FROGLOG

IUCN - The World Conservation Union
Species Survival Commission
Declining Amphibian Populations Task Force

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Amphibians and Climate Change

Observations made over 17 consecutive years at two widely separated amphibian breeding sites in southern England suggest that some species may be responding to climate change by altering their breeding cycle times. At one locality the dates of first spawning by the rare natterjack toad *(Bufo calamita)* have altered such that by 1994 eggs were laid an average of two weeks earlier than was occurring in 1977. At another site populations of the introduced edible frog *(Rana esculenta)* also spawned progressively earlier over the same period, this time with an overall difference of nearly three weeks. Both of these species are on the northerly edges of their biogeographical ranges in Britain, and there is also evidence that after some 150 years of relatively unsuccessful edible frog introductions into Britain the animal has, within the past decade, suddenly begun to expand its range in the country. By contrast the widespread common frog, *Rana temporaria,* has not changed its spawning time over the 17 years of observations at the second site.

Also striking has been the migratory behaviour of newts *(Triturus* species) at site 2. All three native species *(T. vulgaris, T. helveticus* and *T. cristatus)* use the ponds, and all have changed in similar fashion over the past 17 years. The pools are cleared of vegetation every autumn, and inspected nightly to record first arrivals; these have become earlier by an astonishing 5-7 weeks since 1977, changing progressively from February to December. These are of course only vanguard animals and the bulk of the population has not responded so dramatically, but there has been a shift in the month of peak numbers in the ponds from April in the early l980s to March by the mid 1990s.

All of these changes correlate strongly with mean temperatures in the months immediately prior to spawning or migration, and these temperatures have themselves shown steady increases over the past 17 years, averaging >0.1 °C per year. It seems likely that individuals within these amphibian populations are responding rapidly, by behavioural plasticity, to warming trends in winter and early spring temperatures. If these trends are sustained by continued global warming this may be followed by adaptive changes at the population level and thus further significant shifts in breeding seasons. There is as yet little hard information about the effects of climate change on wildlife; amphibians may provide valuable clues because monitoring changes in breeding and migration behaviour is relatively straightforward and could be pursued at a range of sites around the world.

A summary of these data have been published in *Nature* 374: 16 March 1995, p 219.

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Marking Amphibians by Toe-clipping: A Response to Halliday

In spite of the fact that concern has been expressed from both within and beyond the herpetological community, that toe-clipping causes mortality in amphibians, there is a paucity of direct evidence indicating that this is the case. Moreover, the effects of alternative marking techniques on amphibian mortality may also be unquantified.

The study most often cited as evincing a causal relationship between toe-clipping and amphibian mortality was conducted by Clarke (1972). In a mark-recapture study, Clarke correlated the number of toes clipped (1-8) from an individual toad with recapture rates. The correlation 'indicates' that the more toes you clip, the less likely you are to recapture the animal. The author, and many others, take this as evidence that the 'missing' toads had died as a result of the toe clipping. However, two alternative hypotheses were not investigated and cannot be ruled out: 1) the 'missing' toads may not have died, but could have disappeared from the study site (this may or may not have been due to the stress of marking) and 2) mortality, if it occurred, may have occurred for a reason other than toe-clipping. Clarke conducted his study on a golf course; a landscape in which mowing and biocide application are likely to be common causes of mortality for toads. The impact of these factors may be area-specific. Those who use toe-clipping often begin with the codes that require the fewest clipped toes and sequentially work their way to the maximum number of clipped toes. This procedure can result in one-toe clipped amphibians being spatially distant from multi-toe clipped individuals. These sub-populations may be subject to quite different mortality pressures. Clarke gives no indication that he attempted to randomize his marking procedure and, therefore, control for an area effect. There may well be a correlation between the number of toes clipped and mortality, but it is not clear from this study.

