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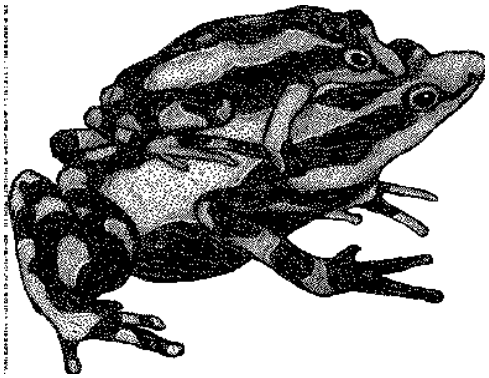

FROGLOG

Newsletter of the IUCN/SSC Declining Amphibian Populations Task Force

August 1997, Number 23.

Golden Toads, Null Models, and Climate Change

By J. Alan Pounds

A decade after the 1987 population collapse that led to the disappearance of the endemic golden toad (*Bufo periglenes*), amphibians in the Monteverde region of Costa Rica's Cordillera de Tilarán show little sign of recovery. Twenty species of frogs and toads (40% of the anuran fauna) have been missing from a 30 km^2 study area throughout the 1990s (Pounds *et al.*, in press).

In the debate over the significance of amphibian declines in undisturbed highland areas, arguments have hinged on standards of scientific proof and the absence of long-term demographic data for most species. Long-term data are essential to judge whether a particular population is in decline. Diverse tropical faunas, however, afford an approach that does not rely on these data.

My co-workers and I asked whether the observed number of disappearances exceeds that expected for naturally fluctuating populations (Pounds *et al.*, in press). To formulate null models that estimate the expected number of disappearances, we examined long-term studies of other amphibian assemblages. We chose studies that were conducted on spatial scales appropriate for comparison with Monteverde and that illustrated how unstable populations can be. From these studies, we estimated the probability that a single species would disappear in response to a natural disturbance such as a drought. Substituting this value in a binomial distribution, we calculated the likelihood that a particular number of species would disappear simultaneously.

In light of the resultant probability distributions, the declines at Monteverde appear to go well beyond natural fluctuations. Even when we doubled our initial probability estimate, our conclusions were the same. We believe that the results confirm the naturalist's intuition; it is indeed extraordinary that so many populations would crash and disappear.

A comparison with breeding birds in the same area puts the loss of anuran diversity in perspective (Pounds *et al.*, in press). The relative frequency of absences for frogs and toads was much greater than that for breeding birds in general. It was similar to that for invasive open-country birds whose habitats had largely reverted from farmland to forest after being annexed to the Monteverde Cloud Forest Preserve. Amphibian habitats, however, seemed unchanged.

Climate may have been a key factor in the declines (Pounds, in press). Although there is growing evidence that epidemic disease has been an important proximate cause of mortality, different pathogens have been implicated in declines on different continents. The patterns suggest the existence of a common denominator, and global warming could fill this role through various mechanisms.

At Monteverde, there is a strong 24-year trend toward more severe dry seasons. Previous analyses suggested that climate had played a role in the 1987 crash (Pounds and Crump 1994). They did not reveal major trends, however, because they focused on monthly and annual data rather than day-to-day patterns. Variability of daily precipitation has increased, leading to drier extremes, without affecting monthly or yearly averages. Days with no measurable precipitation have become more frequent and have increasingly coalesced into dry periods.

The patterns suggest a change in the advective processes that account for most precipitation during the dry season. As moisture-laden trade winds meet the windward (Caribbean) slope of the cordillera and flow upward, they cool adiabatically, producing a large orographic cloud bank. I hypothesize that atmospheric warming has raised the mean height at which condensation begins and thereby has increased the average altitude at the base of this cloud bank. Because higher clouds may pass over the cordillera with reduced turbulence and drag, they may be less likely to produce low-intensity precipitation (mist) before dissipating on the leeward (Pacific) side. Local temperature trends, viewed in relation to the modulating effects of clouds, are consistent with global warming and this condensation-height model.

