

Australia's Vanishing Frogs

EARTHWATCH INSTITUTE FIELD REPORT

November 2003 to March 2004

Project Title: Australia's Vanishing Frogs

Principal Investigator (s): Drs Michael Mahony and John Clulow

Position/Affiliations: Assistant Dean Research Training faculty of Science and information Technology, Senior Lecturer in the School of Environmental and Life Sciences the University of Newcastle, Australia.

Research Site(s): National Parks and State Forests of eastern New South Wales, Australia.

Local Management Status of the Research Site(s):

Watagan National Park
Watagan State Forest
Orara East State Forest

Central Eastern World Heritage Rainforest Reserves
Gloucester Tops, Barrington National Park
Werrikimbee National Park
Washpool National Park
Border Ranges National Park
Yabbra National Park

Scientific names of primary species being studied:

Mixophyes iterates (giant barred frog), *Mixophyes fleayi* (fleayi's barred frog), *Mixophyes balbus* (Stuttering frog), Leaf green tree frogs, *Litoria phyllochroa* complex; Mountain mist frogs *Phyllorhina* species. Species impacted by the amphibian fungal disease Chytridiomycosis.

Key Research Objectives :

- Assess the conservation status of selected frog communities
- Monitor selected identified threatened species and populations
- Investigate the ecology of selected threatened species and communities
- Identify threatening processes
- Seek solutions to threatening processes
- Document the species diversity in isolated rainforest units to uncover their evolutionary relationships

Data Collection and Results

Monitoring of three endangered species continued at eight field sites. These field sites occur in isolated rainforest units that occur on the eastern escarpment of the Great Dividing Range in eastern Australia. Our field sites cover a latitudinal range of about 800 kilometres, and vary in altitude from 20 m above sea level to over 1000 m.

Monitoring involves a study of the population demography of the endangered species at each field site. The status of the populations is considered in terms of the age class structure of the population and birth and death rates. Using these methods we are able to determine by specific sampling methods whether the population is stable, increasing or declining and at what stage in the life cycle impacts occur. Our results over a number of years show a progressive decline in some populations and we link these studies to complementary investigations of the prevalence of the amphibian disease Chytridiomycosis.

At the same time as investigating endangered species and populations we have also conducted field searches for a number of previously poorly studied amphibians to document their life history, ecology and conservation status. In the past year we have described four new species of frog and some of the primary information included in the species descriptions was collected on Earthwatch expeditions.

We have made significant progress toward achieving our original objectives. Major advances have been made in understanding of the population ecology of three critically endangered species. This information is vital in determining if declines occur and in comparative studies between populations. The information will also provide a base-line for reintroduction and restoration programs.

Empirical data on the role of disease in moderating amphibian populations, their spread and transmission in amphibians represent new areas of research for amphibian biologist. Our task has been to investigate the impact of a disease in wild populations in the absence of rapid detection methods. The work is by necessity repetitive and time consuming but we have little choice but to monitor the impacted species and unravel the signs of disease and population decline.

Volunteers assisted in studies of endangered frog populations in eight major areas. In each area there were several sites. In some areas the frogs are doing very well and we are please to report that the populations are strong. By strong we mean that there was evidence of high levels of survivorship in each of the stages of the life cycle. Thus in the field we gathered evidence of adult frogs going about their business, similarly we observed numerous tadpoles and newly metamorphosed frogs.

Contrasted with this situation are the frustrating field sites where we can hardly find any frogs. We are puzzled by the difference between these sites and continue to ask what has changed in the environment, and what role disease plays. The healthy populations provide us with invaluable information on the role of frogs in the forest community and give us a picture of what it was like in other areas before populations disappeared. While it may seem unusual to study populations in areas where they are doing well, such populations offer the only means to assess the level of differences where frogs have

disappeared. Unfortunately, there were very few studies of frog populations prior to the process of decline commenced. If we are to reintroduce species to areas where they have disappeared it is valuable to know the population parameters linked with successful populations. Finally, working at the edge where populations are declining provides the best opportunity to understand the causal factors involved.