The second publication cited by Halliday, Golay & Durrer (1994), does show that toe-clipping of natterjack toads can lead to metastatlc infection and necrosis, sometimes involving

the entire limb. These results certainly warrant concern regarding the marking procedure, especially for species of threatened status. It is remarkable, however, that since the introduction of toe-clipping by Bogert in 1947, so few studies have noted an adverse impact of the procedure on amphibians. Golay and Durrer's findings may represent a widespread phenomenon; the paucity of corroborative reports may stem from biologists' reluctance to report results that indicate that their work impinges on the life of their subjects and, as a result, potentially biases their data.

Further studies must be undertaken on the effects of toe-clipping on amphibians. Although toe-clipping has been a commonly used procedure, the methods by which it is accomplished vary greatly in the amount of toe, number of toes and position of toes removed. Also, some biologists are more careful than others in using sterile equipment and even treating the wounds with antibiotics. Therefore, any future studies using or evaluating toe-clipping should be standardized, and clearly state the procedure followed.

The two most popular alternative marking schemes, pattern mapping and pit tagging, are not without their own drawbacks. Pattern mapping, recording the color patterns of amphibians, has been widely accepted for several species as a reliable, non-invasive technique. However, observation of captive *Ambystoma californiense* at Stanford University indicate that spots can change over time even in adults. Also, pattern mapping is prone to observer bias. While Polaroid pictures may be useful for recording spot patterns, the requisite technology, such as digital scanners, can be sophisticated and expensive. Finally, pattern mapping frequently requires animal handling times well beyond those used in toe-clipping and pit tagging.

Pit tags, small encapsulated bar codes injected into the animal, are expensive ($4.75 to $6.00 per tag, $950 or more for the reading device) and may be less reliable than presumed. In lizards tags have been known to crack as well as be lost when they 'wander' and break through the skin (Germano & Williams, 1993). Evidence as to the lethal and sub-lethal effects of pit-tags on various sizes and species of amphibia are lacking.

For an amphibian marking scheme to be acceptable on scientific and humane grounds, it should be easy to apply, reliable over the course of the study, and cost-effective. In addition, the marking scheme must not severely interfere with the animal's biological functions; it must not cause mortality (e.g. through infection or reduced ability to obtain food or avoid predators), or have sublethal effects on fitness (e.g. reduced growth rate, longevity, reproduction), or influence behavior (e.g. induce dispersal) beyond acceptable limits. The 'acceptable limits' may be determined by individual biologists, research institutes, or even granting bodies. For birds it is widely held that mortality due to capture and marking is acceptable as long as it does not exceed one per cent of the sample. Biologists should recognise that merely capturing and handling an amphibian can cause it stress and may induce acute changes in physiology and behaviour. Existing data on a few ectothermic animals suggest that some short-term, acute stress can induce immuno-suppression lasting for days (e.g. Pickering et al, l982).

The marking method(s) that a biologist chooses to use in an investigation should reflect the goals and limits of the study. For example, the time scale of the study, the level of training of the workers, the nature of the data to be collected, the budget, the conservation status of the target species and the extent of public access to the study site.

In considering moral ground as a determinant for methodologies, biologists should not lose sight of the overall picture. If biologists take a hands-off approach to data collection, information regarding species' status and basic demography will certainly be compromised. In this age of ever increasing threats to biodiversity, we must consider the choice: sparing a few individual amphibians pain, but potentially letting a population or species 'croak' because adequate data was not available for monitoring or recovery programs, or marking a few animals (even if it causes pain or low level mortality) in an effort to collect adequate data on which to base and support conservation initiatives.

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Clarke, R.D. (1972) The effect of toe-clipping on survival in Fowler's toad (*Bufo woodhousei fowleri*). Copeia 1972: 182-185.

Germano, D.J. and D.F. Williams (1993) Field evaluation of using passive integrated transponder (PIT) tags to permanently mark lizards. Herpetological Review 24 (2): 54-56.

Golay, N. and Durrer, H. (1994) Inflammation due to toe-clipping in natterjack toads *(Bufo calamita).* Amphibia-Reptilia 15 (1): 81-83.