Biological patterns also follow the model's predictions. Many premontane breeding bird species have invaded lower-montane habitats, whereas some lower-montane species have retreated up the mountain slopes. In multiple regression analyses, patterns of daily precipitation during the dry season account for most of the year-to-year variation in the rate of invasion by premontane bird species. The same patterns are strongly correlated with abundance in highland populations of anoline lizards that have declined and disappeared. For both climate and biological responses, fluctuations in sea-surface temperature (i.e. the signal of El Niño) account for much of the variation superimposed on the long-term trends. The most extreme patterns of daily precipitation were associated with the 1986-87 warm episode, which immediately preceded the collapse of amphibian populations.

The condensation-height model and evidence for it are summarized in an overview of the biology of Monteverde's amphibians and reptiles in relation to the declines (Pounds, in press). Supporting data and analyses are in a forthcoming paper (A. Pounds, M. Fogden, and J. Campbell, unpubl.), which will be presented in

the BirdLife International/WWF workshop "Impacts of Climate Change on Flora and Fauna" in September at the National Center for Atmospheric Research (NCAR) in Boulder, Colorado.

Global warming is an important threat to highland biological communities. The Monteverde Cloud Forest Preserve announces the formation of the Monteverde Climate Panel, an interdisciplinary group that will focus on this problem. We also announce completion of the Golden Toad Laboratory for Conservation (GTLC), devoted to research, applied conservation, and education. Details will be given in a future issue of *Froglog*.

Work on amphibian declines has been supported by the Tropical Science Center, Stanford University's Center for Conservation Biology, the MacArthur Foundation, Chicago's Brookfield Zoo, and the U.S. National Science Foundation.

Pounds, J.A. (in press) Amphibians and Reptiles. In: *The ecology and natural history of Monteverde, Costa Rica: A background for conservation.* N.M. Nadkarni & N.T. Wheelwright (Eds.), Oxford University Press, Oxford, UK.

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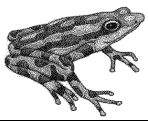

Frog Tea?

Frog species such as *Polypedates eques* and *Rana greeni* were once abundant in the mountainous tea-growing area of Sri Lanka, but are now almost absent. A prominent feature in modern tea production is the use of herbicides, especially around drains and watercourses. The Item by Michael Tyler (*Froglog* 21), on the effect of herbicide wetting agents on amphibian populations, helps to explain the virtual absence of amphibian populations in tea estates and the rapid response of refugial populations when spraying is stopped.

Conversion to organic tea production in this region has contributed greatly to the re-establishment of populations of local frogs. While tremendous gains have been made among local amphibian populations by this conversion, and the cessation of biocide spraying, the question of an agricultural landscape with an efficient, lined drainage system still remains.

The microhabitat potential of the natural landscape has been lost in the design of the modern tea garden. To address this feature, a Sri Lankan company, Lanka Organics Ltd., plans to begin work with a local NGO, the NeoSynthesis Research Centre, to build up amphibian microhabitats in their organic tea garden. The tea thus produced will be certified as benefiting local biodiversity (in the first instance, amphibians) as well as being produced organically.

For more information contact:
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Using Local People to Monitor Frog Populations in Papua New Guinea

