning of the ozone layer, should be cited as a potential cause of these declines. If amphibians are susceptible to increases in ultraviolet radiation, then species living at higher altitudes may be at greater risk. Frogs at higher altitudes are more likely to breed in shallow, clear water and to bask during the day in order to maintain their body temperature. However, the effects of increased UV radiation on frogs remains disputed. In particular, methodological flaws in the experimental approach of some studies make it difficult to conclude that the effects of UVB detected under laboratory conditions are likely to be relevant to amphibian declines in the wild. In particular, UVB levels are unlikely to be a significant factor in pond habitats where high levels of humic acid (derived from leaf litter and aquatic vegetation) act as a major absorber of UV light.

BIOLOGICAL PROCESSES

Habitat loss, disturbance and restoration

Habitat loss and fragmentation is an accepted cause of frog declines, particularly in agricultural and urban regions. A number of studies into the habitat requirements of particular species, as well as broad-scale determinants of frog abundance and species richness were presented. These studies will be useful in conserving important frog habitats, as well as restoring habitats such as ponds.

Disease

The presence and significance of diseases in frogs is a new area of research. Several viral, fungal and parasitic diseases have been found in wild amphibians and some of these are associated with, although not necessarily the cause of, frog declines. Only a few laboratories around the world have the interest, funding or expertise to develop this area of research. The presence of an unusual organism associated with mortalities and declines in Australian frogs, subsequently identified as a Chytrid fungus (Berger *et al.* 1998), was reported. This is a promising area of investigation and it was noted that the pattern of several rapid frog declines, most notably in northern Queensland and central America, are consistent with the spread of a disease.

Predators

The impacts of introduced predators was reported in several studies. Of particular concern was the decline of amphibian species in stream heavily stocked with sport-fish such as trout. This practice is also widespread throughout the wetter temperate regions of Australia, and may be a cause for concern in relation to stream breeding species in particular.

RECOVERY AND CONSERVATION PROGRAMMES

Although a number of individual conservation programmes for amphibians are in existence in different parts of the world, the Action Plan for the Conservation of Australian Amphibians (Tyler 1997) is probably the most detailed and comprehensive available. Some small scale community-based projects were discussed, but a more extensive programme to co-ordinate community and scientific efforts on amphibian conservation has been developed by the Task Force on Declining Amphibian Populations in Canada. An impressive and extensive national network of scientists, agencies and volunteers has been formed to ask some fundamental questions about the status of amphibian populations.

Global efforts to conserve frogs are being co-ordinated through the IUCN SSC Declining Amphibians Task Force (DAPTF). The role of DAPTF is (1) to organize and co-ordinate a global investigation of unexplained and sometimes conflicting data on amphibian population and species declines and disappearances world-wide; (2) to determine the cause(s) for the declines and disappearances and establish whether the cause(s) is (are) regionally or globally linked; and (3) to promote the means by which declines can be halted and reversed.

CONCLUSIONS

The Third World Congress of Herpetology was an important forum for the discussion and dissemination of research ideas and results on amphibian conservation. It is clear that there is no single cause of amphibian declines. However, it is also clear that there are some common features in many of these declines, especially within particular regions. In Europe, declines seem attributable primarily to the loss of vegetation and breeding ponds associated with the increasing spread and intensification of mechanized agriculture and urban development. Clearing of primary rainforest and other native vegetation is rapidly destroying amphibian habitats in tropical South America, South Africa, and Madagascar. While habitat loss and fragmentation are

still the major cause of frog declines globally, there is much encouraging work being carried out into restoration and management of frog habitats in agricultural landscapes.

Dramatic declines and high rates of abnormalities in American frogs are increasingly being linked to environmental contaminants, most notably persistent organic pollutants such as DDT and other pesticides. One of most significant themes of the congress was the research being conducted on the potential impacts of chemical pollutants, including pesticides and herbicides, on larval development and populations. The detection and possible impact of high levels of persistent organic pollutants in amphibians, even in remote and otherwise pristine environments, is of major concern.

In Australia, the rapid decline of Queensland frogs shows some characteristics of an epidemic disease, perhaps triggered by underlying environmental stress. A remarkably similar pattern of declines is evident in Costa Rica and Panama.

Arising from the papers and discussion at the Congress, the following conclusions are offered:

- Comprehensive amphibian conservation strategies, such as the Australian Action Plan, are vital to co-ordinate research, management and public efforts at national and regional levels.
- Long-term population monitoring is required to detect frog declines.
- Surveys of frog populations and the establishment of monitoring sites are urgently required in tropical countries, especially at high altitude (e.g., the highlands of Indonesia and Papua New Guinea).
- Experimental work, including translocation, is required to elucidate potential causes of declines.
- Surveys of chemical contaminants and their acute and chronic effects on amphibians are urgently required in the Pacific Rim.
- Pacific Rim countries should continue to work toward international agreements limiting the manufacture, sale and use of harmful persistent organic pollutants.
- Additional support for disease research is warranted, particularly as part of more comprehensive investigations into unexplained frog declines.
- Disease transmission protocols may need to be introduced in regions with susceptible species.
- Efforts are required to identify and reduce the impact of invasive species, particularly fish and other amphibians.
- Long-term monitoring is required in habitats likely to be first affected by climate change (e.g., coastal habitats, tropical montane regions).
- Monitoring of frog populations as an indicator of "environmental health" has the potential to attract public support for amphibians and conservation generally.
- The work of the DAPTF and its findings need to be more widely communicated to governments and the non-government conservation community.

REFERENCES

Tyler, T. J., 1997. The Action Plan for Australian Frogs. Wildlife Australia. AGPS, Canberra.

Berger, L., Speare, R., Daszak, P., Green, D. E., Cunningham, A. A., Goggin, C. L., Slocombe, R., Ragan, M. A., Hyatt, A. D., McDonald, K. R., Hines, H. B., Lips, K. R., Marantelli, G. and Parkes, H., 1998. Chytridiomycosis causes amphibian mortality associated with population declines in the rainforests of Australia and Central America. *Proc. Natl. Acad. Sci.*, in press.

[1]WWF Australia, G.P.O. Box 528, Sydney, New South Wales, Australia 2001.