Pickering, A.D. et al. (l982) Recovery of the brown trout, *Salmo trutta*, from acute handling stress: a time course study. Journal of Fish Biology 20: 229-244.

More on Toe-clipping

My piece in *Froglog* 10 (August 1994) about welfare and ethical issues relating to toe-clipping generated a good response. Bernardo Ortiz reports that he began to use toe-clipping on *Atelopus elegans* in Colombia after seeing animals surviving in nature, despite much more extensive mutilation of their limbs, apparently resulting from predation. Enrique La Marca (Venezuela) has captured individuals of *Atelopus carbonerensis* 8 and 10 years after toe-clipping, but is now using natural colour patterns to identify individual *A. macubajiensis*.

Bill Magnusson (Brasil) reports the work of two of his students; Peter Bayliss, working on *Bufo marinus* in Australia has detected no effect of toe-clipping on survival; Ulisses Galati has similar data for *B. granulosus*, but these await analysis. A recent paper by Joachim Kuhn (1994) reports no adverse effects of toe-clipping in a German population of *B. bufo*.

Kuhn's study also tested an alternative to toe-clipping, the use of knee-tags, which also had no adverse effect on toad survival. Craig Hassapakis (Provo, Utah) advocates the use of microchips, which can now be used with animals as small as 2cm in length, and refers anyone interested to papers by Fasola et al (1993) and Keck (1994). Chuck Smith (Buffalo, New York) has extensive experience of freeze-branding as a marking method and says that, while it works well for smooth-skinned species like ranids, it is not effective for bufonids and other taxa with granular skin surfaces. On the use of spot patterns, Jamie Reaser reports that this is not a reliable method for tiger salamanders, because an individual's spot pattern changes with age. John Baker (DAPTF Office) has observed a similar phenomenon in *Triturus cristatus* but finds that an individual's spot pattern is virtually stable by the end of the juvenile stage (see also Arntzen & Teunis 1993). Jamie Reaser's letter to us raised a number of other issues and is printed in full above.

My personal view on this issue is that, because we learn so much more about amphibians when we can keep track of individuals, some form of individual identification method is vital. Any method, from scoring spot patterns to inserting pit tags, involves handling and some related level of stress to the animal. In any ethical debate, the level of such distress and of other consequences, must be balanced against what is gained in terms of knowledge. Clipped toes can provide valuable additional data

on age and genetics and, carried out carefully, is probably the quickest, cheapest, most reliable and least stressful marking method available. There is a suggestion, however, that it may be harmful to some species and so, ideally, its effects on the survival of a given species, should be tested before it is used on a large scale.

Tim Halliday

Arntzen, J. & Teunis, S. (1993) A six year study on the population dynamics of the crested newt *Triturus cristatus* following the colonization of a newly created pond. The Herpetological Journal 3: 99-110.

Fasola, M., Barbieri, F. & Canova, L. (1993) Test of an electronic individual tag for newts. The Herpetological Journal 3: 149-150.

Keck, M. B. (1994) Test for detrimental effects of pit tags in neonatal snakes. Copeia 1994: 226-228.

Kuhn, J. (1994) Methoden der Anuren-Markierung für Freilandstudien: Übersicht - Knie-Ringetiketten - Erfahrungen mit der Phalangenamputation. Zeitschrift für Feldherpetologie 1: 177-192.

Amphibian Meetings in Austria, September 1994

During September of last year, two meetings were held in Austria which were attended by many of Europe's amphibian researchers. The first was the 6th meeting of the TRITURUS group, organised by Robert Schabetsberger. These meetings, held every two years, are an informal gathering of researchers interested in any aspect of the biology of the European newts. Collectively, we cover all the *Triturus* species and subspecies, and we have representatives in every country of Europe and Scandinavia, as well as Turkey and several countries of the former USSR. It was agreed during the meeting that we should exploit the existence of the TRITURUS network to gather data on the current status of all taxa in the genus and make this information available to the DAPTF. Work on this project is proceeding.