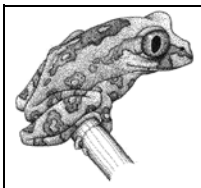
In an effort to begin long-term monitoring of the virtually unknown frog populations of Papua New Guinea, David Bickford of the University of Miami has developed a training program based on a series of standard methods to be utilized by local people on a long-term basis. By utilizing trained local observers (TLO's) in long-term monitoring, two purposes of conservation are served: local peoples are empowered, trained, and indoctrinated in the conservation ethic, and the cost of data acquisition is decreased dramatically without affecting the quality of the data acquired. David has selected two separate methods which sample different components of the frog assemblages of Papua New Guinea. He has modified the visual encounter survey methodology of Heyer *et al.* (1994) into a nocturnal transect more compatible for use with poorly educated local peoples, and has also slightly modified a quadrat method for a standard 5m x 5m leaf litter plot. David initially tried using 8m x 8m quadrats and found that they were unmanageable on the steep terrain characteristic of his research areas. The leaf litter quadrats effectively sample the fossorial and terrestrial frogs and the nocturnal transects sample virtually all the visible frogs. The TLOs typically have education levels equivalent only to US grades 1 or 2. However, because the methods require only basic literacy and numeracy skills, utilizing TLOs has proven to be useful, effective, and feasible for long-term monitoring of frog populations in Papua New Guinea.

Leaf litter sampling is conducted at randomly selected locations determined using a random number table. Each quadrat is a 5 x 5 meter square and is worked by a team of four TLOs, one for each side of the plot. After the limits of the plot have been determined, the beginning sampling time is recorded, and each TLO searches slowly through the leaf litter and ground detritus to locate frogs. A general sweep is conducted by each TLO on each side so that respective layers of leaf litter are brushed from inside the plot to the outside, from in front of the worker, to behind him. In this way, no animals can escape without at least being seen. When frogs are located, they are captured and immediately transferred to a plastic bag. After each TLO has met in the center of the plot, the ending time is recorded, along with data on the species, sex, SVL, location, and mass of each frog. Each frog is then released and habitat variables are recorded. This is an especially powerful technique when properly deployed as it can be used to inventory fossorial and terrestrial species present at a site, as well as to determine species densities and relative abundances. Moreover, since each quadrat is randomly chosen and independent, changes in species assemblages over time can be detected, an important goal of monitoring.

To conduct nocturnal visual encounter surveys, randomly selected transects (usually bush trails) are searched for animals for a prescribed period of time (1 hr) at night. Each transect is worked by a team of four TLOs, the same team working on the quadrate plots. One TLO is selected to record data, one to measure and hold captured frogs, and the other two locate and capture frogs along the transect. The beginning time is recorded, and each TLO searches slowly from ground level to approximately 3 meters above the forest floor to locate frogs with a flashlight or torch. Because this is a visual method, calling frogs are not given special treatment (i.e., only frogs directly visible are captured). When a frog is captured, appropriate data are

recorded and the frog is released. After one hour of searching along the transect, the time is recorded and appropriate environmental variables are recorded. This technique, like the quadrat technique described above, is proving to be extremely useful as it can be used to inventory and monitor virtually all frog species at a site.

For more information on the monitoring program and techniques being developed and utilized in Papua New Guinea, or for sample data sheets, contact: David Bickford, Crater Mtn. Biological, P.O. Box 1261, Goroka, EHP, PAPUA NEW GUINEA.



Commercial Trade in Australian Native Fauna

By Michael J. Tyler
DAPTF Australia

Regulations intended to protect Australian native animals provide for severe penalties for those engaged in illegal export. The Wildlife Protection Act of 1982 prescribes up to 10 years imprisonment and currently a maximum fine of $100,000 (Australian) for traffickers.

I question whether all species should be protected, whether exceptions can be made, and whether the trade could be reduced as a consequence. I appreciate that blanket legislation is perhaps easier to administer, but there are species that are abundant, widespread and 'secure' (in wildlife parlance), and do not need this level of protection. If this Act was sufficiently selective to permit exclusions, a portion of the illegal trade could be halted for ever. Each State and Territory controls the use and management of the fauna within its boundaries. The benefit is State care and interest, but the downside is the lack of cohesion in policy. Certainly there is interaction, but a State unilaterally can regard a species to be 'endangered' for any reason; for example, being found only in a minuscule geographic area near the State boundary, ignoring the fact that it may occupy millions of square kilometres beyond it.