Monitoring of several endangered frog populations provided evidence that frog declines are continuing and that the process reveals a geographic pattern. For two species that have declined from greater than 80% of their historic range the populations that were closely monitored showed no signs of decline, while others were at a stage where the population is likely to disappear altogether within a few years. Unfortunately, as yet there is no management action that is known to reverse amphibian declines.

Significance/Benefits of Research

a) What is/are the significance/benefits of your research at the following levels?

- **Local (in the area of the research site)**
- **National**

The declining frog phenomenon as it is known has received considerable attention among the general community. Public agencies responsible for conservation and land management, wildlife management, and health authorities also have strong interests in the situation. Attention has been drawn by several commentators to the implications of an alarming decline among such a widely distributed group of vertebrates in such a short time frame and across such a variety of habitats on the globe.

In the context of eastern Australia several government agencies are actively involved in dealing with the problem. In particular New South Wales National Parks and Wildlife Service as the lead agency responsible for wildlife conservation is involved in regular discussion of research findings and directions. The principal investigator has worked directly with the Threatened Species Unit of the service in the preparation of Recovery Plans for five endangered frogs, and has conducted targeted surveys dealing with the sick and dying frog syndrome. At the national level the Commonwealth government agency responsible for wildlife conservation is Environment Australia. In the past the PI was commissioned to provide research phase information to the agency for the purpose of preparing documentation necessary for the prioritizing and listing of species under the Environmental Protection and Biodiversity Conservation Act. In 2003 the PI was an invited participant in a workshop organized by Environment Australia to formulate policy to deal with the disease process impacting Australian frogs. There has been a direct link between the field research conducted with the assistance of Earthwatch volunteers and the policy foundations to inform politicians and the public.

Future public policy and directions will be guided by the results of field research. A clear and well-established link exists between the field survey and research and the development and modification of conservation policy. In the past, development of clear policy has had significant impacts on a range of activities. For example, forestry operations now operate under a range of protocols designed to reduce environmental impacts and was developed by understanding the ecology and habitat requirements of

the endangered species. An example of this can be seen in the recently completed Comprehensive Regional Assessment of Forestry Resources in eastern Australia. Fieldwork that we have conducted over a decade, in part assisted by Earthwatch volunteers has contributed to significant reservation of certain habitats in National Parks thus providing a long-term environmental legacy.

- **International**

In 2003-2004 the PI and field assistants presented papers that include in part the results from our field studies at two international conferences. International Wildlife Management Conference (Christchurch NZ) and the International Genetics Conference (Melbourne, Australia). Papers have been accepted for two international conferences in 2004; 19th International Zoology Conference Beijing China and the Third International Conference of Comparative Physiology and Biochemistry, Natal, Africa.

b) How do your findings contribute to issues of sustainability?

Our studies are directly related to understanding and interpreting the natural environment.

At its basic level the global problem of amphibian declines is a result of a disease that has been inadvertently transported to most continents. The problem is one of an invasive species, in this case a disease, and thus unlike most invasive species it is difficult to detect until infections and death occur. Our studies provide a view of a new and worrying development in conservation management and that is the homogenisation of the world's fauna. Global transport of goods is introducing invasive species all over the world and among these are diseases. To island faunas, that have evolved in isolation, such invaders have a devastating impact. By providing clear empirical evidence of this situation we are able to draw more general predictions and begin to consider management options to deal with this situation. In essence we are building the scientific proof for a new paradigm in conservation biology. In the latter half of last century the environmental paradigm was to set aside land in reserves as a means to protect natural communities. This was promoted in the belief that if such reserves were of sufficient size they would help conserve biodiversity. The action of invasive organisms, such as the Chytrid fungus that is devastating amphibian populations, ignores reserve boundary. Species have become extinct in the pristine habitats of the conservation reserves that were set aside to ensure their survival. What has happened to the amphibians can and will happen to many other island and endemic floras and faunas. In addition to the challenge to set aside sufficient areas as natural reserves there is now the challenge to protect the communities these reserves protect from the role of invaders. There is a considerable management challenge to prevent the loss of biodiversity via these causes.