The second meeting, a Workshop on the Population Biology of Amphibians was hosted in Vienna by Walter Hödl and Günter Gollmann. Much of the meeting focused on a long-term study of amphibians on the Danube Island close to the centre of Vienna, an artificial habitat that has been studied by the Vienna group since 1986. The focus of the study is a pond that has been surrounded by a permanent drift fence and which supports breeding populations of eleven amphibian species. In 1994 three new ponds were created on the island and the natural colonisation of these ponds is being monitored. All species have shown quite marked fluctuations in numbers over the 8-year study period, with a number showing marked declines, while others have remained stable.

There was general agreement that, in the past, the emphasis of amphibian population studies in Europe has been almost exclusively focused on aquatic populations and that there is an urgent need for more data to be collected on the terrestrial phase of the life cycle; for many species, 90% of growth takes place on land and we have very little idea what determines variation in growth and survival on land. While the aim of the meeting was to discuss a number of general aspects of amphibian ecology, such as methodology and the analysis of genetic patterns, much discussion focused on the results and possible future developments of the Danube Island study. There was general agreement that a good drift fence does yield an enormous amount of valuable data, but a number of people raised the possibility that it may also influence the demographic processes that it is intended to measure. In particular, a very effective drift-fence may impede the outward movement of small metamorphs and so reduce recruitment to a population. Changes in the numbers of animals recorded during the Danube Island study may thus reflect variation in the various species' ability to negotiate the drift fence, rather than more general environmental effects on their numbers. One speaker reported anecdotal observations that anurans arriving at a fenced pond may be deflected to another breeding site. Perhaps the answer to these problems is to not build drift fences with the intention of intercepting all animals, but rather to sample the population, allowing a number of animals, particularly the younger ones, to pass unimpeded.

The meeting also discussed the relative merits of various marking techniques, such as toe-clipping, pit-tagging and the use of colour patterns, and we saw a demonstration of the use of pit-tags with the crested newt *Triturus dobrogicus*.

Anyone wanting to know more about the Danube Island project should contact Walter Hödl or Günter Gollmann: Institut für Zoologie, University of Vienna, Althanstrasse 14, A-1090 Wien, Austria.

Tim Halliday

Rana arvalis Populations and Radioactive Pollution

Investigations of amphibians from different parts of a radioactive trace in the eastern Urals, from 1992-93, showed a predominance of *Rana arvalis* on polluted land. These populations were typified by a high ratio of females to males, and a high ratio of the striped morph of this species. Large metamorphs and small adult size were observed, which may reflect more rapid growth and early onset of sexual maturity.

Increases in abnormalities at the morphological, cytological and chromosomal level were recorded in juveniles and adults. Frogs tended to have elevated metabolic rates and changes in the liver and spleen. Fertility was reduced and eggs were smaller than normal; higher embryo mortality and decreases in energy storage and tolerance were also observed.

Phenotypic, physiological and genetic differences between populations on the radioactive trace and other animals may be partly a response to conditions of radioactive pollution and partly a demonstration of the ability of *Rana arvalis* to adapt to reproduce in an unusual environment.

This research was supported by the Russian Fund of Fundamental Investigations (#93-04-7888).

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News from Sri Lanka

The Chairman of the IUCN Reptiles and Amphibians Specialist Group for South Asia, Dr. Indraneil Das, gave a public lecture on 'An Action Plan for the Conservation of the South Asian Herpetofauna' at the University of Ceylon (Sri Lanka), Peradeniya on 7

December 1994. This was also the occasion for the launch of the Journal LYRIOCEPHALUS (see below).

Faunal inventories are underway in a number of protected areas in Sri Lanka and these would necessarily include the study of amphibian populations.

The anthropogenic threat to amphibian taxa and numbers comes from habitat destruction, consequent to an increase in urbanisation and industrial expansion. The effect of the use of pesticides in agricultural activities, though not clearly quantified, may be a source of danger. Another possible cause for some alarm is the increase in tourist traffic (both local and foreign tourists within the country - areas hitherto inaccessible or visited in modest volume now see much larger numbers. This is an aspect worthy of further investigation. Another investigation underway is a survey of the use of amphibian taxa for biological/medical studies in schools and universities of Sri Lanka.