To avoid citing an Australian example, I would refer to the cane toad, *Bufo marinus*. The States, Territory and Australian Governments have spent millions of dollars seeking means of eradicating this imported pest. Its natural range extends from the Amazon Basin of Brazil, through central America to the U.S.A., where it just crosses the Texan boundary. Texas has protected the species and regards it as endangered because its continued presence there is precarious. Clearly the cane toad as a species is not endangered, and a polite guffaw might be appropriate.

The corollary is that a protected species may not always be in need of the legislative protection afforded it. The green treefrog *Litoria caerulea* is a good example. Coveted by pet keepers throughout the world, this species is abundant in Australia and not one in need of protection to ensure its survival. At a remote cattle station in the Northern Territory I found two happily swimming in a toilet bowl, and a further 33 in the cistern above it. Yet no one can export one for commercial gain. And so they are exported illegally, despite the risks.

I suggest that for species that are abundant, it should be possible to devise legal, regulated export. There should be a system whereby breeding establishments overseas could be inspected and licensed to import one dozen male frogs and one dozen females. The licensees would pay a fee sufficient to cover the costs of inspection and registration, to obtain fewer than those I found in a single toilet. The market for this species could be met, and the incentive for illegal export destroyed.

The concept that I propose would not include any species that has any conservation concern; solely those species that are abundant. We are not talking about selling rare parrots, amphibians or reptiles, but individuals of species whose populations will be unaffected if they are culled in the literal sense.

Not everyone will be enthusiastic about the proposal. The animal rights movements perceive all trade and use of native species as immoral, and other individuals argue that no species should be kept in captivity. Sadly many highly endangered species are only found in zoos, and it is via zoos that reintroduction programs are possible, such as the release of Przwalski horses from Dubbo and Monarto Zoos in their homeland of Mongolia.

Legalised trade is considered unacceptable by others because they perceive species being switched, and difficulty in monitoring such a scheme. So let me put it in perspective. The hobby of keeping frogs as pets is very common in the USA, UK, Germany and Holland. On mainland Europe several countries ban the keeping of native species (to conserve the dwindling populations), but permit the keeping of exotics. In the USA there are several private breeding establishments which are successfully producing young frogs. In the case of the green treefrog they often have trouble in that the offspring of a mating are predominantly abnormal. Colleagues at Adelaide University have demonstrated subtle differences in the genetic make-up of this species across its huge geographic range, and a likely cause of the abnormalities is that they are pairing frogs from different parts of Australia. What the breeding establishments need is fresh stock from a known locality.

License six breeders in the USA, four each in Germany, the UK and Holland, and the market will be satisfied. It would involve a once-off series of shipments of a grand total of about 500 frogs. People are permitted to breed and trade in green treefrogs in Australia, so what is wrong in letting folk overseas enjoy them too? And in the process make it no longer financially attractive for there to be an illegal export trade.

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Review: The Action Plan for Australian Frogs

Published by Wildlife Australia in April 1997 and written by Michael J. Tyler (DAPTF Australia), this Action Plan is a coherent review of the status of Australia's 27 species of most "endangered" and "vulnerable" frogs; and lays down management objectives with which to facilitate each species' recovery. The budgetary requirements of these management objectives are also laid out.

The target species include 11 *Litoria spp.*, *Nyctimystes dayi* and 15 members of the family Leptodactylidae. The "Recovery Outline" for each species covers taxonomic data, species survival status, distribution and habitat details, reasons for declines, recovery and management objectives, and organisations involved in the species' recovery. Appendices include a checklist of Australian frogs, as well as summaries of the conservation status of the target species and the possible reasons for their declines. A further 14 species likely to be of conservation concern are also listed.

The Action Plan also makes valuable recommendations for species recovery based on the particular problems associated with amphibian conservation. It serves well as a model for other action plans covering the amphibians of any country or geographic unit.