Dissemination of Results

a) Have you provided details of results from your research to or within:

- Scientific papers (indicate status; e.g., peer reviewed or in progress/press)

- Thumm, K and Mahony, M. J. (2002) Hatching dynamics and bet hedging in a temperate frog *Pseudophryne australis* (Anura: Myobatrachidae). *Amphibia-Reptilia*.
- Thumm, K and Mahony, M. J. (2002) Evidence for continuous iteroparity in a temperate zone frog, the red crowned toadlet *Pseudophryne australis* (Anura: Myobatrachidae). *Australian Journal of Zoology*. 50:151-167
- Browne, R.K., Clulow, J. & Mahony, M. (2002) The short-term storage and cryopreservation of spermatozoa from hylid and myobatrachid frogs. *CryoLetters* 23:129-136.
- Browne, R.K., Mahony, M. & Clulow, J. (2002) A comparison of sucrose, saline, and saline with egg-yolk diluents on the cryopreservation of cane toad (*Bufo marinus*) sperm. *Cryobiology*. 44:251-257.
- Browne, R.K., Clulow, J., & Mahony, M.J. (2002) The effect of saccharides on the post-thaw recovery of cryopreserved cane toad spermatozoa. *Cryo-Letters*. 23:121-128.
- Hamer, A., Lane, S, & Mahony, M. (2002). The role of an introduced fish in displacing a native amphibian into marginal habitat: the case of the mosquito fish *Gambusia holbrooki* and the endangered green and golden bell frog *Litoria aurea* in south-eastern Australia. *Oecologia* 132: 445-452.
- Hamer, A.J., Lane, S.J, & Mahony, M. J. (2002). Management of freshwater wetlands for the endangered green and golden bell frog (*Litoria aurea*): roles of habitat determinants and space. *Biological Conservation* 106: 413-424.
- Schmid, M., Haaf, T., Steinlein, C., Nanda., & Mahony, M. (2002) Chromosome banding in Amphibia. XXV. Karyotype evolution and heterochromatin characterization in Australian *Mixophyes* (Anura, Myobatrachidae). *Cytogenet Genome Res*: 97:239-253.
- Knowles, R., Mahony, M.J., Armstrong, J and Donnellan, S. (2003) Systematics of sphagnum frogs of the genus *Philoria* (Anura: Myobatrachidae) in eastern Australia. *Rec.Australian Museum*. 2003.
- Mahony, M. J., Donnellan, S. C., and Murphy, M. (2003) External features to distinguish three sympatric species of *Crinia* (Anura: Myobatrachidae) in northeast New South Wales. *Aust. Zool.* (accepted).
- M. Mahony, S. C. Donnellan, S. J. Richards, and K. McDonald (2003). Species Boundaries Among Barred River Frogs, *Mixophyes* (Anura: Myobatrachidae) In North-Eastern Australia, With A Description Of Two New Species (submitted to *Herpetologica*).

- **Management plans and reports (in progress or completed)**

Mahony M. (2004) Reintroduction of the Green and Golden Bell Frog to the Shortland RAMSAR wetlands. Wetland Centre, Shortland, Australia. (in progress)

- **Presentations (given or planned)**

Mahony M. (2004) Australia's Vanishing Frogs. Seminar presented to the School of Organismic and Evolutionary Biology, Harvard University. April 2004. (30 academics and students present).

Mahony M. (2004) Australia's Vanishing Frogs. Seminar presented to Concord Land Trust Harvard University. April 2004. (100 members of the public and students present).

Mahony M. (2004) Australia's Vanishing Frogs. Seminar presented to Middlesex School, Concord MA. April 2004. (300 students plus academic staff present).

- **Popular articles or films (in progress or completed)**

- Books, chapters, illustrations