LYRIOCEPHALUS

Lyriocephalus is a new journal published by the Amphibian and Reptile Research Organisation of Sri Lanka (ARROS). It covers a number of aspects dealing with the biology, ecology, natural history and conservation of amphibians and reptiles in Sri Lanka. It is to be published twice a year. The journal is written in English and it contains colour plates.

The editorial board consists of W.R. Breckenridge, Indraneil Das, D.G.A. Perera and Anslem de Silva.

Address for correspondence:
Anslem de Silva, c/o Faculty of Medicine, University of Peradeniya, Peradeniya, Sri Lanka.

The Lyriocephalus Editorial Office address is: 15/1 Dolosbage Road, Gampola, Kandy, Sri Lanka.

Publications of Interest

Andreone, F. (1994) The amphibians of Ranomafana rain forest, Madagascar - preliminary community analysis and conservation considerations. Oryx: 28 207-214.

Corn, P.S. (1994) What we know and don't know about amphibian declines in the West. pp. 59-67, in W.W. Covington and L.F. DeBano (tech. coords) Sustainable ecological systems: implementing an ecological approach to land management. US Forest Service Gen. Tech. Rep. RM-247. (Reprint requests to: Steve Corn: National Biological Service, 4512 McMurry Ave., Ft. Collins, CO 80525-3400. corns@mail.fws.gov).

de Silva, A. (1994) An introduction to the herpetofauna of Sri Lanka. Lyriocephalus 1: 3-19. (Gives status and endemicism).

Kuhn, J. (1994) Methoden der Anuren-Markierung für Freilanstudien: Übersicht - Knie-Ringetiketten - Erahrungen mit der Phalangenamputation. Zeitschrift für Feldherpetologie 1: 177-192. (Techniques for marking anurans in field studies: survey - knee labels - experiences with toe-clipping).

Murphy, J., Adler, K., & Collins, J. (1994) Captive management and conservation of amphibians and reptiles. Society for the Study of Amphibians and Reptiles. Phone: Robert D. Aldridge, 314 977-3910/3916, Fax: 314 977-3117

Oldfield, B & J.J. Moriarty (1994) Amphibians and reptiles native to Minnesota. Univ. MN Press, Minneapolis, 240 pp.)

Orchard, S. A., (1994) Amphibians in British Columbia: forestalling endangerment. In L.E. Harding and E. McCullum (eds.), Biodiversity in British Columbia: our changing environment. p. 127-132. For more information contact: Lee Harding, Head, Ecosystem Health, Canadian Wildlife Service, RR1, 5421 Robertson Road, Delta, British Columbia, Canada V4K 3N2
Phone: (604) 946-8546
FAX: (604) 946-7022
EMail: hardingl@cwsvan.dots.doe.ca

Thurow, G. (1994) Suggested interim responses to the amphibian decline problem. Bull. Chicago Herp. Soc. 29: 265-268.

CITES Appendix Amendments

At its meeting in Florida in November 1994, CITES members met with other interested parties to consider amendments to the CITES Appendices. It was agreed that *Bufo periglenes* should be included in Appendix I and *Mantella aurantiaca* in Appendix II.

If anyone is interested in the analyses prepared by IUCN/SSC on these two species, or in seeing a summary of all the Appendix amendments made at the meeting, we can supply copies.

Amphibian and Reptile Conservation

Due to the great interest and in order to better serve its members, ARC will now be published as a quarterly magazine/scientific journal.

Please note that voice mail number has been changed to (801)379-8900. The new email address is: ARC@yvax.byu.edu

New DAPTF Working Group Chairs

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Chemical Contaminants Working Group
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US Rocky Mountains Group
Charles R. Peterson replaces Bruce Bury, who has left to take up a new post in Corvallis, Oregon, in co-chairing this group.
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