The Action Plan can be viewed at: **http://www.biodiversity.environment.gov.au/plants/threaten** or obtained

from The Australian National Botanical Gardens for $15 (Australian) plus postage and handling. *Contact:* A.N.B.G., The Botanical Bookshop, PO Box 351, Jamison, ACT 2614, AUSTRALIA.
Tel: +61-6 - 257 - 3302
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DAPTF Merchandise

DAPTF Stickers (adhesive-backed or window stickers) featuring our *Neobatrachus* motif are still available, and we can now accept cheques in British pounds sterling (**£1 each**) or US dollars (**$2 each**).

NEW! Sew-on patches for your fieldwork jacket or rucksack, featuring a similar design to the stickers in green and yellow are now available for **£3 each** (pounds sterling) or **$5 each** (US dollars). Please send all orders for the above items to John Wilkinson at the Task Force office (address below). Please make cheques payable to DAPTF.

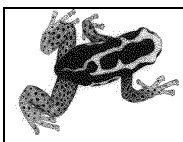
Froglog Shorts

DONATIONS We are very pleased to announce that the $10,000 challenge issued by our Anonymous Donor for climate change seed grants has been matched. An asterisk indicates a response to this challenge grant. We gratefully acknowledge receipt of the following donations from 1 April through 31 July 1997. **Organizations:** *****Arizona-Sonora Desert Museum; *****Cleveland Zoological Society; *****Columbus Zoological Park Association, Inc.; *****Detroit Zoological Institute; *****Emporia Friends of the Zoo, Inc.; *****Wilhelm Ludwig Ferdinand Martens Fund for Protection of Wildlife; *****Miami Metrozoo, Zoological Society of Florida; *****Minnesota Herpetological Society; *****National Aquarium in Baltimore; *****New York Herpetological Society; The Phoenix Zoo; *****Salzburger Tiergarten Hellbrunn; *****The San Francisco Zoological Society; Taiwan Council of Agriculture, Forestry Department; *****Toledo Zoological Gardens; *****Wildlife Conservation Society (Bronx Zoo). **Individual Donors:** J. Kevin Aitkin; Jay Bowerman; *****Park Carter; Gary J. Cohen; *****Mary McDermott Cook; Melinda Courtney; Kevin de Queiroz; *****E. Fred Elledge; James R. Firth; Nadine Foley; James Fowler; *****Carol Frank; *****Karen S. Graham; *****Brian Gray; Alexandra B. Hoge; Mrs. M. Hope; *****Douglas E. Johnston; J. Eric Juterbock; Ewald Lapioli; *****Richard L. Lardie; R. Jane Lynch; *****Glenn Manning; Alan McCready; Marilyn Ortt; *****Hubert R. Quinn; *****Albert Robbins; Rina Marie Rodriguez; *****Mr. & Mrs. Edward R. Rose III; *****Hobart Smith; Albert Spencer; Michael Sredl; Raymond Stein; Charles Thomas; Judith K. Torrence; Unknown from Hawaii.

Tropical field experience is sought by two biologists hoping to enhance their research skills before attending graduate school. Services may be donated in return for food and travel expenses. I*f you can help, please contact Michael Anderson:* **andersom@ava.bcc.orst.edu**

New Working Group Chairs have been appointed for Bermuda and the People's Republic of China. *Contact* ***(Bermuda):*** Don W. Linzey, Department of Biology, Wytheville Community College, 1000 East Main St., Wytheville, VA 24382, USA.
(China): Wang Yuezhao, Chengdu Institute of Biology, Academia Sinica, Chengdu, Sichuan, PO Box 416, People's Republic of China.

The 2nd Annual Meeting of the Canadian Amphibian and Reptile Conservation Network and the 7th Annual Meeting of the Task Force on Declining Amphibian Populations in Canada (**DAPCAN**) will be held at Arcadia University, Wolfville, Nova Scotia on October 3-5, 1997. *For further information contact:* Stan Orchard, 1745 Bank Street, Victoria, British Columbia, CANADA.
sorchard@islandnet.com



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